Better Lawns

- ESTABLISHMENT
- MAINTENANCE
- RENOVATION
- LAWN PROBLEMS
- GRASSES

HOME AND GARDEN BULLETIN NO. 51
UNITED STATES DEPARTMENT OF AGRICULTURE
PRECAUTIONS

The pesticides mentioned in this publication are available in several different formulations that contain varying amounts of the active ingredient. Because of differences in active ingredient, dosage rates are not indicated in this publication.

The user is cautioned to read and follow all directions and precautions given on the label of the pesticide formulation that will be used.

Prepared by

Plant Genetics and Germplasm Institute
Agricultural Research Service

Washington, D.C. Revised October 1975
Better Lawns

You don't have to be an expert to grow a good lawn. But you do have to adhere to sound establishment and maintenance practices.

You have to consider: (1) Construction of the lawn—how it is graded and drained, and how the seedbed is prepared; (2) selection of grasses, and how and when they are planted; and (3) maintenance, which includes fertilizing, mowing, watering, and controlling weeds, diseases, and insects.

ESTABLISHMENT

Following are things to do before you start preparing the soil for a lawn on a new building site:

1. Push the top 4 to 6 inches of soil to one side until the building and subsoil-grading operations are complete.
2. Remove all building debris such as bricks, stones, boards, paper, paint cans, and wire. Do not bury such material in the subsoil.
3. Plan the lawn to avoid a terrace, or a system of terraces, if possible. Terraces are hard to maintain.
4. If the subsoil is poorly drained it may be necessary to install tile drains. Do not attempt to install them without professional guidance. Consult a tile dealer or your county agricultural agent or State agricultural experiment station.
5. It may be necessary to protect trees if the new lawn level is to be considerably higher than the existing level. Trees can be killed by root suffocation when covered deeply by soil. To protect a tree, build a well of brick or stone around it at the existing level. Spread a 6-inch layer of crushed stone or gravel on the existing level and extend it 6 to 10 feet outward from the wall. Let the new lawn level build up around the wall. This will allow air to reach the roots of the tree. Make the diameter of the walled-in area 3 to 5 feet larger than the diameter of the tree.

Preparing The Soil

Plow, disk, spade, or otherwise loosen the subsoil so that it can be worked. Work the soil only when moisture conditions are normal. Do not work soil when it is saturated with moisture.

Slope the subsoil away from the house. The slope should not exceed 1-foot drop in 16 linear
In preparing the seedbed, begin by loosening the topsoil.

feet. A slope of 1-foot drop in 50 linear feet is adequate for good surface drainage.

When the subsoil grading is completed, mix in lime if needed, and phosphate fertilizer before covering the subsoil with topsoil. The lawn begins with the subsoil.

Soil testing services to determine the degree of acidity are available through your county agricultural agent or State agricultural experiment station. You can do the testing yourself with an inexpensive testing kit.

If soil testing is not available, a seedman, nurseryman, or farmer can tell you whether you live in a general area of acid or alkaline soils. The amount of lime to apply will vary with the original acidity of the soil and the type of soil. Dolomitic ground limestone, which contains magnesium and calcium, is best but is not available in all places.

Spread a 4- to 6-inch layer of topsoil uniformly over the subsoil. Use the topsoil that you saved. Avoid forming low spots or hollows. Use a hand rake for leveling and spreading.

You may need additional topsoil. Be cautious when buying it. Some "topsoil" is actually subsoil, or it may contain debris, toxic salts, noxious weeds, other undesirable plants, or seeds.

Additional lime may be needed after the topsoil is spread. Apply it while you are working the soil—before the finish grade of the topsoil is established.

Some soils require additional treatment. If the soil is mostly sandy or gravelly, or mostly heavy clay, you may need to incorporate soil additives into the soil to improve its organic-matter content or to improve the texture of the soil. Do these things while you are preparing the soil.

Add peat, well-rotted manure, spent mushroom soil, decomposed sawdust, or tannery sludge to
sandy or gravelly soils. Silt or clay may also be added.

Manure, sewage sludge, tannery sludge, and sawdust should be well decomposed before adding them to the soil. Sawdust should be 8 to 10 years old, or should be composted. Cocoa shells, buckwheat hulls, peanut hulls, rice, hulls or similar materials are satisfactory soil additives if they are composted.

Two to four cubic yards of soil additive per 1,000 square feet of lawn will generally be adequate.

Do a thorough job of incorporating additives into the soil. Failure to do so will create layers in the soil that may cause serious maintenance problems in later years. Layers of sand or gravel in the soil often stop water movement. This prevents the development of deep grass roots. Layers of organic matter often remain saturated with water. This prevents penetration of the layers by the grass roots because the layers lack oxygen.

You can also add organic matter to the soil by turning under a green manure crop 4 to 6 weeks before planting the grass.

In the northern part of the United States spring plantings of soybeans, sweet clover, red clover, sudangrass, or ryegrass provide good green manure for turning under in August.

In the southern part of the United States fall plantings of crimson clover, hairy vetch, winter rye, or ryegrass provide good green manure for turning under prior to spring lawn planting. These crops also provide a cover for the soil during the fall and winter.

If you have heavy clay soil you can modify the texture by adding sand, perlite, vermiculite, or calcined clay. The amount of material to use depends on the existing composition of the soil. A desirable clay loam soil contains 40 to 50 percent of sand, 30 percent or more of clay, and 20 to 30 percent of silt.

Preparing To Plant

Plowing or spading followed by disk ing and hand raking are the best methods of preparing the soil for planting.

Rotary tillage may also be used. If repeated too often, this type of tillage tends to “float” the finer particles of soil to the surface. The beating action of the tiller may destroy some of the soil structure. Hand raking is necessary to level the soil and to prevent the formation of depressions and hollows where water might concentrate.

Soil fertility varies greatly. Soil tests, available through your county agricultural agent or State agricultural experiment station, are the basis for determining the fertility of your soil and may serve as the basis for fertilizer recommendations.

Just prior to planting, apply a complete, inorganic fertilizer (one containing nitrogen, phosphorus, and potash) and rake it lightly into the soil. The percent-
After plowing (or spading) and disk ing, level the soil with a hand rake.

age figures on the bag in which fertilizer is purchased refer to nitrogen, phosphoric acid, and potash, in that order. For example, a 5–10–5 fertilizer contains 5 percent of nitrogen, 10 percent of phosphoric acid, and 5 percent of potash.

Apply the fertilizer at a rate that will provide 2 pounds of actual nitrogen per 1,000 square feet unless a test has shown that the soil needs a larger or smaller amount. Table 1 gives the amounts of fertilizer needed to provide 1, 2, or 3 pounds of actual nitrogen per 1,000 square feet.

Phosphorus, a nutrient that is important when grasses are being established, is lacking in many soils. The deficiency can be overcome by applying 25 pounds of superphosphate 0–20–0 per 1,000 square feet during preparation for planting. Mix it thoroughly into the top 3 to 5 inches of the soil where the roots of the seedling plants will feed.

**Planting**

To establish a successful lawn you should (1) select high-quality seeds or planting material, and (2) select grasses that are adapted to your soil and climate.

Mixtures of grasses are commonly planted throughout the central and northern latitudes of the United States. Single species of grasses are planted more often in the South than in other parts of the country.

In choosing a grass, or mixture of grasses, consult your county agricultural agent, your State agricultural experiment station, a seed dealer, or a nurseryman. Examine the analysis tags on the seed containers before you buy. State and Federal laws require that the tags give the percentage of each grass seed in the con-
tainer, the purity and germination, and the date of test.

**Seeding**

Grasses for which seed are available may be planted by hand or with a mechanical seeder. To obtain uniform distribution, mix the seed with small amounts of a carrier, which may be topsoil or sand. Divide the mixed material into two equal parts. Sow one part in one direction and the other part crosswise to the first sowing.

Cover the seed lightly by hand

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**Table 1.—Fertilizers for lawn use and application rate**

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Type</th>
<th>Amount per 1,000 square feet when amount of nitrogen desired is—</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1 pound</td>
</tr>
</tbody>
</table>

### For establishment and maintenance

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Type</th>
<th>Pounds</th>
<th>Pounds</th>
<th>Pounds</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-10-5</td>
<td>Complete, organic</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>4-12-4</td>
<td>do</td>
<td>25</td>
<td>50</td>
<td>75</td>
</tr>
<tr>
<td>5-10-10</td>
<td>do</td>
<td>20</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>10-10-10</td>
<td>do</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>8-8-8</td>
<td>do</td>
<td>13</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>10-6-4</td>
<td>do</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>7-40-6</td>
<td>do</td>
<td>14</td>
<td>28</td>
<td>42</td>
</tr>
<tr>
<td>10-20-10</td>
<td>do</td>
<td>10</td>
<td>20</td>
<td>30</td>
</tr>
<tr>
<td>6-12-4</td>
<td>do</td>
<td>17</td>
<td>34</td>
<td>50</td>
</tr>
</tbody>
</table>

### For maintenance

<table>
<thead>
<tr>
<th>Fertilizer</th>
<th>Amount per 1,000 square feet when amount of nitrogen desired is—</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 pound</td>
</tr>
</tbody>
</table>

**Processed sewage sludge** | Nitrogen, organic | 17 | 34 | 51 |
**Ammonium nitrate** | Nitrogen, inorganic | 3 | 6 | 9 |
**Ammonium sulfate** | do | 5 | 10 | 15 |
**Nitrate of soda** | do | 7 | 13 | 20 |
**Steamed bonemeal** | Nitrogen, phosphorus, organic | 50 | 100 | 150 |
**Cottonseed meal** | Nitrogen, organic | 17 | 34 | 51 |
**Peanut hull meal** | do | 50 | 100 | 150 |
**Cocoa shell meal** | do | 50 | 100 | 150 |
**Castor pomace** | do | 20 | 40 | 60 |
**Dried cattle manure** | Complete, organic | 50 | 100 | 150 |
**Dried sheep manure** | do | 70 | 140 | 210 |
**Sewage sludge** | Nitrogen, organic | 50 | 100 | 150 |
**Animal tankage** | Nitrogen, phosphorus, organic | 15 | 30 | 45 |
**Tobacco stems** | Nitrogen, potash, organic | 50 | 100 | 150 |
**Urea** | Nitrogen, inorganic | 3 | 5 | 7 |
**Processed tankage** | Nitrogen, organic | 13 | 26 | 39 |
**Soybean meal** | do | 17 | 34 | 51 |
**Urea-form** | Nitrogen, synthetic | 3 | 6 | 9 |

1 A complete fertilizer contains nitrogen, phosphorus, and potash.
2 An inorganic fertilizer is a chemical fertilizer that is easily soluble and quickly available to plants.
3 Milorganite and Huo-actinite are processed sewage-sludge materials.
4 An organic fertilizer is slowly available to plants over a period of time.
5 Agrinite is processed tankage material.
raking or by dragging with a brush or mat. Cover large seeds 1/4 to 3/8 inch deep, and small seeds 1/8 to 1/4 inch deep. Firm the seeded area by rolling with a light roller or cultipacker.

Mulching with a light covering of weed-free straw or hay will help hold moisture and prevent washing of the seed during watering or rainfall. One 60- to 80-pound bale of straw or hay mulch will cover 1,000 square feet adequately. Mulches applied evenly and lightly need not be removed. Peat moss and uncomposted sawdust are not satisfactory mulches.

On terraced areas, or on sloping banks, cheesecloth, open-mesh sacking, or commercial mulching cloth will help hold the moisture and seeds in place. Grass will grow through the mulching material, which may be left to rot.

New seedlings should be kept moist until well established. Once seeds have begun to germinate they must not dry out or they will die. Avoid saturating the soil, however; excessive moisture is favorable for the development of "damping off," a fungus disease.

**Sodding**

Unless good-quality sod is available, and complete coverage is needed immediately, the expense of sodding is seldom justified except on steep slopes or terraces where washing may be a serious problem.

To sod, prepare and fertilize the seedbed in the same manner as for seeding. Firm the seedbed with a roller after final hand raking. Sod should not be cut more than 1 inch thick. Sod cut 3/4 inch thick will knit to the underlying soil faster than thicker sod. Lay the sod pieces as you would lay brick and fit them together as tightly as possible. After laying the first strip, place a broad board on the sodded strip. Kneel on this board, and move it forward as the job progresses. This eliminates tramping on the prepared seedbed.

After the sod is laid, tramp it lightly and topdress it with a small amount of topsoil. Work the topdressing into the cracks between the sod pieces with a broom or the back of a wooden rake. Keep the sod moist until it is well established.

**Vegetative Planting**

Seed for many grasses is not available, or does not produce plants that are true to type. Such grasses must be planted by vegetative methods such as spot (or plug) sodding, strip sodding, sprigging, or stolonizing. Grasses planted by vegetative methods include zoysia, improved strains of bermudagrass, St. Augustinegrass, centipedegrass, creeping bentgrass, and velvet bentgrass. Centipedegrass and velvet bentgrass may also be seeded.

Whether plugged, strip sodded, sprigged, or stolonized, the planted material must be kept moist until well established. During the first year light applica-
tions of a nitrogenous fertilizer (ammonium sulfate, ammonium nitrate, or urea) every 2 to 4 weeks during the growing season will help speed the spread of the plants.

**Spot Sodding.**—Spot sodding is planting small plugs or blocks of sod at measured intervals. Generally, the plugs are set 1 foot apart, but they may be set closer together if more rapid coverage is desired. Fit the plugs tightly into prepared holes and tamp them firmly into place.

**Strip Sodding.**—Strip sodding is planting strips of sod end to end in rows that are 1 foot apart. The sod strips should be 2 to 4 inches wide. Firm contact with surrounding soil is necessary.

**Sprigging.**—Sprigging is the planting of individual plants, runners, cuttings, or stolons at spaced intervals. Sprigs or runners are obtained by tearing apart or shredding solid pieces of established sod. The space interval should be governed by rate of spread of the grass, how fast coverage is desired, and the amount of planting material available. Bermudagrasses spread more rapidly than the zoysias. Sprigs or runners may also be planted end to end in rows rather than at spaced intervals.

**Stolonizing.**—Stolonizing is practicable only when large amounts of planting material are available for planting large areas or highly specialized areas such as golf course putting greens. Shredded stolons are spread over the area with mechanized equipment. The spreading is followed by diskimg or rolling and top-dressing.

Large bermudagrass areas may be established by spreading shredded stolons with a manure spreader and diskimg lightly to firm them into the soil. This method requires 90 to 120 bushels of stolons per acre. Creeping bentgrass and velvet bentgrass...
can be stolonized by spreading shredded stolons at a rate of 10 bushels per 1,000 square feet, topdressing with topsoil to a depth of ¼ inch, and rolling to firm the stolons into the topdressing.

**When To Plant**

Table 2 gives the rate and time of seeding grasses that are established by seeding. Table 3 gives the rate and time of planting grasses that are established by vegetative planting methods.

**MAINTENANCE**

**Fertilizing**

Fertilizers that contain organic and inorganic nitrogen are used to maintain lawns. Organic nitrogen costs more per unit of actual nitrogen than inorganic nitrogen; but it releases its nutrient value to the grass more slowly than inorganic nitrogen, and thus gives more uniform stimulation to the grass over a longer period.

Organic nitrogen is available as processed sewage sludge, cottonseed meal, soybean meal, animal and vegetable tankage, and other waste organic byproducts. Inorganic fertilizers are available as dry materials (standard farm fertilizers) or as liquid or dry concentrates that must be diluted with water before they are applied.

Fertilize bluegrass, fescues, and other cool-season grasses (those that make their maximum growth in the spring and fall and are dormant or semidormant in hot weather) in the early spring and early fall. Fertilizing in the summer does not help these grasses and it may stimulate crabgrass and other weeds.

Use the color of the grass and rate of growth program. In general, the annual amount can be divided into 3 or 4 applications a year. For best results, the major portion of the fertilizer should be applied in the fall. A split application—one in early fall and again 4 to 6 weeks later—will help to avoid excessive growth and will prolong green color in the fall. In the spring, apply enough fertilizer to keep the grass growing vigorously but avoid over-stimulation. The grass should be permitted to "harden off" with the approach of hot weather. Light fertilizer applications in the spring will prevent lush growth of grass, reduce the incidence of disease, and will lessen the amount of mowing. Organic, or urea-form, nitrogen fertilizer may also be used in the spring to prevent burning, reduce overstimulation of the grass, and provide for a more continuous supply of nitrogen.

To get quality growth of cool-season grasses, apply fertilizer at the rate of 3 to 5 pounds of actual nitrogen per 1,000 square feet.

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Note: Maintenance practices vary with the species of grass and with soil and climate conditions. Recommendations in this bulletin are general. For specific, local recommendations, consult your county agricultural agent or State agricultural experiment station.
<table>
<thead>
<tr>
<th>Grass</th>
<th>Pounds of seed per 1,000 square feet</th>
<th>Time of seeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bahiagrass</td>
<td>2-3</td>
<td>Spring.</td>
</tr>
<tr>
<td>Bermudagrass</td>
<td>2-3</td>
<td>Spring.</td>
</tr>
<tr>
<td>Blue gramagrass (unhulled)</td>
<td>1-1 1/2</td>
<td>Spring.</td>
</tr>
<tr>
<td>Buffalograss (treated)</td>
<td>1/2-1</td>
<td>Spring.</td>
</tr>
<tr>
<td>Canada bluegrass</td>
<td>2-3</td>
<td>Fall.</td>
</tr>
<tr>
<td>Carpetgrass</td>
<td>3-4</td>
<td>Spring.</td>
</tr>
<tr>
<td>Centipedegrass</td>
<td>3-4</td>
<td>Spring.</td>
</tr>
<tr>
<td>Chewing fescue</td>
<td>3-4</td>
<td>Fall.</td>
</tr>
<tr>
<td>Colonial bentgrass (Highland, Astoria)</td>
<td>1-2</td>
<td>Fall.</td>
</tr>
<tr>
<td>Creeping bentgrass (Penncross, Seaside)</td>
<td>1-2</td>
<td>Fall.</td>
</tr>
<tr>
<td>Crested wheatgrass</td>
<td>1-2</td>
<td>Fall.</td>
</tr>
<tr>
<td>Japanese lawngrass (hulled)</td>
<td>2-3</td>
<td>Fall.</td>
</tr>
<tr>
<td>Kentucky bluegrass, common</td>
<td>2-3</td>
<td>Spring.</td>
</tr>
<tr>
<td>Kentucky bluegrass, Merion</td>
<td>2-3</td>
<td>Fall.</td>
</tr>
<tr>
<td>Red fescue</td>
<td>3-5</td>
<td>Fall.</td>
</tr>
<tr>
<td>Redtop</td>
<td>1-2</td>
<td>Fall.</td>
</tr>
<tr>
<td>Rough bluegrass</td>
<td>3-5</td>
<td>Fall.</td>
</tr>
<tr>
<td>Ryegrass (domestic and perennial)</td>
<td>4-6</td>
<td>Spring-fall.</td>
</tr>
<tr>
<td>Tall fescue (Alta, Ky. 31)</td>
<td>4-6</td>
<td>Fall.</td>
</tr>
<tr>
<td>Velvet bentgrass</td>
<td>1-2</td>
<td>Fall.</td>
</tr>
<tr>
<td>Mixture for sunny areas: 75% bluegrass, 25% red fescue</td>
<td>2-4</td>
<td>Fall.</td>
</tr>
<tr>
<td>Mixture for shady areas: 25% bluegrass, 75% red fescue</td>
<td>2-4</td>
<td>Fall.</td>
</tr>
</tbody>
</table>

per year. Merion bluegrass will require 5 or more pounds of actual nitrogen per thousand square feet annually. Early summer fertilization may also be necessary with this variety.

Fertilize bermudagrass, zoysia, St. Augustinegrass, and other warm-season grasses (those that make their maximum growth in hot weather) during the summer months when they are most active.

Warm-season grasses are more variable in their nitrogen requirements than cool-season grasses. Bermudagrass requires 5 to 10 pounds of actual nitrogen per 1,000 square feet per year, applied in 3 to 5 applications from early spring to late fall. St. Augustinegrass and zoysia require less nitrogen than bermudagrass but require more than carpetgrass, centipedegrass, and bahiagrass, which fall in the low-fertility group. Warm-season grasses in the low-fertility group will benefit, however, from 2 applications of fertilizer per year.

Do not apply fertilizer, particularly an inorganic fertilizer, when the grass leaves are wet. Water the lawn immediately after applying fertilizer to wash the fertilizer off the leaves and prevent burning of the grass plants.

**Liming**

Acid sandy soils generally require light applications of ground
### Table 3.—Vegetative grasses—rate and time of planting

<table>
<thead>
<tr>
<th>Grass</th>
<th>Amount of planting material per 1,000 square feet</th>
<th>Time of planting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bermudagrass</td>
<td>10 square feet of nursery sod or 1 bushel of stolons.</td>
<td>Spring-summer.</td>
</tr>
<tr>
<td>Buffalograss</td>
<td>25-50 square feet of sod</td>
<td>Spring.</td>
</tr>
<tr>
<td>Carpetgrass</td>
<td>8-10 square feet of sod</td>
<td>Spring-summer.</td>
</tr>
<tr>
<td>Centipedegrass</td>
<td>8-10 square feet of sod</td>
<td>Spring-summer.</td>
</tr>
<tr>
<td>Creeping bentgrass</td>
<td>80-100 square feet of nursery sod or 10 bushels of stolons.</td>
<td>Fall.</td>
</tr>
<tr>
<td>Velvet bentgrass</td>
<td>80-100 square feet of nursery sod or 10 bushels of stolons.</td>
<td>Fall.</td>
</tr>
<tr>
<td>Zoysia</td>
<td>30 square feet of sod when plugging; 6 square feet of sod when sprigging.</td>
<td>Spring-summer.</td>
</tr>
</tbody>
</table>

or pulverized agricultural limestone every 2 or 3 years, and clay soils require heavier applications every 5 or 6 years. Lime can be applied at any season; late fall or winter, however, are the best times.

### Watering

Sandy soils, because of their high porosity and low moisture-retaining capacity, require frequent watering in small amounts. Clay soils require infrequent watering in large amounts.

Do not water the lawn until the grass shows signs of wilt. Then apply enough water to wet the soil 6 inches deep or more. Do not apply water faster than it can be taken in by the soil. Avoid watering the lawn lightly at frequent intervals; this causes shallow growth of grass roots and stimulates growth of weeds. The deeper rooted the grass, the less often it is necessary to water.

### Mowing

Mow lawns of cool-season grasses to a height of about 2 inches. Close mowing, especially in hot weather, will weaken or may kill most cool-season grasses. Mowing to a height of 1½ to 2 inches keeps down weed competition. Crabgrass, in particular, can be reduced by the shading effect of taller permanent grasses on the crabgrass seedlings.

Mow lawns frequently even though you remove little top growth. Leave the clippings on the lawn unless growth is excessive. Do not let the grass grow unusually high and then clip it back. This is a shock to the physiological makeup of the plants and necessitates removal of the clippings to prevent smothering of the grass and buildup of diseases.

Warm-season grasses, particularly bermudagrass, require closer mowing than most cool-season grasses. Bermudagrass should be cut frequently to a height of ½ inch or less to maintain fine-quality turf. Other warm-season grasses such as zoysia, centipedegrass, carpetgrass and St. Augustinegrass should be...
mowed to a height of about 1 inch.

Whether you use a hand mower, a power reel mower, or a rotary power mower, it should be sharp enough to cut the grass cleanly without bruising or tearing the leaves. The cutting edge of the bedknife of reeltype mowers and the reel blades should be sharp, and the reel should be set firmly against the bedknife. Make adjustments of the bedknife or of the roller (whichever determines the height of cut) on a flat surface such as a concrete walk or floor. Rotary mower blades require frequent sharpening. This can be done with a steel file. Height of cut by most rotary mowers is fixed by adjusting the wheels in holes or slots on the mower frame.

**RENOVATION**

Perhaps the lawn you established, or inherited from the builder or previous owner, isn’t doing so well. You may have to reconstruct the lawn completely, or you may be able to renovate it without destroying the existing desirable grasses. It all depends on what is wrong with the lawn.

### Fertilizer-Pesticide Combinations

Numerous fertilizer-pesticide combinations, especially those containing herbicides, are being sold to homeowners. They are popular because herbicides, insecticides, and fungicides can be applied along with the fertilizer.

One problem with such combinations is that chemicals are being applied that would normally be used less frequently or not at all. In some instances, fertilizers containing preemergence crabgrass herbicides are applied in the fall when, in fact, the herbicide should be applied in the spring. Fertilizer combinations containing dicamba (2-methoxy-3, 6-dichlorobenzoic acid), or 2,4-D may injure or kill trees or shrubs when applied to grass under them. Pushing a fertilizer spreader back and forth under a shrub or tree often results in applying much more than the recommended rate of material.

Another problem is the concentration of the ingredients. There is no way of adjusting the rate of application for different uses.

Combination fertilizer and broadleaf weed herbicides are often applied when broadleaf weeds are not present in the lawn. Also, there is a tendency to apply fertilizer with a broadleaf weed killer in the summer when cool-season grasses should not be fertilized.
Reconstruction is usually necessary when lawns are improperly drained. The cause may be the nature of the soil itself, or improper subsurface and surface drainage.

If reconstruction is necessary, tear up the lawn with a plow or a spade and establish a new one. Follow the suggestions given previously under “Establishment.”

Faults that can usually be corrected by renovating an existing lawn include lack of plant nutrients, acid soils, surface compaction, too much shade, too many undesirable grasses, and general neglect.

Early fall is the best time to renovate a lawn. If less than 50 percent of the lawn consists of desirable grasses, it is usually best to get rid of all the grasses, prepare a new seedbed, and plant new grasses. If more than 50 percent of the lawn consists of desirable grasses you can usually replant without preparing a new seedbed. Grasses that spread rapidly, such as bermuda, centipede, or St. Augustine, can be renovated without a new seedbed being prepared if the percentage of desirable grasses is somewhat lower than 50 percent.

Here are the steps in lawn renovation:

1. Get rid of all weeds, leaves, and undesirable grasses. Mow closely, rake to remove the clippings, leaves, and other debris, and then apply chemical weed killers to eliminate undesirable species. (Chemical weed killers are discussed on pp. 13–15.)

2. Rake the lawn vigorously, or cultivate it in such a way that the surface of the soil is loosened. This forms a rough seedbed for planting.

3. Fertilize, lime, and plant in the same manner prescribed for establishing a new lawn.

Be sure to determine the cause of lawn deterioration, and then carry out a corrective program, or your lawn will require renovation again within a few years.

**LAWN PROBLEMS**

**Weeds**

Good maintenance is the best way to control weeds. A well-kept lawn has fewer weeds than a poorly kept one. Since perfect maintenance is seldom achieved on all lawns in a neighborhood, and weeds spread from lawn to lawn, it is often necessary to use herbicides to control weeds.

Many herbicides on the market today will control broadleaf weeds, crabgrass, and other weedy grasses. Select the right herbicide for the weed you wish to control. Follow the directions and precautions listed on the container label. Following are recommendations for chemical control of some common lawn weeds.

**Crabgrass**

Crabgrass is an annual that develops from seeds produced the
previous year. New plants continue to establish from late spring until the first fall frost. The plants mature during late summer and early fall, forming purplish seed heads that give the lawn an unsightly appearance.

Crabgrass will not tolerate shade. A thick, dense turf that is cut no shorter than 1½ inches offers shade conditions that retard the growth of crabgrass.

If you control seed production for several years, the viable seed supply in the soil will diminish to a point where it is no longer a serious threat to the lawn.

To help prevent reinfestation from seed, rake the lawn to bring immature seed heads of crabgrass within the reach of the mower, and then mow. If the seed heads have matured, use a grass catcher on the mower.

Pre-emergence treatments:
There are several herbicides that have been consistent in controlling crabgrass in bluegrass lawns if applied in early spring before crabgrass has germinated. Crabgrass germinates when minimum night temperatures do not go below 55°-60°F, the temperature at which forsythia blooms.

Residues of most pre-emergence crabgrass herbicides will also retard or prevent the germination of lawn grass seeds for 2 to 4 months after treatment and reseeding must be delayed. However, siduron [1-(2-methylcyclohexyl)-3-phenylurea] can be applied at the same time lawn grasses are planted for selective crabgrass control in the new seeding.

Bensulide [N-(beta-0, 0-diisopropyl dithiophosphorylethyl) -benzene sulfonamide] controls crabgrass well but lawn grasses cannot be seeded in the treated area until 6 to 12 months afterwards depending upon the amount of rain and the type of soil. The lawn may be overseeded in the fall when crabgrass is dying because of cold weather and then treated the following spring with bensulide for crabgrass control during the next growing season.

DCPA [dimethyl-2,3,5,6-tetra-chloroterephthalate] when applied in April has given excellent control of crabgrass without injury to established bluegrass, red fescue, and other common lawn grasses. It is sold as a dry, granular material.

Other herbicides suitable for controlling crabgrass as it germinates are benefin (N-butyl-N-ethyl-a,a,a,-trifluoro-2, 6-dinitro-p-toluidine), and terbutol (2,6-did-tert-butyl-p-tolyl methylcarbamate).

Post-emergence treatments:
Herbicides are also available to control crabgrass after it emerges. DSMA (disodium methanearsonate) and closely related methylarsonates give good con-

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1 Compare the active ingredient (chemical name) on the bag or container to obtain the desired herbicide. The herbicide containing the greater percentage of active ingredient is generally more economical to purchase.
control if properly applied. Two or three applications are usually necessary at 7- to 10-day intervals. This herbicide is sold under various trade names and should be used according to the directions on the container label.

**Other Grasses**

For control of perennial grasses such as orchardgrass, timothy, quackgrass, nimblewill, and others: Dalapon [2,2-dichloropropionic acid] may be applied to individual plants or infested areas. Because lawn grasses also are killed by this treatment, use care in treating weeds and limit the areas sprayed. Dalapon usually will disappear from warm, moist soil within 3 to 6 weeks, but persists longer in cool or dry soils.

**Broadleaf Weeds**

Most common broadleaf weeds can be eliminated with one or more applications of 2,4-D [2,4-dichlorophenoxyacetic acid]. If you use the proper amounts, one application will kill such weeds as plantain, buckhorn, or dandelion without damaging the permanent lawn grasses.

The chemical suppresses white clover but will seldom kill it at normal lawn application rates.

Sodium salt or amine forms of 2,4-D are the best for home use. Sprays are more effective and less expensive than dusts.

Early spring and early fall, the peak periods of weed germination and growth, are the best seasons to apply 2,4-D. Pick a time when rain is not expected for at least 12 hours. Apply the chemical in a coarse spray under low pressure. On small areas, use a sprinkling can. Avoid mowing for 3 or 4 days following an application. Weeds treated with 2,4-D die within 2 to 4 weeks. A second application in 6 to 8 weeks may be necessary.

Apply fertilizer shortly before or shortly after treating with 2,4-D to stimulate grass growth so that it will crowd into the bare spaces left by the killed weeds. If weeds were numerous, and many bare spots are left, it may be necessary to seed grass at the next suitable seeding season.

Avoid getting 2,4-D, and silvex [2-(2,4,5-trichlorophenoxy) propionic acid] on vegetables, flowers, shrubs, or other desirable plants; it may severely injure or kill them. Avoid spraying on windy days. Use them on lawn seedlings only after the grass is tall enough to mow.

It is difficult to remove injurious traces of herbicides from spraying equipment. Do not use a sprayer that contained herbicides to apply insecticides or fungicides to vegetables, flowers, or shrubs.

**Chickweed**

Silvex controls both common and mouse-eared chickweed. Ap-
ply the chemicals in late fall or
winter when the permanent
grasses are dormant and the
chickweed is actively growing.

White Clover

White clover, if you consider it
a weed in your lawn, can be con-
trolled by one or two applications
of silvex.

Diseases

Lawn and other turf grasses
vary in their susceptibility to
diseases. Diseases are more like-
ly to occur when lawns have been
improperly established or main-
tained. Inadequate soil aeration
or drainage, overwatering, and
improper fertilizing or clipping
may lead to disease problems.

Some lawn diseases can be con-
trolled by using fungicides. Many
kinds of fungicides are on the
market.

Injury from other causes is
often mistaken for disease symp-
toms. Such injuries include burn-
ing with chemical fertilizers, dog
damage, insect damage, burning
of the grass caused by placing
rugs, mats or similar objects on
the lawn in hot weather, burning
by chemical weed killers, and
drought.

Brown Patch

Brown patch is a fungus dis-
ease that attacks practically all
kinds of turf grasses. Is is most
serious on Kentucky bluegrass,
bentgrass, ryegrass, centipede-
grass, and St. Augustinegrass.
The fungus produces irregularly
shaped brown spots 1 inch to
several feet in diameter. The
spots have a dark "smoke-ring"
effect around the outer edges
where the fungus is active. Ex-
cessive nitrogen fertilization in-
creases the extent of this disease.

The disease appears rapidly
during periods or high humidity
when daytime temperatures drop
from 80°-95° to 60°-70° F. at
night, and dew or fog develops.

You can control brown patch
by avoiding overstimulation with
nitrogen, and by applying Dithane
M-45 (a coordination product of
zinc ion and manganous ethylene-
bis [ditho-carbamate]), and
Dyrene (2,4-dichloro-6-(o-chlo-
roanilino)-s-triazine).

Dollarspot

Dollarspot is a fungus disease
that is most severe on Kentucky

Following are some of the com-
mon lawn diseases and recom-
mendations for controlling them.

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__Mention of a trade name does not
constitute a guarantee or warranty of
the product by the U.S. Department of
Agriculture or an endorsement by the
Department over other products not
mentioned.

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bluegrass, bentgrass, ryegrass, centipedegrass, and St. Augustinegrass. The fungus causes straw-colored spots that are about the size of a silver dollar. The spots often merge to form large, irregular areas of damage. Dollar spot is most prevalent in spring and fall during periods of cool nights and warm, humid days.

Dollar spot can be controlled by applying Dithane M-45 or Dyrene.

**Leafspot**

Leafspot, a disease that causes reddish-brown to purple-black spots on the leaves of Kentucky bluegrass and sometimes spreads to the crown, causes considerable damage.

Damage can be reduced by: (1) Mowing no shorter than 1\(\frac{3}{4}\) to 2 inches; (2) using adequate fertilizer but avoiding overstimulation with nitrogen; (3) using Merion Kentucky bluegrass wherever possible (it is less susceptible to leafspot than common Kentucky bluegrass); (4) using mixed plantings of several grasses.

For the control of leafspot with fungicides, several applications at 7- to 10-day intervals, starting with the first symptoms of the disease, are necessary. Actidione-thiram (cycloheximide plus bis (dimethylthiocarbamoyl) disulfide) captan (N-[trichloromethyl] thio]-4-cyclohexene-1,2-dicarboximide), zineb (zinc ethyl-
enebis [dithiocarbamate]), and Dyrene.

**Snow Mold**

Snow mold is a fungus disease that is commonly found in the northern part of the United States during late fall, winter, and early spring. The fungus causing the disease thrives under the cool moist conditions of melting snow. The disease first appears as a white cottony growth on the leaves. As the leaves are killed they turn brown and frequently mat together.

Preventive cultural treatments include adequate drainage, avoiding the use of nitrogenous fertilizers late in the fall, raking to remove accumulations of leaves and other debris, and other practices that will help dry the lawn quickly in the spring. Several applications of Dyrene during the winter on lawns that were infested with snow mold in previous seasons will help prevent the disease.

**Slime Molds**

Bluish-gray, black, or yellowish masses of slime molds may appear in the lawn during periods of wet weather. They cause damage by smothering the grass. Break up the masses by sweeping with a broom. They will usually disappear when the lawn dries out: During long periods of wet weather, sweep the lawn and then dust with Dithane M-45 or zineb fungicide to prevent serious damage.
Insects

Many kinds of insects and insect-like pests damage lawns. Some, such as the grubs of May beetles, Japanese beetles, Asiatic garden beetles, and oriental beetles, feed on the roots of the grass. Others, such as sod webworms, armyworms, and cutworms, feed on the leaves or stems. Still others, such as chinch bugs, false chinch bugs, and leafhoppers, suck juices from the grass. Ants are examples of another group of pests. They dig holes in lawns and throw up mounds of earth.

Chlordane is effective for grubs and ants; diazinon for sod webworms and billbugs; malathion for leafhoppers; and carbaryl, diazinon, ethion, and tetraprolyph thiopyrophosphate for chinch bugs. Follow all directions and heed all precautions on the insecticide label.

Other Pests

Other pests, such as moles, pocket gophers, and field mice occasionally damage lawns. Since these pests usually invade lawns to feed on grubs and other insects, a good insect-control program that removes their food supply will generally keep them away.

Traps in mole tunnels are effective against moles. Poison baits will control pocket gophers and field mice but are not readily taken by moles.

Moss

Lack of fertility is the most common cause of moss in a lawn. Moss never develops in a healthy lawn. Other causes of moss in a lawn are poor drainage, high soil acidity, improper watering, too much shade, soil compaction, or a combination of these causes.

If moss gets established, remove it by hand raking or burning with ferrous ammonium sulfate. Apply ferrous ammonium sulfate to the moss spots in concentrated amounts when the moss is damp. Do not wash the material into the soil.

Moss will return to the lawn if the causal factor is not corrected.

Algae growing in moist areas under trees is sometimes mistaken for moss. Algae is a freshwater plant that can be eliminated by applying ferrous ammonium sulfate. Algae will return if the causal factor, usually poor drainage, inadequate light, or low fertility, is not corrected.

Shade

It is hard to maintain good turf under trees, particularly if the trees are the shallow-rooted type, such as sugar maples. Following are suggestions that may improve turf under trees:
Lawn Weeds Controlled By — 2,4-D

<table>
<thead>
<tr>
<th>Weed Name</th>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buckhorn plantain</td>
<td>Plantago lanceolata</td>
</tr>
<tr>
<td>Carpetweed</td>
<td>Mollugo verticillata</td>
</tr>
<tr>
<td>Cinquefoils</td>
<td>Potentilla species</td>
</tr>
<tr>
<td>Daisies</td>
<td>Chrysanthemum species</td>
</tr>
<tr>
<td>Dandelion</td>
<td>Taraxacum officinale</td>
</tr>
<tr>
<td>Dichondra</td>
<td>Dichondra repens</td>
</tr>
<tr>
<td>Docks</td>
<td>Rumex species</td>
</tr>
<tr>
<td>Hawkweed</td>
<td>Hieracium species</td>
</tr>
<tr>
<td>healall</td>
<td>Prunella vulgaris</td>
</tr>
<tr>
<td>Lambquarters</td>
<td>Chenopodium album</td>
</tr>
<tr>
<td>Mayweed</td>
<td>Anthemis cotula</td>
</tr>
<tr>
<td>Moneywort</td>
<td>Lysimachia numularia</td>
</tr>
<tr>
<td>Mustards</td>
<td>Brassica species</td>
</tr>
<tr>
<td>Pennycress</td>
<td>Thlaspi arvense</td>
</tr>
<tr>
<td>Pepperweed</td>
<td>Lepidium species</td>
</tr>
<tr>
<td>Plantains</td>
<td>Plantago species</td>
</tr>
<tr>
<td>Puncture vine</td>
<td>Tribulus terrestris</td>
</tr>
<tr>
<td>Shepherds purse</td>
<td>Capsella Bursa-pastoris</td>
</tr>
<tr>
<td>Speedwell</td>
<td>Veronica species</td>
</tr>
<tr>
<td>Velvetea</td>
<td>Abutilon theophrasti</td>
</tr>
<tr>
<td>Vervains</td>
<td>Verbena species</td>
</tr>
<tr>
<td>Wild carrot</td>
<td>Daucus carota</td>
</tr>
<tr>
<td>Wild garlic</td>
<td>Allium vineale</td>
</tr>
<tr>
<td>Wild onion</td>
<td>Allium canadense</td>
</tr>
<tr>
<td>Yarrow</td>
<td>Achillea millefolium</td>
</tr>
<tr>
<td>Yellow rocket</td>
<td>Barbarea vulgaris</td>
</tr>
</tbody>
</table>

**Silvex**

<table>
<thead>
<tr>
<th>Weed Name</th>
<th>Species Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black medic (yellow trefoil)</td>
<td>Medicago lupulina</td>
</tr>
<tr>
<td>Buttercups</td>
<td>Ranunculus species</td>
</tr>
<tr>
<td>Catsear</td>
<td>Hypochaeris radicata</td>
</tr>
<tr>
<td>Chickweed (common)</td>
<td>Stellaria media</td>
</tr>
<tr>
<td>Chickweed (mouse-ear)</td>
<td>Cerastium vulgatum</td>
</tr>
<tr>
<td>Ground ivy</td>
<td>Glechoma hederacea</td>
</tr>
<tr>
<td>Knotweed</td>
<td>Polygonum species</td>
</tr>
<tr>
<td>Lespedeza</td>
<td>Lespedeza species</td>
</tr>
<tr>
<td>Pearlwort</td>
<td>Sagina procumbens</td>
</tr>
<tr>
<td>Pennywort</td>
<td>Hydrocotyle sibthorpioides</td>
</tr>
<tr>
<td>Purslane</td>
<td>Portulaca oleracea</td>
</tr>
<tr>
<td>Sorrels</td>
<td>Rumex species</td>
</tr>
<tr>
<td>Spurges</td>
<td>Euphorbia species</td>
</tr>
<tr>
<td>White clover</td>
<td>Trifolium repens</td>
</tr>
</tbody>
</table>

1. Use shade-tolerant grasses. In the northern part of the United States the best shade grasses are red fescue, Chewings fescue, and rough bluegrass, in that order. Manilagrass and St. Augustinegrass are the best shade grasses in the mid-South and in the deep South, respectively.

2. Fertilize the grass frequently but do not overstimulate with nitrogen.

3. Remove unnecessary trees.

4. Prune the remaining trees heavily to remove dead or low branches. This will allow more light to fall on the grass.

5. Prune shallow-tree roots that compete with the grass for nu-

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trients and moisture. This can be done without harming the tree.

6. Fertilize the trees to keep them from competing with the grass nutrients. Punch holes around the tree 2 to 4 feet deep with a crowbar or a stick as far out as the branches reach. Put fertilizer in the holes.

7. Apply lime if the soil has become strongly acid.

8. Remove fallen leaves and other debris frequently.

9. Fertilize in the early spring to help the grass begin vigorous growth before leaf-shedding trees develop new leaves.

10. When you water, wet the soil at least 6 inches deep.

11. If you can't get turf grass to grow under trees, plant one of the ground cover plants described on page 28.

Soil Compaction

To prevent soil compaction, cultivate and aerate the soil under the turf periodically. Machines to do this may be rented from equipment dealers, nurseriesmen, or landscape gardeners, or you can have the work done on contract.

If done properly, aeration does not harm the lawn or roughen the turf. Aeration permits better penetration of water and fertilizer.

GRASSES AND GROUND COVER PLANTS

Following are descriptions of common lawn grasses and ground cover plants, including statements on how they grow, where they grow best, their requirements, and how to establish them.

Grasses

Annual Bluegrass

Annual bluegrass (Poa annua) has little value as permanent turf because it dies suddenly when high temperatures occur in June, July, or August. It is used chiefly to overseed warm-season turf grasses during the winter months. Only small amounts of seed are available. It normally begins growth in late summer or early fall from seed produced earlier in the same year. It will often grow throughout the winter.

Annual bluegrass requires a cool, moist soil and good fertility. It will survive under close mowing and shade. It produces large quantities of seed heads even when mowing as low as 1/4 inch. It is a pest in many highly specialized turf areas, particularly golf courses.

Bahiagrass

Bahiagrass (Paspalum notatum) is a low-growing perennial that spreads by short, heavy runners. It grows best in the southern Coastal Plains region. It is established by seeding.

Common bahia, which has extremely coarse-textured leaves, is recommended for forage only. Paraguay and Pensacola, strains having finer-textured leaves than common bahia, are useful on
large areas such as airfields, where good cover is more important than turf quality. These strains produce a dense, rather coarse and uneven turf, and are difficult to mow with an ordinary reel-type mower.

**Bermudagrass**

Many varieties or strains of bermudagrass (*Cynodon dactylon*) are sold. Each variety generally has a specialized use. Common bermuda, a coarse-textured grass, is the only variety for which seed is available. Other varieties are established vegetatively.

Bermudagrass is commonly grown in the southern part of the United States. Common seeded bermudagrass is not suited to the northern part of the United States, but vegetative plantings of cold-tolerant sections have survived as far north as Chicago and New York.

Varieties of bermudagrass used in lawns in the southern part of the United States include Tiflawn, Everglades No. 1, Ormond, Sunturf, Texturf 10, and Texturf 1F. Tiflawn is finer in texture than common bermudagrass, and it is deep green. It has outstanding disease-resistant qualities. Tiflawn is a vigorous grower and will form a heavy mat unless it is mowed closely and often. The texture of Everglades No. 1 is finer than that of Tiflawn, and the green is darker. This grass tends to grow prostrate. Ormond is coarser in texture and grows more upright than Everglades No. 1. Of the three varieties, Everglades No. 1 requires the least maintenance.

Varieties of bermudagrass that are used in high-quality lawns receiving maximum maintenance, and in golf course putting greens and fairways, include Tifgreen, Tiffine, Tifway, Bayshore, and Tifdwarf. These varieties are medium green. They are fine in texture.

A variety of bermudagrass called U–3 has been grown successfully in the vicinity of Philadelphia, Pa., Norfolk, Nebr., Cleveland, Ohio, and St. Louis, Mo. It is most widely used in the so-called “crabgrass belt,” a roughly triangular region cornered on Philadelphia, St. Louis, and Richmond, Va. U–3 has finer blades than common bermudagrass. It resists disease and insect damage, and holds its color late into the fall when properly fertilized. It grows well in hot, humid weather. Tufcote is also grown in this area.

Bermudagrass grows vigorously, spreading by aboveground runners and underground root-stalks. It often becomes a serious pest in flower beds and other cultivated areas. Once established in those places it is difficult to eradicate.

Bermudagrass will not thrive under conditions of shade, poor drainage, high acidity, or low fertility. It requires frequent heavy applications of nitrogen in readily available form. Although drought resistant, it requires moderate amounts of water dur-
ing dry periods. It must be clipped closely in order to form a dense turf.

**Blue Gramagrass**

Blue gramagrass (*Bouteloua gracilis*) is a low-growing, perennial grass that is adapted to a wide range of soil conditions throughout the Great Plains region. It is highly drought resistant. Its use as a turf grass is limited to cool, dry places where little or no irrigation water is available.

Blue gramagrass is a bunch-type grass that can be established easily from seed. Unless watered, it becomes semidormant and turns brown during severe drought periods. Seed produced in a given area should be used for plantings in that area only.

**Buffalograss**

Buffalograss (*Buchloe dactyloides*) is a stoloniferous perennial grass that is used commonly in sunny lawns of prairie homes in the Great Plains region. It is highly drought resistant. The grass is fine leaved and dense during the growing season. It turns from grayish green to the color of straw when growth stops in the fall. It grows best in well-drained, fairly heavy soils. Buffalograss can be established by sodding or seeding.

**Canada Bluegrass**

Canada bluegrass (*Poa compressa*) forms a thin, poor-quality, open turf. It can be used in seed mixtures on playgrounds, athletic fields, or similar areas.

Canada bluegrass will grow in sandy or gravelly soils of low fertility. It will not grow well in soils having high acidity or poor drainage. It will not withstand clipping below 1½ inches. It is extremely tough and resists wear.

**Carpetgrass**

Carpetgrass (*Axonopus compressus*) is a rapidly spreading stoloniferous perennial grass that produces a dense, compact turf under mowing, but is quite coarse textured. It can be established quickly by seeding or by sprigging or sodding. Seeding is the cheapest method.

Carpetgrass grows best in moist, sandy-loam soils or those that have a relatively high-moisture content throughout the year. It does not grow well in dry soils or in regions that remain dry during part of the growing season. It will thrive under limited fertilization in poor soils, but is extremely sensitive to lack of iron. It resists disease and insect damage, but does not tolerate salt water spray. It will withstand trampling and heavy wear.

Carpetgrass produces tall seed heads that are difficult to mow and make the lawn look rough or rugged. Mowing frequently with a rotary mower to a height of 1 inch is recommended.

**Centipedegrass**

Centipedegrass (*Eremochloa ephiruroides*) spreads rapidly by
short creeping stems that form new plants at each node. It forms a dense, vigorous turf that is highly resistant to weed invasion. It is usually established vegetatively; some seed is available.

Centipedegrass is considered the best low-maintenance lawn grass in the southern part of the United States. It requires less mowing, less watering, and less fertilizing than other southern lawn grasses. It is seldom damaged by disease or insects, but may be severely damaged by salt water spray. It is sensitive to the lack of iron. An annual application of a complete fertilizer will improve the quality of centipedegrass lawns. Although it is drought resistant, centipedegrass should be watered during dry periods.

Centipedegrass should not be planted in farm lawns; it may escape into pastures and destroy their grazing value.

**Colonial Bentgrass**

Colonial bentgrass (*Agrostis tenuis*) is a fine-textured, tufted-type grass with few creeping stems and rhizomes. It forms a dense turf when heavily seeded and closely mowed.

Colonial bentgrass is used chiefly in high-quality lawns and putting greens. It is more expensive to maintain than ordinary lawn grasses. It is popular in the New England States, Washington, and Oregon.

Colonial bentgrass requires fertile soil and frequent fertilizer applications. It must be watered during dry periods. It is susceptible to a wide variety of diseases. It must be mowed closely; when cut about 3/4 inch it becomes fluffy and forms an undesirable spongy mat.

Several strains of colonial bentgrass are sold. Highland is the hardiest variety. It is bluish green. It grows moderately fast. Another variety, Astoria, is bright green. It is not as drought resistant or as aggressive as Highland. Although Astoria requires more care than Highland, it produces a better-quality lawn if properly managed. Other colonial bentgrass suitable for lawns include New Zealand browntop and some strains of German bentgrass.

**Creeping Bentgrass**

Creeping bentgrass (*Agrostis palustris*) is not often used in home lawns, but it is used extensively in golf course putting greens throughout the United States. It has profuse creeping stems that produce roots and stems at every node, and it develops a dense sod. It must be mowed closely (3/16 to 3/8 inch), brushed regularly, and topdressed periodically to prevent formation of an undesirable mat or thatch.

Creeping bentgrass requires soils having high fertility, low acidity, good drainage, and high water-holding capacity. A regular program of fertilization, watering, and disease control
Climatic regions of the U.S. in which the following grasses are suitable for lawns:

must be followed to maintain good-quality turf.

Varieties available include Seaside, which is established by seeding and is used in golf greens along the west coast; Penncross, a seeded type that is available for specialized turf areas; and several strains that have been selected from established greens and are established vegetatively—Arlington, Collins, Cohansey, Washington, Congressional, Pennpar, Pennlu, and Old Orchard.

Crested Wheatgrass

Crested wheatgrass (Agropyron cristatum) is a perennial bunchgrass. It thrives in most soils in the central and northern Great Plains and Intermountain regions. It is recommended in dry, cool areas of those regions where irrigation water is not available. It is established by seeding.

Crested wheatgrass will withstand long, dry periods and heavy wear if not cut too closely. It
makes most of its growth in the spring and fall; it becomes semi-dormant and turns brown in the hot summer months.

**Japanese Lawngrass**

Japanese lawngrass (*Zoysia japonica*) is a low-growing perennial that spreads by above-ground runners and shallow rootstocks. It forms a dense turf that resists weed invasion and disease and insect damage.

Japanese lawngrass grows best in the region south of a line drawn from Philadelphia, Pa., westward to San Francisco, Calif. It will survive in the region north of that line but its use there, except in some localities, is impracticable because of the short summer growing season. The grass turns the color of straw when the first killing frost occurs in the fall and it remains off-color until warm spring weather.

Common Japanese lawngrass is coarse in texture. It is somewhat undesirable for home lawn use but is excellent for large areas such as airfields and playgrounds. Meyer zoysia, a selection of common Japanese lawngrass, is more desirable than Japanese lawngrass for home lawns. It is more vigorous, retains its color later in the fall, and regains it earlier in the spring. Meyer zoysia sod is available from a number of nurseries. There is no seed.

Although Japanese lawngrass will survive in soils of low fertility, it makes best growth when given liberal applications of complete fertilizers having a high nitrogen content. It is relatively drought tolerant in the humid regions. It is highly resistant to wear and will withstand close clipping.

Japanese lawngrass may be established by sprig planting the stems, by spot sodding, or by seeding. Three to four growing seasons are generally required to get complete coverage.

Emerald zoysia is a hybrid between Japanese lawngrass and mascarene grass that has proven superior to Meyer zoysia in the southern part of the United States. The grass is fine leafed, dense growing and dark green in color.

**Kentucky Bluegrass**

Kentucky bluegrass (*Poa pratensis*) is a hardy, long-lived, sod-forming grass that spreads by underground rootstocks. It is one of the most widely used lawn grasses in the United States. It is the basic lawn grass in cool, humid regions and in cool, dry regions where adequate irrigation water is available.

Common Kentucky bluegrass will not withstand poor drainage or high acidity. It grows best in heavy, well-drained soils of good fertility that are neutral or nearly neutral in reaction. In soils of low fertility, liberal applications of nitrogen, phosphorus, and potash are needed. Bluegrass is highly drought resistant; it has the ability to go into a semidormant condition during hot summer months.
Common Kentucky bluegrass may be injured if mowed shorter than 1½ inches. It will not tolerate heavy shade. Because it becomes established slowly, common Kentucky bluegrass is often planted with faster-growing grasses that provide cover and prevent weed invasion while the bluegrass is becoming established.

**Merion**

Merion Kentucky bluegrass has proved superior to common Kentucky bluegrass in many regions of the United States. It can be clipped more closely, and is less susceptible to leafspot disease than common Kentucky bluegrass, although it is susceptible to rust and stripe smut. Merion Kentucky bluegrass also appears to be more heat and drought tolerant, more vigorous, and more resistant to weed invasion than common Kentucky bluegrass. For best growth, it requires greater fertility and more maintenance than common Kentucky bluegrass. It responds well to high applications of nitrogen. Among other varieties of Kentucky bluegrass found commercially are: Newport, Park, Nugget, Pennstar, Windsor, Baron, and Fylking.

**Kikuyugrass**

Kikuyugrass (*Pennisetum clandestinum*) is a perennial grass that spreads by coarse underground rootstocks. It produces a coarse-textured spongy or mat-ted turf that is 3 to 5 inches thick and difficult to mow at lawn height. Its use has been confined to locations in coastal California, where it is now considered a pest and is being eradicated. It is not recommended for lawn use.

**Manilagrass**

Manilagrass (*Zoysia matrella*) is closely related to Japanese lawngrass and has many similar characteristics. It is stoloniferous, and forms a dense carpetlike turf that resists weeds, wear, disease, and insect damage. Manilagrass is adapted to the southern part of the United States.

Manilagrass is sensitive to highly acid soils. It responds well to liberal applications of nitrogenous fertilizer. It turns brown when the first killing frost occurs and remains dormant until spring. It is established by sprigging or spot sodding.

**Mascarenegrass**

Mascarenegrass (*Zoysia tenuifolia*) is a low-growing stoloniferous grass that is adapted to very few locations in the United States. Its growth requirements with respect to moisture, nutrients, and soil are about the same as those for manilagrass, but it is not as winter hardy as manilagrass or Japanese lawngrass. It becomes sodbound and humps up as it grows older, which encourages weed invasion. Limited amounts of mascarenegrass sod are available in Florida and California.
Meadow Fescue

Meadow fescue (*Festuca elatior*) is a hardy, short-lived perennial that is used primarily for pasture and hay. It does not form a solid sod. It grows best in heavy, moist soils, and will withstand extremely wet soils. An excellent seed producer, it is often found in poor-quality lawn seed mixtures.

Orchardgrass

Orchardgrass (*Dactylis glomerata*) is a tall-growing, perennial bunch grass that forms coarse-textured tufts but never a solid turf. It does not grow well in soils having high acidity or poor drainage, but it resists drought and tolerates shade. It can withstand low fertility. Seed is abundant, and it is sometimes used in poor-quality lawn seed mixtures.

Red Fescue and Chewings Fescue

Red fescue (*Festuca rubra*) and Chewings fescue (*F. rubra var. commutata*) rate next to Kentucky bluegrass as the most popular lawn grasses in the cool humid regions of the United States. Red fescue spreads slowly by underground rootstocks. Chewings fescue is a bunch-type grower. Both are established by seeding.

Both fescues are used extensively in lawn seed mixtures. They grow well in shaded areas, and they tolerate high acidity. They require good drainage but will grow in poor, droughty soils.

Red fescue and Chewings fescue are fine textured. They have bristlelike leaves that stand upright. When seeded heavily they form a dense sod that resists wear. They heal slowly when injured by insects, disease, or other means. Mowing consistently below 1½ inches can cause severe damage. The grasses grow slowly.

Improved strains of red fescue on the market include Pennlawn, Illahee, and Rainier. No improved strains of Chewings fescue are on the market.

Redtop

Under lawn conditions, redtop (*Agrostis alba*) is a short-lived perennial. It seldom lives more than two seasons when closely mowed. It is commonly used in lawn seed mixtures in the northern temperate regions of the United States to provide quick cover while more permanent grasses are developing. It is often seeded alone in temporary lawns. In the southern part of the United States it is used for winter overseeding of bermudagrass to provide year-round green color.

Heavy seeding helps overcome redtop's tendency to develop a coarse open-type turf. Redtop tolerates a wide range of soil and climatic conditions, including temperature extremes. It grows in soils that are highly acid and poorly drained. It resists drought and has a low fertility requirement.
**Rescuegrass**

Rescuegrass (*Bromus catharticus*) is a short-lived perennial bunch grass that grows best in fertile soils in humid regions where the winters are mild. It is sometimes used in the southern part of the United States as a winter grass in large bermuda-grass plantings, such as golf course fairways.

**Rough Bluegrass**

Rough bluegrass (*Poa trivialis*), also known as roughstalk bluegrass, is a shade-tolerant perennial that is useful in lawns only in the extreme northern part of the United States. It is established by seeding. It is seriously injured by hot, dry weather. It has leaves of the same texture as Kentucky bluegrass. The stems and leaves lie flat, giving the turf a glassy appearance. Roughstalk meadowgrass is lighter green than Kentucky bluegrass. It spreads by short aboveground runners.

Roughstalk meadowgrass has a shallow root system, and will not withstand heavy wear. It should be used in shady areas where the traffic is not heavy.

**Ryegrass**

Italian or annual ryegrass (*Lolium multificorum*) and perennial ryegrass (*Lolium perenne*) are propagated entirely by seed that is produced in the Pacific Northwest, or imported. Much of the ryegrass used for lawns in the United States is a mixture of annual, perennial, and intermediate types.

Many commercial lawn seed mixtures contain too much ryegrass; the ryegrass competes with the permanent grass seedlings for moisture and nutrients. On sloping areas, it is sometimes advisable to include a small amount of ryegrass in the lawn seed mixture to help prevent soil erosion. The use of perennial ryegrass in lawn seed mixtures often results in ragged-appearing lawns that are difficult to mow. Coarse clumps of ryegrass may persist in the lawn for several years.

In the southern part of the United States annual or common ryegrass is used for winter overseeding of bermudagrass in lawns, and on golf greens and tees. Among fine-textured ryegrass varieties are Pennfine, Manhattan, Norlea, Pelo, and NK101.

**St. Augustinegrass**

St. Augustinegrass (*Stenotaphrum secundatum*) is the No. 1 shade grass of the southernmost States. It is a creeping perennial; it spreads by long runners that produce short, leafy branches. It can be grown successfully south of Augusta, Ga., and Birmingham, Ala., and westward to the coastal regions of Texas. It is established vegetatively. Seed is not available.

St. Augustinegrass will withstand salt water spray. It grows best in moist soils of good fertility. It produces good turf in
the muck soils of Florida. Liberal applications of high-nitrogen fertilizers are necessary, especially in sandy soils.

St. Augustinegrass can be seriously damaged by chinch bugs, and it is susceptible to armyworm damage and several turf diseases.

**Tall Fescue**

Tall fescue (*Festuca arundinacea*) is a tall-growing perennial bunch grass that has coarse, dense basal leaves and a strong, fibrous root system. It is also used for pasture. It is established by seeding.

Because of their wear-resistant qualities, two improved strains of tall fescue, Kentucky 31 fescue and Alta fescue, are used often on play areas, athletic fields, airfields, service yards, and other areas where a heavy, tough turf is needed rather than a fine-textured turf.

Tall fescue will grow in wet or dry, acid or alkaline soils, but it grows best in well-drained, fertile soils. It will withstand a moderate amount of shade.

**Timothy**

Timothy (*Phleum pratense*) is a coarse perennial bunch grass that grows best in the northern humid regions of the United States where its main use is hay for livestock. It has no use as a lawn grass, but it is often found in poor-quality lawn seed mixtures. It is sometimes suitable in nonuse areas to provide cover.

**Weeping Lovegrass**

Weeping lovegrass (*Eragrostis curvula*) is a vigorous perennial bunch grass that grows best in the southern Great Plains region. It is an excellent erosion-control plant on nonuse areas but is not good for home lawns because it will not withstand frequent close mowing. It grows in any type of soil but grows best in sandy loams.

**Velvet Bentgrass**

Velvet bentgrass (*Agrostis canina*), the finest textured of the bentgrasses, is used mainly in high-quality lawns and putting greens in the New England States and the Pacific Northwest. It forms an extremely dense turf from creeping stems. It can be established by seeding or by vegetative planting.

Velvet bentgrass is adapted to a wide range of soil conditions but makes its best growth on well-drained, fertile soils having low acidity. It is not as aggressive as creeping bentgrass and is slow to recover from all types of injury. It requires close mowing, regular brushing, and periodic topdressing. A regular program of fertilizing, watering, and disease control is necessary to maintain high-quality turf. Only one variety of velvet bentgrass is available in the United States: the Kingstown variety.
Ground Cover Plants

Vines and other low-growing plants can often be planted on areas where it is difficult to establish or maintain satisfactory grass cover. Such areas include heavily shaded places, steep banks, rough and rocky areas, terraces, and drainage ditches.

Dichondra

Dichondra (Dichondra repens, D. Carolinensis) is a perennial that forms a low, dense mat under favorable conditions. It can be established by seeding or by vegetative planting. Dichondra is native to the Coastal Plain States from Virginia to Texas, but it is not considered a desirable lawn plant except in central and southern California.

Dichondra is closely related to the milkweed and the morning-glory. Its leaves are pale green, and kidney shaped. It grows best in heavy soils. The plant does not require a high fertility level, but it requires large amounts of water. It will grow in partial shade, but is stemmy and undesirable and will crowd out all other vegetation, including bermudagrass.

English Ivy

English ivy (Hedera helix) is a hardy trailing evergreen vine that thrives in shaded areas but will grow in direct sunlight. It develops a very dense mat that should be pruned occasionally. English ivy is particularly useful on steep banks or around the base of trees.

Japanese Snakebeard (Mondo)

Japanese snakebeard (Ophiopogon japonica), or Lilyturf, is a bunch-growing member of the lily family. It grows 8 to 12 inches high, and bears purple to white flowers. It is used in the southern part of the United States under trees in poor soils. It is propagated vegetatively, and should be set close together because it spreads slowly.

Japanese Spurge

Japanese spurge (Pachysandra terminalis), or Pachysandra, is a low-growing evergreen plant that spreads by suckers. The plants are about 8 inches high. They have dense wedge-shaped leaves and bear inconspicuous greenish-white flowers. They are established by division or by cuttings. Plants should be set 1 foot apart.

Japanese spurge is used in the Eastern United States from New England to Georgia. It is particularly recommended in Virginia, North Carolina, South Carolina, Kentucky, and Tennessee.

Lippia

Lippia (Lippia camescens) is used as a substitute for grass throughout the Southwest, par-

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1 For more detailed information about ground covers, see Home and Garden Bulletin 175, “Growing Ground Covers.”
particularly in Arizona. Lippia leaves are dark green. They are oblong, and seldom more than 1 inch long. Lippia will not survive temperatures below freezing, and may be injured by temperatures somewhat higher than freezing. It is also susceptible to nematode damage. Lippia has been known to crowd out bermudagrass when mowed regularly. It is established by vegetative planting.

**Partridge Berry**

Partridge berry (*Mitchella repens*) is a low-growing creeping evergreen that is native to the Southeastern United States. It grows well in shaded areas having moist, fertile soils. Its leaves are small, glossy, and round. It produces pinkish-white flowers in the spring; these are followed by scarlet fruit in the fall and winter.

Partridge berry is established by cuttings from vegetative material that can be found along streambanks and in wooded areas in the southeastern part of the country.

**Periwinkle Common**

Common periwinkle (*Vinca minor*), or myrtle, is a hardy low-growing evergreen that spreads by creeping stems. It has small, dark-green, glossy leaves. It develops violet blue flowers.

Common periwinkle will form a dense mat that shades out weeds and grasses. It grows best in moist soils that are high in organic matter. It is partial to dense shade, but it will grow satisfactorily under dry conditions in direct sunlight. Periwinkle is established by cuttings and can be planted any time when the soil is not frozen.

**White Clover**

White clover (*Trifolium repens*) is regarded by some as a desirable ground cover plant in lawns. It is regarded by others as a pest.

Grass growing in proximity to white clover may be benefited by the nitrogen-fixing ability of the nodules on the clover roots. The plant often grows in patches of varying size, giving the lawn an uneven appearance. Some persons object to the white flower the plants form, and to the fact that it attracts bees. Another disadvantage is that white clover disappears during hot, dry weather. Contrary to claims made, white clover will not compete successfully with crabgrass.