

ommended. Ordinary mercury and high-pressure sodium lamps are satisfactory, but require special installation. A lighting engineer can help you with your garden lighting plans.

Other than selecting annuals that are resistant to air pollution damage, there is little that can be done to protect them from this menace. It does pay, however, to reduce the amount of nitrogen fertilizer applied and the frequency of watering. High soil moisture and nitrogen levels cause soft, succulent growth which is particularly susceptible to air pollutants. Moderate applications will retard growth and make the plants better able to survive.

Although no practical antipollutant chemical treatments are available, antitranspirant sprays may be of some benefit. These are latex, wax, or plastic waterproofing materials that are sprayed on the foliage and stems in spring and summer when growth is rapid. Antitranspirant products are sold by garden supply dealers. Apply according to directions on the container.

Dust, soot, fly ash, and other solid residues—another form of pollution—also settle on plants in the garden.

These are unsightly, and interfere with plant growth. Syringing with water sometimes is sufficient. But you may have to resort to soapy water, heated to a little above air temperature.

Use only a very mild soap (not a laundry powder or liquids). Apply the solution to the foliage with a laundry sprinkler, avoiding excessive runoff or drip. In 5 or 10 minutes, flush off the grime with a fine nozzle on the hose.

Many a gardener becomes discouraged when summer heat, wind, drought, pollution, and other hazards take their toll. But growing annuals can be fun. Avoid overextending yourself—plant what you can take care of properly. Above all, don't be a "scratch and plant" gardener.

Good gardening practices improve your chances of success, and help you reap the rewards and satisfactions of beautifying the environment—at least your little corner of the world—with flowering annuals.

For further reading:

U.S. Department of Agriculture, *Growing Flowering Annuals*. Home and Garden Bulletin 91, Wash., D.C. 20250, 1970.



selecting lawn grasses, from bahia to zoysia

GRASSES constitute one of the most appealing parts of our outdoor environment. They provide recreational and beautification areas for children and grownups in the form of lawns, athletic fields, golf links, parks, and roadsides.

Most people may fail to realize that grasses are important in pollution control. They prevent wind and water erosion and they supply vital organic matter to the soil. They also absorb carbon dioxide and enrich the atmosphere with oxygen through plant photosynthesis.

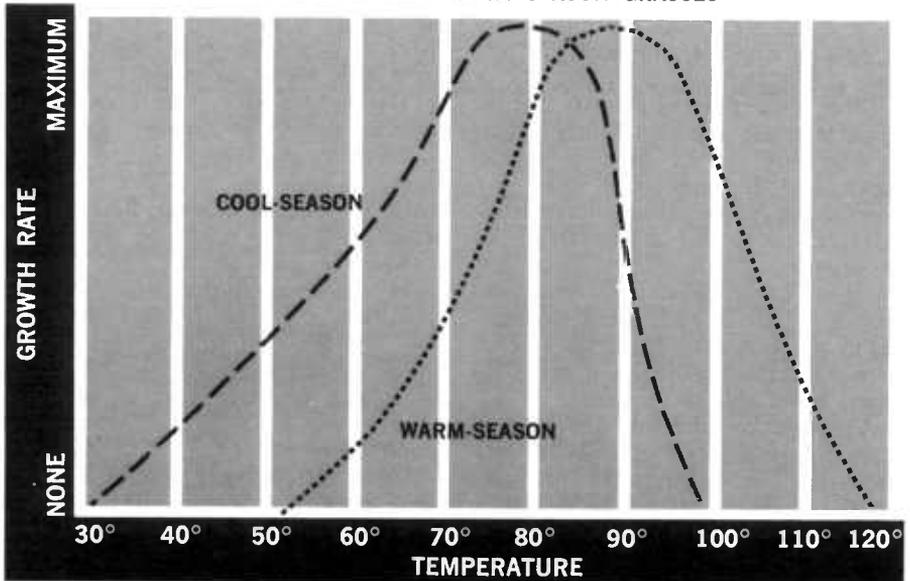
Selection of turfgrasses depends in

large part on climatic conditions. Cool-season grasses grow best in the North and warm-season grasses in the South. The growth cycle of grasses varies with temperature.

Seedbed preparations are similar for establishing nearly all grasses. First you should plow, disk, or rototill to loosen the subsoil.

Lime is generally required for soils east of the Mississippi River. Apply 50 to 80 pounds of ground limestone per 1,000 square feet every 5 to 6 years. When there is uncertainty about the need for lime, the soil should be tested.

RELATION OF TEMPERATURE TO GROWTH RATE
IN COOL AND WARM SEASON GRASSES



If lime is needed, it should be incorporated into the soil, along with 30 to 40 pounds of phosphorus 0-20-0 per 1,000 square feet. On established lawns, apply lime on the surface.

Before planting seed, sprigs, or sod pieces, apply a complete fertilizer containing nitrogen, phosphorus, and potash. The analyses on the bag are always listed in the order mentioned. For example, a 10-6-4 fertilizer contains 10 percent nitrogen, 6 percent phosphorus, and 4 percent potash.

Apply 10 pounds of a fertilizer containing 10 percent nitrogen per 1,000 square feet and rake into the soil. Apply with a 20-10-10 fertilizer, 5 pounds per 1,000 square feet.

Fertilizer is seldom required on western soils where blue grama and buffalograsses are used for turf.

Plant the seed adapted to your region

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evenly over the seedbed with a spreader or by hand. If the seed is applied by hand, mix it with sand or soil to provide bulk. Half of the seed should be sown in one direction and the other half at a right angle to the first seeding. Lightly rake the seed into the soil to a depth of a quarter of an inch.

Scatter weed-free straw, hay, pine needles, or other mulch material over the seeded area. Mulch reduces erosion and provides shade and favorable moisture conditions for the emerging seedlings. One 60- to 80-pound bale of mulch is about enough per 1,000 square feet. About half of the soil should be visible after the mulch is laid.

Water the area lightly two or three times daily until the seedlings become established. Mulching materials need not be removed if you use them in moderate amounts and distribute them well.

Most southern grasses such as bermudagrass, St. Augustinegrass, and zoysia are established from sprigs (individual plants or runners) or pieces of sod. The sod or sprigs can be planted at 1-foot intervals. However, the closer together the sprigs, plugs (round cores

of grass and soil), or sod pieces are planted, the more rapidly your lawn will become established.

If your lawn has thinned out so only half of the perennial grasses remain, you can still restore it without plowing and reseeding the entire area.

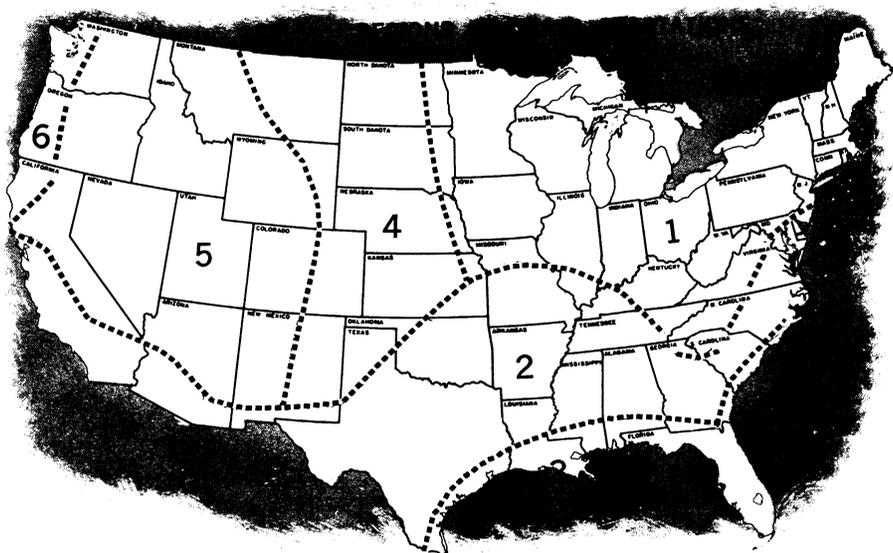
For cool-season grasses (Kentucky bluegrass, red fescue, bentgrass, etc.) rake dead areas to remove the thatch and loosen up the soil. The seed must come in contact with the soil in order to germinate.

After seeding, raking, and mulching, spread fertilizer over the lawn at recommended rates. Water the newly seeded areas two or three times daily. Continue to mow the lawn at the recommended height for the species.

Late August and September are the best times for renovating cool-season lawns, although seeding bare areas in early spring is frequently successful.

Southern grasses that spread by runners (stolons) may be sprigged or sodded into dead areas without much soil preparation. Make a slit in the soil with a spade, insert the sprig, and firm the soil with your foot. Soil can be stripped with a spade and sod pieces laid and firmed into the soil the same way as with sprigs. Water the replanted areas and apply fertilizer over the entire lawn. Continue to mow as usual.

Cool-season grasses make their best growth in the fall and spring—Kentucky bluegrass, red fescue, Colonial bentgrass, crested wheatgrass, ryegrass,



CLIMATIC REGIONS, IN WHICH THE FOLLOWING GRASSES ARE SUITABLE FOR LAWNS:

1. Kentucky bluegrass, red fescue, and Colonial bentgrass. Tall fescue, bermuda, and zoysiagrasses in the southern part.

2. Bermuda and zoysiagrasses. Centipede, carpet, and St. Augustinegrasses in the southern part; tall fescue and Kentucky bluegrass in some northern areas.

3. St. Augustine, bermuda, zoysia, carpet, and bahiagrasses.

4. Nonirrigated areas: Crested wheat, buffalo, and blue gramagrasses. Irrigated areas: Kentucky bluegrass and red fescue.

5. Nonirrigated areas: Crested wheatgrass. Irrigated areas: Kentucky bluegrass and red fescue.

6. Colonial bent, Kentucky bluegrass, and red fescue.

Lawn Grasses: Planting Time, Propagation, Fertilization, and Mowing Height

Grass	Best planting time	Seed (lbs. per 1,000 sq. ft.)	Sod (sq. ft.) ¹	Fertilizer (lbs. of nitrogen 1,000 sq. ft.)	Height of mowing (in.)
Bahia	Spring	2-3		4	2
Bentgrass, Colonial	Fall	1-2		4-6	½-1
Bermuda (hulled)	Spring	1-1½	5-10	5-10	¾-1
Blue grama	"	1-1½		²	1-2
Buffalo (treated)	"	½-1½	25-30	²	1-2
Carpet	"	3-4	8-10	2-3	2-2½
Centipede	"	¼-½	8-10	2-3	1-1½
Crested wheat	Fall	1-2		0-1	2
Ky. bluegrass	"	1½-2		3-6	1½-2
Red fescue	"	3-4		2-3	1½-2
Rough bluegrass	"	1½-2		2-4	1½-2
Ryegrass	"	3-4		3-4	1½-2
St. Augustine	Spring	None	8-10	4-5	2-2½
Tall fescue	Fall	5-6		3-5	2
Zoysia	Spring	None	8-10	4-6	¾-1½

¹ Needed to sprig 1,000 sq. ft.

² Seldom required on most soils.

rough bluegrass, and tall fescue. Warm-season grasses are planted in the spring and make their best growth during the summer months—bermuda, bahia, blue grama, buffalo, carpet, St. Augustine, zoysia, and centipede grasses. Climatic regions of lawn grass adaptation are shown in the map with this chapter. For planting times, propagation, fertilization, and mowing height, see the table on this page.

Colonial bentgrass (*Agrostis tenuis*) is a fine-textured grass with a few creeping stems and underground rootstocks (rhizomes). It forms a dense turf when heavily seeded and closely mowed. Colonial bentgrass is used for high-quality lawns in many of the New England States and west of the Cascade Mountains in Washington and Oregon (regions 1 and 6 on the map that appears on page 113).

Colonial bentgrass requires fertile soil and frequent fertilizing. It must be watered during dry periods and it is susceptible to a wide variety of diseases.

Two strains of Colonial bentgrass are generally planted for lawns, Astoria and Highland.

Crested wheatgrass (*Agropyron cris-*

tatum), a seeded perennial bunchgrass, will thrive in most of the soils of the northern Great Plains and intermountain areas (regions 4 and 5). It is recommended for dry, cool areas where irrigation water is not available.

Crested wheatgrass withstands long, dry periods and heavy wear if not mowed too closely. It grows mostly in the fall and spring and becomes dormant during hot summer months.

Kentucky bluegrass (*Poa pratensis*) is a hardy, long-lived, perennial, sod-forming grass that spreads by underground rootstocks. It is one of our most widely used lawn grasses. Kentucky bluegrass is well adapted to regions 1 and 6 and grows in regions 4 and 5 if irrigated. It is propagated by seed.

Kentucky bluegrass will not grow well on poorly drained sites or in acid soils (below pH 6.0). Soil testing will indicate whether your soil is acid or alkaline in terms of pH. A pH of 4 is very acid and a pH of 7 is neutral. Merion was one of the first improved varieties to be released but others such as Fyking, Pennstar, Windsor, Prato, Sodco, and Park are now marketed.

Red fescue (*Festuca rubra*) and



Kentucky 31 fescue lawn on new home site
in Tennessee.

Chewings fescue (*Festuca rubra* var. *commutata*) rate next to Kentucky bluegrass in importance for northern humid regions. Red fescue will spread slowly from underground rootstocks. Chewings fescue is an upright, bunch-type grass.

Both fescues are established by seeding, and both are used extensively in mixtures with Kentucky bluegrass. They grow well in medium-shaded areas and on poor, droughty soils.

Improved varieties of red fescue are Pennlawn, Illahee, Golfrood, and Ruby. Jamestown is the only available improved strain of Chewings fescue.

Rough bluegrass (*Poa trivialis*) is a shade-tolerant perennial that is useful for lawns only in the North. It is established by seeding. Rough bluegrass prefers moist sites. It is seriously injured by hot, dry weather.

The leaves are similar in texture to Kentucky bluegrass but are shiny. Stems and leaves lie flat and are lighter green than most Kentucky bluegrasses.

Italian or annual ryegrass (*Lolium multiflorum*) and the perennial ryegrass (*Lolium perenne*) are propagated by

seed. Much ryegrass lawn seed is a mixture of both annual and perennial ryegrasses.

Many commercial lawn seed mixtures contain too much ryegrass; the ryegrass competes with the slower growing Kentucky bluegrass and red fescue. For a late spring seeding and on slopes, it is advisable to include some ryegrass for green color and to avoid erosion.

Perennial ryegrass varieties include Pennfine, NK-100, Pelo, Manhattan, and Norlea. Varieties of annual ryegrass include Astor, Gulf, Magnolia, and Tifton 1.

Tall fescue (*Festuca arundinacea*) is a tall-growing, perennial bunchgrass that has coarse, dense, basal leaves and a strong fibrous root system. It is vigorous, grows well on both wet and dry sites, but does best on heavy soils.

Because of their wear-resistant qualities, two varieties of tall fescue—Kentucky 31 and Alta—are seeded in lawns, play areas, athletic fields, airfields, and other areas where a tough turf rather than a fine-textured turf is needed.

Kentucky 31 tall fescue forms a tough, durable turf throughout much of the transition zone where neither cool-season grasses nor warm-season grasses are especially well adapted. Tall fescue is seldom seriously injured by insects or diseases.

When seeded at heavy rates (see table with this chapter), tall fescue produces finer leaves, the plants do not clump as readily, and a quite respectable lawn results.

Bahiagrass (*Paspalum notatum*) is a low-growing perennial that spreads slowly by short, stout underground rootstocks. It grows best in the South Central Plains, and is established by seeding. Several varieties are adapted to sandy soils from central North Carolina to eastern Texas. This grass is primarily for pastures and roadsides but the varieties Paraguay and Pensacola are used for lawns.

Bermudagrass (*Cynodon* spp.) is adapted to regions 2 and 3, where many varieties are sold. Each variety generally is for a specific use.

Common bermudagrass is coarse textured and propagated from seed. Other varieties are established vegetatively because the seed is sterile or is nearly so.

Bermudagrass grows on a wide range of soils from heavy clays to deep sands, provided they are fertile. It grows satisfactorily on both acid and alkaline soils and has a high tolerance to saline conditions. It persists on relatively infertile soils yet high nitrogen fertilizing is required for good-quality turf. While rated drought tolerant in humid regions, it cannot grow in arid regions without supplementary irrigation.

Bermudagrasses are not shade tolerant; however, there are slight differences among varieties.

Bermudagrass will grow vigorously, spreading by runners and underground rootstocks. It often becomes a pest in flowerbeds and other cultivated areas. Once established, it is hard to eradicate.

This grass turns brown following the first frost and does not become green again until warm weather occurs in the spring. But even with its shortcomings, bermudagrass is one of our most widely used turfgrasses.

Varieties of bermudagrass that are used in high-quality lawns receiving maximum maintenance and on golf course greens, tees, and fairways are Tifgreen, Tiffine, Tifway, Bayshore, and Tifdwarf.

The bermudagrasses require frequent, heavy applications of nitrogen fertilizer in water soluble form. Bermudagrasses also require dethatching once or twice a year to remove dead runners, roots, and leaves that accumulate.

Blue gramagrass (*Bouteloua gracilis*) is a low-growing, perennial bunchgrass adapted to parts of the Great Plains. As a turfgrass it is limited to cool, dry sites where there is little or no irrigation available.

This grass is highly drought resistant and is established from seed. It becomes semidormant and turns brown during excessively dry periods.

Buffalograss (*Buchloe dactyloides*) is a fine-leaved, warm-season, sodforming perennial that spreads by runners. It grows on the Great Plains from western Minnesota to central Montana, south to northwestern Iowa, Texas, and Arizona. It is drought resistant, tolerant of alkaline soils, and adapted to clay soils.

USDA agronomist discusses turfgrass research at a Beltsville, Md., field day.



Buffalograss can be established from sod pieces or by seeding.

Carpetgrass (*Axonopus affinis*) is a rapid spreading, perennial grass. It spreads by runners and produces a dense, compact turf when mowed, but is coarse textured. It can be established by seed or sodding. Carpetgrass is most abundant in lowland areas from coastal North Carolina to Florida and westward to Texas. It grows best in moist, sandy loam soils or those which have a relatively high content of moisture throughout the year. It sometimes invades infertile, upland sites but does not grow well in dry soils or in regions which remain dry during part of the growing season.

Carpetgrass produces tall seedheads that are difficult to mow and make the lawn look ragged. Mowing frequently with a rotary mower is recommended.

No improved varieties are available.

Centipedegrass (*Eremochloa ophiuroides*) will spread rapidly from short, creeping runners that form plants at each node or joint. It forms a dense, weedfree turf. Centipedegrass is usually planted vegetatively, but some seed is available.

This is considered the best low-maintenance grass for the South. It has survived winter conditions as far North as northern Alabama and central areas of North Carolina.

Centipedegrass requires less mowing, less watering, and less fertilizing than other southern grasses. Applications of iron compounds correct yellowing.

Centipedegrass should not be planted on farm lawns—it may escape and contaminate cropland. Common centipedegrass is most extensively planted.

Oklawn is a variety selected for tolerance to drought and high temperatures; it grows in shade as well as in full sunlight.

St. Augustinegrass (*Stenotaphrum secundatum*) is the best shade-tolerating grass for the South. It is a creeping perennial and spreads by long runners that produce short, leafy branches. It is restricted to the Gulf Coast States and milder parts of California. It is established vegetatively.

This grass can withstand salt water spray. It grows best in soils of high fertility.

St. Augustinegrass is very susceptible to chinch bug injury and to brown patch disease. Varieties available for lawns are Bitter Blue and Floratine.

Three species of zoysiagrass are recognized and used for turf. These are *Zoysia japonica*, *Z. matrella*, and *Z. tenuifolia*. They are distinguished primarily on the basis of size, vigor, and winter hardiness.

Common zoysia, *Zoysia japonica*, also known as Japanese lawngrass, can be propagated vegetatively or from seed. It is rather coarse leaved and is used to some extent for lawns.

Meyer zoysia, a selection from common zoysia, is intermediate in leaf width between common and *Zoysia matrella*. It is well adapted to the mid-Atlantic area. Meyer zoysia is more desirable for home lawns because of its finer textured leaves. It must be propagated vegetatively by sprigs, sod pieces, or plugs.

Although Meyer zoysia survives in soils of low fertility, it makes best growth when given liberal applications of complete fertilizers high in nitrogen. Meyer zoysia is relatively drought tolerant in humid regions. This grass is highly resistant to wear and withstands close clipping.

Emerald zoysia is a hybrid variety superior to Meyer zoysia in the South. The grass is fine leaved, dense growing, and dark green.

Manilagrass (*Zoysia matrella*) has about the same leaf texture as emerald but is a lighter green. Manilagrass is adapted to the South. It produces a dense carpetlike turf that resists weeds and wears well. Manilagrass is sensitive to highly acid soils. It responds well to liberal applications of nitrogen fertilizer and is established by sprigging or spot sodding.

Mascarenegrass (*Zoysia tenuifolia*) is a stoloniferous grass that is the least winter hardy of the zoysiagrasses. It is adapted to a very few locations in Florida and California. It ultimately becomes sod bound and humps up.

All zoysiagrasses turn offcolor during cool weather and become brown with the first killing frost. Zoysias do not become green until the warm weather in spring.

Points to remember: A lawn is not difficult to establish and maintain if a few cardinal principles are followed. Preparing a good seedbed is a start toward obtaining a good lawn. Select and plant lawn seed or lawn mixtures adapted to your region and location.

Fertilize your lawn according to the needs of the lawn grass species or mixture in your lawn. Do not overstimulate the lawn with nitrogen fertilizer. Succulent grass requires more frequent mowing, and may be more readily in-

fectured by fungus diseases. Too much nitrogen causes shallow rooting.

Do not water established lawns frequently and lightly. When the lawn shows need for water (slight wilting and footprinting), water the soil deeply to at least 6 inches, and do not water again until the symptoms reappear.

Mow at the recommended height for the dominant species in the lawn. Mowing frequencies will vary with the grass species in the lawn. The bermudagrasses and bentgrasses require more frequent mowing than do most upright-growing grasses.

Where shade is a problem, use grass species that are more shade tolerant, and remove lower branches of trees.



protecting lawn grasses against pests, wear

LAWN GRASSES, like people and pets, respond to the attention or abuse they receive. Unlike man and animals they can't complain when a disease attacks or an insect bites nor can they depart the scene when the environment becomes unfavorable. The user and the enjoyer of grass must watch for symptoms of attacks by pests or signs of abuse in order to speedily correct the trouble and maintain an esthetically appealing carpet of green.

Most diseases of lawn grasses are caused by fungi. They occur as microscopically small filaments (called mycelia) that are parasitic within or on plant parts. Masses of these cobwebby or cottony fungus filaments are sometimes visible on grass blades.

Many fungi attacking grasses reproduce by means of microscopic fruiting structures called spores. They are most noticeable when grasses infected with rust or smut fungi are being mowed and the spores are released like dust into the air.

Some fungi, such as mushrooms and

slime molds, are not true disease organisms. They do not attack lawn grasses directly but are discussed with disease organisms because they commonly occur in lawns.

You can avoid or reduce damage from some fungus-caused diseases by following recommended cultural practices, growing disease-resistant varieties, or applying fungicides according to the manufacturer's or the turf specialist's instructions.

Helminthosporium leaf spot and foot rot gets its name from the *Helminthosporium* fungi that are among the most widely distributed and destructive lawn grass diseases. On Kentucky bluegrass, one of the species most severely damaged, the disease occurs mainly during cool, moist weather of spring and fall. The foot rot stage generally occurs during warm, dry summer months.

Infection in lawn grasses is most conspicuous on the leaves where reddish-brown spots develop. The leaf spots are often characterized by lighter-colored centers. Diseased leaves usually shrivel