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THE HOME LAWN

. . . Good Turf for Utility and Beauty

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PREFACE

A grass turf for home lawns, parks, cemeteries, playgrounds, highway rights-of-ways or around an industrial plant adds usefulness, value and beauty to the surroundings. Principles discussed in this bulletin will apply to any turfed area, with modification to fit the particular situation.

Seldom-used turf such as some lawns and parts of cemeteries require less water and fertilizer than intensely used areas such as football fields and playgrounds. Intensively used areas will require more frequent aeration and heavier rates of fertilizer than are discussed in this bulletin.

A beautiful lawn or other turf area adds to the enjoyment and health of people.

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THE HOME LAWN

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A beautiful, well-kept lawn adds to the material value of a home and is a basic requirement for a completely attractive yard. Properly planted and well-kept turf gives an aspect of spaciousness, provides a cool, restful cover, and prevents soil blowing and washing.

Basic fundamentals, such as the choice of adapted grasses, good drainage, proper watering, fertilizing and mowing, insure success in building and maintaining good turf.

This bulletin discusses the fundamentals in establishing and caring for turfed areas.

TURF GRASSES FOR TEXAS

Of the 550 species of grasses in Texas only a few are suitable for turf. Turf grasses are not permitted to mature normally and produce seed. Food materials, essential for growth and development of roots and stems, are manufactured in the leaves; yet, throughout the growing season large amounts of foliage are clipped weekly. It is not surprising, therefore, that only a few grasses are able to stand such treatment and produce desirable turf.

Choice of a turf grass depends on the geographic location of the property, the amount of water available for irrigation, the degree of shade present and the kind of usage anticipated. Turf grasses are classified as warm-season (growing in late spring, summer and early fall) and cool-season (growing in late fall, winter and early spring).

Warm-Season Turf Grasses

Warm-season grasses most often used and recommended for turf purposes are Bermuda, St. Augustine and buffalo. Zoysia, centipede, carpet are other warm-season turf grasses.

BERMUDA (*Cynodon dactylon*) is the turf grass most widely adapted to Texas conditions. It is a narrow-leafed, vigorous growing perennial, with both above ground (stolons) and below ground (rhizomes) creeping stems. It is drouth resistant and spreads rapidly. Bermuda is resistant to most turf diseases. When properly managed, weeds are not a problem in bermuda turf. It makes a dense turf when mowed frequently at a height of one to two inches. It grows in all sections of Texas. Contrary to popular belief, bermuda is not a low fertility plant—it must be fertilized to produce good turf. During extended drouths, water is needed to keep the grass green. In the drier regions water is needed for the existence of bermuda.

Bermuda as a turf grass: (1) does not grow in shade; (2) turns brown after the first frost in the fall and, with continued low temperatures, does not become green until after the last spring freeze; and (3) is more of a nuisance than other turf grasses in flower beds and gardens because of the rhizomes. Although the leaves of bermuda turn brown after the first frost, it will tolerate low temperatures since the rhizomes will produce new leaves when growing conditions are favorable.

Table 1 lists methods that may be used to establish bermuda.

ST. AUGUSTINE (*Stenotophrum secundatum*) is a wide-leaved perennial with stolons (runners) creeping on the surface. It is not as widely adapted as bermuda. It is recommended for the Dallas-Fort Worth area southward and eastward. It grows in shade and in open areas when adequate moisture and fertility are available. St. Augustine will remain green after frosts that kill bermuda above the ground.

St. Augustine, when supplied with adequate moisture and fertility, forms a dense, thick turf, usually crowding out all other grasses and weeds if growing conditions are favorable. It should be cut at a height of one to two inches. It grows best in fertile, well-drained, sandy loam soils adequately supplied with organic matter. Since the plant spreads from surface runners only, it is easily controlled in flower beds and gardens.

St. Augustine as a turf grass: (1) is susceptible to certain diseases, notably large brownpatch and leaf spot; (2) is attacked by insects (chinch bugs and leaf hoppers); (3) needs more water than bermuda; (4) will not survive as low temperatures as will bermuda or buffalo; and (5) is a wideleafed, coarse textured plant. *St. Augustine does not produce live seeds; consequently, it must be established by planting sod or runners of other St. Augustine plants.*

TABLE I

Methods of Propagating the Various Lawn Grasses, Showing the Type of Material, the Quantity and the Best Season for Establishing

Grass	Established from	Method of planting	Quantity per 1000 sq. ft.	Best planting season
Bermuda	Seed	Broadcast	½ to 1 pound	Spring to early fall
	Sprigs	Sprig 6″ apart in 12″ rows	5 to 10 sq. ft. sod	
	Sod	Solid—lay as bricks	Same as area to be sodded	
St. Augustine	2″ sod blocks or runners	2″ blocks on 12″ centers; runners broadcast on prepared seed bed	Sod blocks—30 sq. ft. of nursery sod Runners—3 to 6 sq. ft. of nursery sod	Spring and early summer
Buffalo	Seed	Broadcast	½ to ¾ pounds	Spring
	4″ sod blocks	On 1½ to 2 ft. centers	25 to 50 sq. ft. of nursery sod	
Centipede	Shredded Sod (sprigs) or 2″ sod blocks	In 8″ rows 12″ apart	5 to 10 sq. ft. of nursery sod	Spring to early fall
Zoysia	2″ sod blocks	2″ sod blocks on 6″ centers	40 to 50 sq. ft. of nursery sod	Spring and early summer
Ryegrass	Seed	Broadcast	6 to 8 pounds	Oct. to Nov.
Alta or Ky. 31 fescue	Seed	Broadcast	6 to 8 pounds	Oct. to Nov.
Kentucky bluegrass	Seed	Broadcast	1½ to 2 pounds	Oct. to Nov.

Refer to Table 1 for methods of establishing St. Augustine.

St. Augustine is often confused with carpet grass (*Axonopus affinis*) and is mistakenly called "carpet grass" in many sections of Texas. The two are easily distinguished if the seed heads are present. Seed heads of St. Augustine are single, short, flat, thick, corky stems (spikes). The seeds are sunken into one side of this spike. Carpet grass seed heads are long, slender, drooping stems that fork at the end into two and occasionally three branches (racemes), somewhat like crabgrass. Some evidence of these stems is always present, either growing or lying on the ground.

Vegetatively, the two species may be distinguished by the growth habit of the leaves. The leaves of St. Augustine arise from the collar at a quarter angle, while those of carpet grass arise directly from the collar in a manner similar to most other grasses. Other differences between the two species are: (1) St. Augustine grows in shade, carpet does not; (2) St. Augustine will not live in low, wet areas, carpet thrives in such areas; and (3) St. Augustine must be established from plant material since it produces no live seed; carpet produces live seed. Carpet grass is not generally used as a turf grass and very few lawns of carpet are found in Texas.

BUFFALO (*Buchloe dactyloides*) is a low-growing, perennial plant native to South-central Texas and areas westward and northward. Buffalo grass is one of the few species having separate male and female plants. Buffalo is cold, drouth and heat tolerant. It is recommended in dry regions where facilities for watering are not available. Surface growth may take on a dry appearance during extended dry periods but the roots are not easily injured. Mowing is not essential, but lawns mowed, fertilized and watered are more attractive. Since the plant spreads from surface runners only, it is easily controlled in flower beds and gardens by cultivation.

Buffalo will not grow in shade. It grows best on fertile, well-aerated, heavy soils. Buffalo grass is not recommended in East Texas or the Gulf Coast Prairie region.

Buffalo as a lawn grass: (1) has a dry, unattractive appearance during periods of prolonged drouth and in late fall, winter and early spring; (2) is not aggressive and may be invaded by weeds and other faster-growing grasses; and (3) will not tolerate shade. Attempts to maintain satisfactory turf outside its adaptive region have not been very successful.

Table 1 gives methods of establishment.

ZOYSIA species including Japanese lawn grass (*Zoysia japonica*) and Manila grass (*Zoysia matrella*), are excellent turf grasses if properly handled.

Japanese lawn grass can be grown in most areas of Texas; Manila grass, on the other hand, is adapted only in Central and South Texas. Japanese lawn grass is wider leafed, endures more cold and grows more rapidly than does Manila grass. Both are considered slow growers when compared with bermuda or St. Augustine. Two-inch sod pieces on 12-inch centers would require a minimum of two years to completely cover an area that bermuda would cover in two months. Zoysia, like bermuda, requires periodic watering, if it is to remain green.

Zoysia grasses form a tough, dense turf that is wear-resistant. Zoysia grows in shade as well as in sunlight and requires little mowing.

Refer to Table 1 for methods of establishment.

CENTIPEDE (*Eremochloa ophiuroides*) is often called "Chinese lawn grass" and "lazy man's grass." It is a creeping, perennial grass with medium width leaves. Only surface runners are produced, thereby making it easy to eradicate.

Centipede is intermediate between bermuda and St. Augustine in many respects; it is more shade tolerant than bermuda and tolerates less shade than St. Augustine. The width of leaf and, to a certain degree, the color are also intermediate between the other two species.

Centipede grass browns off after the first frost, requires as much water as St. Augustine and will not survive low temperatures.

Centipede is adapted to sandy, well-drained soils in East, South and Central Texas. It is a recommended turf grass in the humid Southeastern States, but it is not widely used in Texas. Results obtained with centipede have been most erratic—some users have been quite successful, others have failed entirely. It is known to be of low quality as a forage or pasture plant; thus, if used on a farm lawn, care should be taken to prevent centipede spreading to pasture or crop land.

Cool-Season Turf Grasses

Under certain conditions cool-season grasses may be planted to have a green lawn during the winter. No combination of cool-season and warm-season grasses so far has proved entirely satisfactory for maintaining a year-round green turf.

The most satisfactory results are obtained from overseeding bermuda and St. Augustine with annual ryegrass.

RYEGRASS (*Lolium perenne and Lolium multiflorum*).

Lolium perenne is a perennial and *Lolium multiflorum* is an annual ryegrass. Most seed of these species are sold as domestic ryegrass—a mixture of the perennial and annual types. Relatively pure seed of annual ryegrass or perennial ryegrass may be purchased. Under Texas lawn conditions, both species act as annuals except in the Panhandle where perennial ryegrass, under proper watering and care, is a good, permanent lawn grass.

Ryegrass is a fine-leafed bunch grass (with no stolons or rhizomes). Unless properly fertilized it turns pale yellow. It is susceptible to rust, a disease that often destroys it in mid-spring.

Ryegrass is used for winter lawns in Texas. It is not recommended on lawns established in grasses other than bermuda. Unless a good management program is followed, damage to the base turf (bermuda) will result from using ryegrass. This is particularly true when cold late springs occur, because the ryegrass will remain in the lawn area long after the base grass is making early growth; hence, it competes with the base grass for light, nutrients and moisture.

ALTA *and* KENTUCKY 31 FESCUE (*Festuca elatior*, var. *arundinaceae*) are two strains of tall fescue. Alta was selected in Oregon and Kentucky 31 in Kentucky. They are tall-growing perennial bunch grasses. When seeded heavily and clipped short and regularly, they form a dense, coarse turf that is highly resistant to hard wear. They have a wide range of adaptation to soil conditions, but grow best on fertile, well-drained soils. They are moderately shade tolerant and highly drouth resistant. In North, Central and West Texas where irrigation is possible, they may provide green turf the year round. Their use as a general lawn grass is still questionable, particularly where other species are adapted.

Table 1 gives recommended seeding dates and rates.

KENTUCKY BLUEGRASS (*Poa pratensis*) is a fine-leaved, creeping perennial lawn grass. It is widely used in the Northern United States, therefore, in Texas it will grow only in the Panhandle under irrigation. It grows best under shady conditions and on soils high in calcium and phosphorus. Supplemental feeding of nitrogen is necessary for best performance. Kentucky bluegrass is susceptible to leaf-spot diseases.

A new strain known as Merion (B-27) shows particular promise. It withstands close mowing and carries some resistance to leaf spot. Merion is not necessarily adapted over a greater range than common Kentucky bluegrass.

ESTABLISHMENT OF A NEW TURF

Three distinct steps or phases should be recognized in the establishment of turf. One is the preparation of the soil. This involves grading, drainage, incorporation of organic matter, sand or loam, supplying adequate plant food, and finally seedbed preparation. Another is the establishment of the grass. The third phase is the care and maintenance of the young grass during its development.

Preparing the Soil

Soil is the foundation of the lawn. As with any structure, the end product is no better than the foundation upon which it is built. The first step in preparing a new turf area is to remove all debris, such as stones, lumber and trash.

In most instances, the character of the soil will need to be altered considerably. A sandy loam high in organic matter is considered most satisfactory for turf. If the original surface soil contains too much clay, a sandy topsoil should be added and mixed in; similarly, if the topsoil is too sandy, clay or loam may be added. Often some coarse sand should be added to the soil. In all cases, *organic matter should be added.* This organic matter may be peat, compost, well-decomposed gin trash, well-decomposed sawdust (preferably hardwood), leaf mold, or some similar material. Coarse sand and organic matter should be thoroughly mixed with the seedbed. This mixing can be done by repeated cultivating operations such as disking or plowing. Incorporation of these materials is essential to provide for adequate aeration and drainage, water infiltration and improvement of the water-holding capacity. In addition, organic matter provides "life," tilth and acts as a "store house" for soil nutrients. Such materials make soils more productive.

The area should be properly graded to provide for surface drainage. The soil should be graded so as to gradually slope away from the house, walks and driveways. A fall of one foot in every 40 to 50 feet is adequate for drainage, provided no pockets or depressions exist. In some cases, artificial drainage outlets may be needed to take care of excess water. Normally, natural drainage outlets may be used.

If a considerable part of the lawn area needs to be filled, such as a depression or ditch, a loam soil high in organic matter should be used. If such soil is not readily available, sand, organic matter or clay may be mixed and used.

Terraces should be avoided if possible. On areas where the lot slopes steeply, retaining walls, rather than terraces, should be built. When trees are to remain in the lawn area, the soil should be graded gradually away from the trunk. Should a fill of over two or three inches above the existing surface surrounding a tree be required, a retaining wall should be built to prevent covering the roots too deeply. This should be constructed at least three to four feet from the trunk.

Adding Plant Food or Fertilizer

Soils in East Texas are normally deficient in nitrogen, phosphate, potash and lime. Nitrogen and phosphate are deficient for good turf in other parts of the State. Potash may become a limiting factor in producing good turf when adequate amounts of nitrogen and phosphorus are used in areas not normally deficient in potash.

Applications of fertilizers should be at rates and combinations indicated by soil tests.

Usually plowing or spading under the equivalent of 10 to 20 pounds of 20 per cent superphosphate and four to six pounds of muriate of potash (where needed) per 1,000 square feet will supply the fertilizer needed for deep root development. In East Texas, ground limestone should be added at the rate of 50 to 100 pounds per 1,000 square feet. If organic matter is incorporated, three to five pounds of ammonium nitrate or five to seven pounds of ammonium sulfate per 1,000 square feet should be added. This is needed to aid in decomposing most of the available forms of organic matter. A complete fertilizer of a 1-2-1 (10-20-10, 5-10-5) or 1-1-1 (8-8-8) ratio may be used for nitrogen, phosphorus and potash. This should be worked into the soil at approximate rates of two pounds of nitrogen per 1,000 square feet. This would be the equivalent of 20 pounds of 10-20-10, 40 pounds of 5-10-5 or 25 pounds of 8-8-8.

See Table 2 for other fertilizer equivalents.

After soil conditioners such as coarse sand, organic matter, lime and fertilizer, have been worked into the soil, it should be harrowed, raked or otherwise smoothed. Prior to the last grading operation, a complete fertilizer should be added and the area watered thoroughly. An application of 20 to 30 pounds of 10-5-5 or 25 to 35 pounds of 8-8-8 per 1,000 square feet is adequate for this "starter" fertilizer.

See Table 2 for rates of other fertilizer combination.

TABLE II

Per cent of Nutrients in Various Commercial Fertilizers and the Recommended Rates Per Application in Fall and Spring for Turf

Fertilizers grade[1]	Ratio of plant food elements	Per cent[2] N	Per cent[2] P_2O_5	Per cent[2] K_2O	Amount to apply to get two pounds of nitrogen per 1000 square feet[3]
5-10-5	1-2-1	5	10	5	40
12-24-12	1-2-1	12	24	12	17
4-12-4	1-3-1	4	12	4	50
10-30-10	1-3-1	10	30	10	20
8-8-8	1-1-1	8	8	8	25
10-5-5	2-1-1	10	5	5	20
0-14-7	0-2-1	0	14	7	—

[1] Other fertilizer materials are available and can be used. The amount needed to supply two pounds of nitrogen per 1,000 square feet from any fertilizer can be calculated in the following manner: the nitrogen content of the fertilizer divided into 100 gives the amount of fertilizer needed to supply one pound of nitrogen. Thus, doubling the figure gives the amount required to supply two pounds of nitrogen per 1,000 square feet. For example: in the case of 5-10-5, 5 into 100 equals 20; thus 20 pounds of 5-10-5 are required to supply one pound of nitrogen; 40 pounds are required to supply two pounds of nitrogen per 1,000 square feet.

[2] or pounds of nutrients per 100-pound sack of fertilizer.

[3] Length times width equals square feet. For example, an area 50 feet long and 20 feet wide contains 1000 square feet.

TABLE III

Per cent of Nitrogen in Various Fertilizers and the Recommended Rates for Turf, After a Spring Application of Nitrogen and Phosphate, or a Complete Fertilizer, and until Time for the Fall Application.

Material	Per cent[1] N	P_2O_5	K_2O	Amount to apply per 1000 sq. ft.	Frequency of application
Cottonseed meal	6	2	TR	15 pounds	Every 40 to 50 days
Processed sewage sludge Milorganite	6	3	0	15 pounds	Every 40 to 60 days
Hou-actinite	6	3	0	15 pounds	Every 40 to 60 days
Ammonium nitrate	33	0	0	4 pounds	Every 20 to 30 days
Ammonium sulfate	21	0	0	6 pounds	Every 20 to 30 days
Nitrate of soda	16.5	0	0	8 pounds	Every 20 to 30 days

[1] or pounds of nitrogen in a 100-pound sack of fertilizer.

Final Grading

The last step in preparing the soil for establishing the grass is the final grading (often called fine grading). Thorough watering will have melted clods and firmed the seedbed. On small lawns fine grading may be done by hand raking. Large areas may be smoothed as much as possible by harrowing. The area should be raked free of all large clods and stones which may have worked to the surface. Any depressions which showed up as a result of firming or settling the soil may be filled or high places worked down. Walks and driveways should be flush with the final lawn surface. The area is now ready for seeding, sprigging or sodding.

Establishing Grasses

Whether the lawn should be seeded, sprigged or sodded will depend on the type of grass used and the rapidity of cover desired. Table 1 shows the type of material to be used, methods of planting, quantities needed and best seasons to plant.

Seeding

Seed for lawns should be of high quality and have a high percentage germination and purity. This information is required by State law on all seed sold in lots of over 10 pounds. Reputable seed dealers are always willing to aid in choosing the best seed possible.

Low priced seed often are the most costly because they may have a low percentage germination and purity. Purchase seed of one species only. A "lawn mixture" is not recommended. Seed mixtures usually are cheaper because they are diluted with useless grasses. Only one species will ultimately dominate regardless of how many are sown.

The use of small distributors is recommended but hand sowing of seed is satisfactory. Divide the seed into two lots of equal parts, one to be broadcast as one walks back and forth in a given direction, the second lot is to be sown as one walks at right angles to the first seeding. This method provides for better distribution of seed.

Following seeding, the area should be watered lightly and often enough to keep the surface moist until a good stand of grass is established. This will vary from 7 to 14 days, depending mainly on climatic conditions.

Sprigging

Sprigging is the setting of runners or small sod blocks (two to four inches square) in small holes or furrows dug in the area.

Lawns may be sprigged at any time during the growing season when adequate moisture is available. Sprigging must be used for establishing grasses which cannot be propagated by seed. The distance between sod blocks or sprigs should depend on the rapidity of growth and on how soon a cover is desired. Sprigs of bermuda may be covered; those of other grasses should be only partially covered. Sod blocks or sprigs should be packed firmly into the soil.

Sodding

Sodding is the laying of solid strips of sod. Sodding, because of the high cost involved, is never recommended unless there is immediate need for complete coverage. When sodding is necessary, the strips of sod should be trimmed to a thickness of ½ to ¾ inch and cut in blocks 12 to 18 inches square. The sod should be laid like brick on a smooth surface that has been firmed by rolling. It should be free of footprints, stones and all depressions or mounds. After the sod is laid, pack or tamp lightly. The sod should be kept watered and after it has rooted, top-dress with a thoroughly mixed and screened (¼ mesh) mixture of topsoil, sand and organic matter. Fill in all cracks completely.

Care Immediately After Establishment

Newly established turf areas should be watered. The waterings should be light and frequent enough to prevent the surface from drying. As the young seedlings develop, or as the sprigs or sod begin to take root and grow, the frequency of watering should be reduced and the amount applied at any given time increased. Such procedure permits the development of a deep root system and ultimately reduces the amount of water needed.

The height to clip will depend upon the species planted. Newly turfed areas should be clipped as soon as the grass attains a heigh of 1½ to 2 inches. Lawns should be clipped frequently enough to prevent removing more than ¼ to ½ inch of growth at any one clipping. Never more than 1 to 1½ inches of growth should be allowed between clippings. Tips of the leaves only should be clipped, never the entire leaf or stem.

Newly established lawns are likely to become weedy before the area is covered with grass. Weeds should be controlled by frequent mowing. Controlled mowing, adequate fertilization and judicious use of water aid in reducing weed problems.

Where weed eradication is necessary, the safest, although more expensive, method is hand weeding. Use of chemicals for weed control is discussed later.

MANAGEMENT OF ESTABLISHED TURF

After the lawn has been properly established, the future success, both of a newly established and an old lawn, depends entirely on the management practices. Constant care and attention are essential to maintain a good turf. Four major factors—feeding, watering, aerating and mowing—are involved in maintaining turf.

Although these factors are discussed separately, all are interrelated and the four cannot be separated in actual practice. No one factor can be said to be more important than another; proper attention to each is necessary if the best possible lawn is to be maintained. Inadequate attention to any one of these will result in a thin, unthrifty turf invaded with weeds.

Feeding or Fertilizing

Supplying the necessary plant food for the grass plant is often neglected by the home owner. Just as the farmer feeds his cotton and corn, and as the ranch man feeds his livestock, so must the home owner feed his grass by applying the proper fertilizer. Cost of the relatively small amount of plant food required for healthy, vigorous turf is small in comparison with the returns realized. If clippings are caught and removed from the lawn, increased rates of fertilizing will be necessary, since upon decomposition the clippings return some plant food to the soil.

Why Feeding is Necessary

Plant food elements required in largest amounts by grass plants are nitrogen, phosphorus and potassium, but these must be applied in the right proportion to give satisfactory results. Nitrogen is the key element in turf production. It produces vegetative growth and gives the plant a deep green color. Phosphorus stimulates development of a good root system. Potassium affects the physiological processes of the plant. All three elements are a necessary part of all living plant tissue. Calcium is the structural component of cell walls and is essential in root development.

Many other elements play important roles in the nutrition of plants. When nitrogen, phosphorus and potash are properly balanced, other elements which are necessary for plant growth usually are present in sufficient amounts to produce good lawns.

Plant food deficiencies produce certain definite characteristics. Nitrogen deficiency causes stunted growth of the

entire plant. The leaves are relatively small, thin and yellowish-green to lemon color, frequently referred to as "firing." Careful examination shows yellow to brown color at the tip of the leaf and down to the midrib. The roots are stunted but usually less than the tops. Nitrogen deficiency is often confused with lack of moisture. A water or moisture deficiency is indicated by wilting of the plants or curling of the leaves.

Phosphorus deficiency causes slow growth of the entire plant. The leaves are an unhealthy dark green and often irregularly distributed brown patches occur. The roots are stunted, but less so than the tops.

Potassium deficiency causes stunted growth; the entire plant eventually dries up and takes on a brownish color. The leaves appear dull green, sometimes yellow, and margins of the leaves turn brown, often bronze colored spots develop and the tips are scorched. The older leaves are affected first.

Calcium deficiency causes stunted growth; the leaves become hard and stiff and mottled or brown spots are common. The roots are stubby, profusely branched and the growing tips usually die.

When lawns receive the correct kind and amount of plant food, they are healthy, green, thrifty and free of weeds. Weeds cannot compete with a well fed and properly managed lawn grass. Too, it takes much less water to maintain a beautiful green turf when adequate plant food is available.

When to Feed

Knowing the proper time to feed your grass is just as important as knowing what to feed it. Turf requires frequent feedings if it is to remain green and vigorous throughout the growing season. Turfed areas should receive an application of complete fertilizer in the spring and early fall. In general, a fertilizer with a 2-1-1 ratio should be used, and this should be applied at the rate to supply two to three pounds of nitrogen per 1,000 square feet. On non-calcarious soils the lawns should be limed at the rate of 50-100 pounds of ground limestone per 1,000 square feet every two or three years. If the lawn is to remain green and vigorous throughout the growing season, one pound of actual nitrogen (see Table 3) per 1,000 square feet should be added every 30 to 40 days. In addition, the lawn should be watered during periods of prolonged drouth. Such a feeding program will, of course, necessitate more frequent clippings.

What and How Much to Feed

Plant food for turf should carry a high percentage of nitrogen with enough phosphorus and potash to assure vigor

and health. Grasses are heavy feeders on nitrogen; consequently, on a yearly basis more of this element must be supplied than of phosphorus and potash. A nutritional balance must be maintained between the three major elements. This is accomplished by the fall and spring feedings of a complete fertilizer in areas where potash is not adequate, and by use of a fertilizer containing just nitrogen and phosphorus where potash is adequate. The root system is developed during the fall and early spring; hence, if a complete plant food and adequate calcium is available at this time extensive and deep root growth is promoted. Nitrogen applied separately during the growing season is used in producing top-growth and does not decrease the size and depth of the root system.

Choice of the type and grade of fertilizer material to use depends upon the price, quantity available and the ease of handling. One part of a commercial fertilizer, such as 12-24-12, 8-8-8 or 5-10-5 mixed with two parts of processed sewage sludge or cottonseed meal makes an ideal turf fertilizer. (Raw sewage sludge should not be used.) These materials may be applied separately or as a mixture at the rate of 25 pounds per 1,000 square feet in the fall and 25 pounds per 1,000 square feet again in the spring. Twenty to 30 pounds of 10-5-5 organic base fertilizer may be substituted for this mixture. If 12-24-12 is used alone, 20 pounds per 1,000 square feet should be applied in spring and fall. Table 2 shows the amount and rate of these materials to apply.

Additional nitrogen may be supplied from one of several sources, as given in Table 3. Slowly decomposing (organic) forms of nitrogen such as processed sewage sludge or cottonseed meal, while generally more expensive, are more desirable than readily available or soluble (inorganic) types, such as ammonium nitrate, ammonium sulfate and nitrate of soda because they are available longer and they avoid overstimulation. If inorganic types are used, smaller amounts must be applied more frequently than organic types. Inorganic types of nitrogen are likely to burn the grass unless properly handled. Table 3 shows the amount of nitrogen carried in each type. Cost of the actual amount of nitrogen contained should be carefully considered. For instance, one could afford to pay twice as much for a sack of ammonium nitrate, which contains 33 per cent nitrogen, as for a sack of nitrate of soda which contains 16.5 per cent nitrogen.

How to Apply

Fertilizer may be distributed by hand or by a fertilizer distributor. Distribute the fertilizer evenly, and avoid skips and overlapping. The best way is to divide the amount of

plant food to be used into two equal lots. One lot should be applied length-wise and the other half cross-wise of the area as described under seeding. This insures uniform and complete coverage.

Watering

Watering is the maintenance practice that is more often done incorrectly. Lawns should never be watered until the grass shows a definite need. Grass suffering from lack of moisture takes on a definite sheen and the plants wilt and curl. When this occurs, the lawns should be thoroughly soaked to a depth of 6 inches or more. Light sprinklings are never recommended except during excessively hot spells following a prolonged period of heavy rainfall. Light daily sprinklings at this time reduce scalding during such periods.

Deep watering of 6 inches or more encourages development of a deep root system capable of utilizing more efficiently the nutrients available deep in the soil.

Light frequent sprinklings produce shallow, weak root systems which encourage weed invasions. Shallow rooting does not allow efficient utilization of plant food or moisture in the soil. Disease incidence is more likely to be severe under conditions which produce shallow rooting. Light sprinklings continued over a long period may make the maintainence of a good lawn prohibitive. Also the root system is alive even though top-growth is dead, so water the lawn for a healthy root system during excessively dry periods in the winter.

Aeration

A good soil for growing plants is a mixture of soil solids, water and *air*. The solid particles of soil, under ideal conditions, adhere to each other with organic matter to form groups or granules. The solid portion should constitute about 50 per cent of volume of a good soil, and the remaining 50 per cent would be pore space. Air and water should occupy the pore space in equal proportions. A soil is said to be well or properly aerated when these conditions exist.

The practice of using a hollow-tined fork or a four-pronged spading fork on lawns to aerate the soil is not common; however, such practices will produce more desirable turf. Cultivation to improve soil aeration is common on golf courses and other well kept turfed areas. Aerifying the soil is a means of loosening the soil to allow: (1) air (oxygen) to get into the soil, which is essential for root development; (2) water to move into and through the soil; and (3) the soil to hold more water. It also prevents compaction which in turn

prevents soil erosion and plant food loss through surface run-off. Eliminating the compacted condition is necessary for proper oxygen-water relationships which make for vigorous healthy turf that is resistant to disease and drouth. Frequently-used parts of the lawn should be aerated as often as necessary to keep the soil in a good physical condition.

Mowing

Improper mowing is responsible for the deterioration of many lawns. Close clipping encourages thinning out of turf, shallow rooting and, subsequently, a lack of resistance to drouth, diseases and the invasion of weeds. Clipping too close also allows drying and baking of the soil during the summer.

The leaves not only produce the green color desired of a lawn, but are necessary for the manufacture of food required by the entire plant. When excessive amounts of the leaves are removed the entire plant suffers. The lawn should be clipped to a height of one and one-half to two inches, depending on the species of the lawn. Creeping types of grasses can withstand closer clipping than bunch types. Clipping at a height greater than two inches results in many of the same troubles as clipping too close.

Proper mowing requires a sharp, well-adjusted lawn mower. The mower should be sharp enough to cut the tips of the leaves and not bruise or crush them. Both the cutting edge of a bedknife and the reel should be sharp. Time spent picking up stones and sticks ahead of mowing is well spent. Regular checkup on the adjustments of the reel and bedknife are necessary. The reel should be set firmly, yet not too closely against the bedknife. The height of the bedknife should be determined by placing the mower on a flat surface and adjusting the set screws so that each end of the bedknife is exactly the desired height.

OCCASIONAL TURF PROBLEMS

Emphasis has been placed on choice of the proper turf grass, establishment of a new turf, and management of established turf. Problems which occasionally arise in the production of turf includes weed, disease and insect control, clover in turf and the renovation of old lawns.

Weed Control

Weeds never become a problem on properly managed turf. When grass thins out and weeds invade turf, one should study the management practices being followed and correct any one

that is being done improperly. There is no substitute for good lawn management as a method of controlling weeds.

If weeds are eliminated with chemicals or by hand methods, the turf should be fed a balanced fertilizer and proper management practices should be followed. Such practices create an environment suitable for thrifty growth of turf grasses.

Crabgrass, chick weeds, henbit and knotweed may be controlled with potassium cyanate, phenyl mercuric acetate or sodium arsenite. All of these materials discolor the turf; none should cause permanent injury if used according to the manufacturer's directions. Extreme caution must be exercised when handling any of these materials, particularly arsenicals, as many are poisonous to shrubbery, flowers and animals.

Disease Control

Disease control may be necessary on some lawns, particularly St. Augustine turf. St. Augustine lawns are frequently attacked by brownpatch during periods of hot humid weather. Brownpatch is characterized by irregularly-shaped browned areas, usually somewhat circular in shape, varying from four to 48 inches in diameter. On badly infested turf the patches may run together so that no circular areas are evident. The fungus is active on the outer borders of the affected area. The ring of affected grass is sometimes referred to as a "smoke-ring" because of its blue, water-soaked appearance. As the disease spreads, these dark areas turn light brown. This disease may be controlled by the use of Tersan, Special Semasan, Calo-chlor and other materials. These materials should be applied according to directions on the container. As with weed control, properly managed lawns are less likely to be attacked by disease, and if they are, are likely to recover more rapidly than are lawns poorly managed.

Insect Control

Insects likely to give trouble on lawns are chinch bugs (particularly on St. Augustine), sod-web worms, army worms, grubs, cutworms, ants and mole crickets. Red bugs and ticks, while doing no damage to the turf are a nuisance. Most insects may be controlled by the use of DDT or chlordane. Ants, chinch bugs, ticks and red bugs are best controlled by the use of the chlordane products. These materials are sold under several trade names and in various forms. They should be applied according to the manufacturer's recommendations.

Lead arsenate at the rate of 20 pounds per 1,000 square feet is effective in controlling many lawn insects. Arsenicals

in any form are poisonous and care should be exercised in their handling and storage.

Rhodes grass scale may cause severe damage to turf in South Texas. There is no completely effective control for the mature scale, at the present time. An application of chlordane at the recommended rate (¼ pounds of actual chlordane per 1,000 square feet) followed by a second application in 14 days is effective against the immature or crawler stage of the scale. Some types of bermuda may be severely burned by this treatment. The chlordane should not be applied to soft, succulent grass or to grass recently stimulated by nitrogen fertilization.

Parathion, an extremely poisonous material, is partially effective against the mature scale. *PARATHION SHOULD BE USED ONLY BY THOSE ACCUSTOMED TO HANDLING POISONS OF THIS NATURE.*

Clover in Turf

Clover is not recommended for use on turf areas. The tender growth stains clothing, is easily injured by trampling and shades grass in the spring. Generally it does not persist during the summer. The presence of volunteer clover indicates nitrogen deficiency and soil compaction.

Although clover is not recommended, it adds some green to lawns during the winter and early spring before the permanent lawn grasses begin growth. It also supplies some nitrogen for the grass if properly inoculated, however, it should not be expected to supply the total amount needed. If clovers are not removed from the lawn area they should be kept under control by frequent mowing.

Renovating Old Lawns

Renovation becomes necessary when the old turf is run down, weedy and is in a generally undesirable condition, or when a new species is to be introduced.

Steps to follow in renovating lawns include mowing the entire area closely, apply weed control chemicals if needed, then aerating, disking, plowing or in some manner loosening the surface. The area should be fertilized, leveled and the turf re-established. Very often, unless a new species is to be introduced, sufficient plants from the old sod are present to form a desirable sod. Try to ascertain the cause for the deterioration of the old sod, then correct and avoid it on the new lawn.