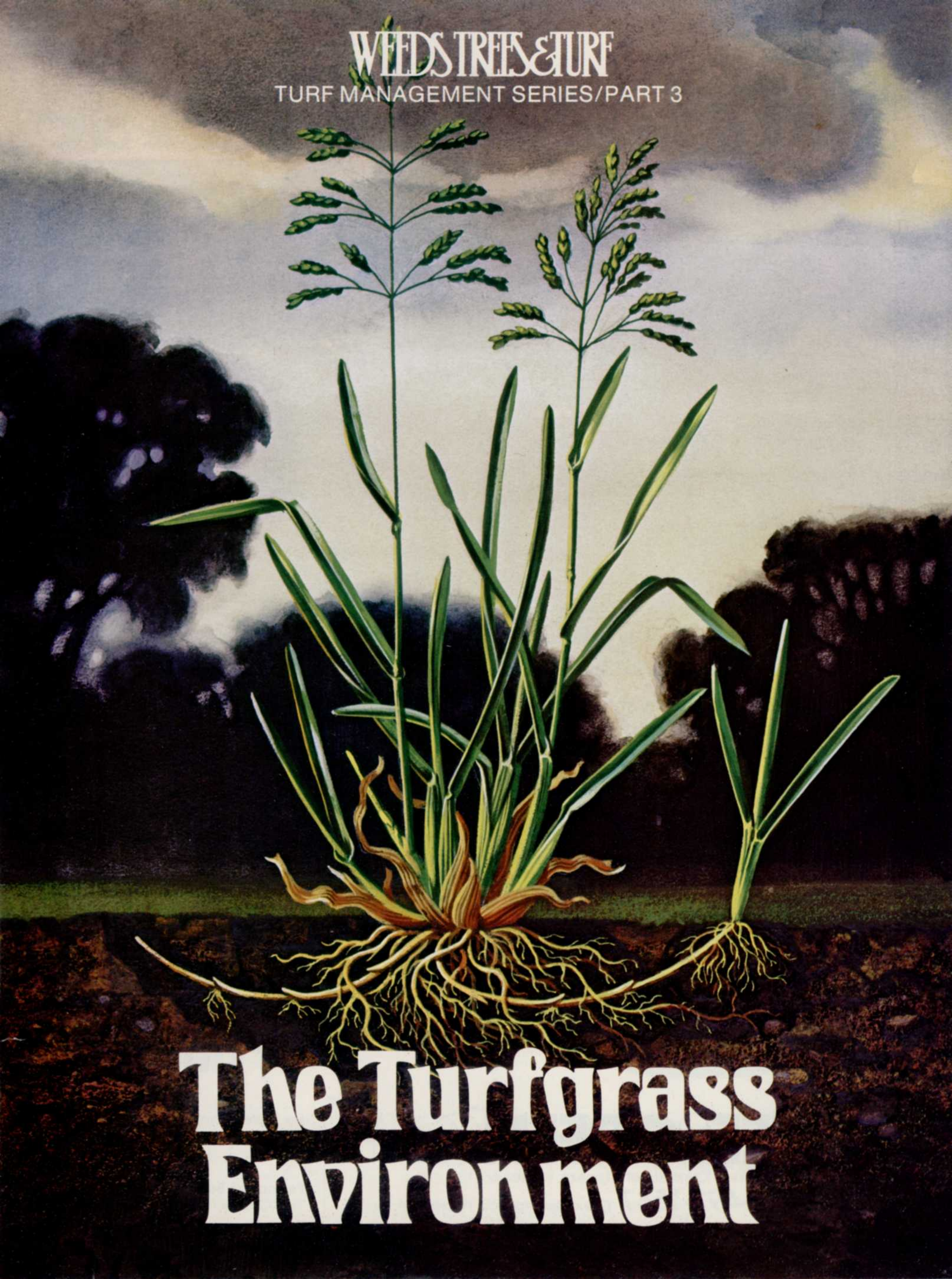
WEEDS TREES & TURF
TURF MANAGEMENT SERIES/PART 3



The Turfgrass Environment

SITE CONSIDERATIONS

Soil samples *should be taken for every site and tested for texture, nutrients, and pH.*

Progress in turfgrass science provides today's lawn installers with high quality turfgrass seed and sod. The biggest risk has therefore become the readiness of the site for the seed or sod.

The site must provide the physiological needs of the desired turfgrass. The purpose of this article is to describe these needs and how to alter a site to supply them.

No professional lawn installation should proceed without a thorough evaluation of the site and a soil test. The results should be discussed with the customer with a simplified explanation of the needs of the desired turfgrass. Geographically impractical turfgrass species should be eliminated and the customer's desired level of maintenance should be established. Share your knowledge of improved turfgrasses. There is a good selection of both seed and sod so the customer can have a custom lawn. Today, a quality lawn is a sales tool in real estate. The residential customer can have an individualized lawn in addition to a sales advantage.

The commercial customer installing a new lawn at its building site is a tougher challenge. If the landscape architect is not up on improved turfgrasses, it takes a strong salesman to get improved varieties in the specifications. Too many industrial sites, multi-family housing developments, and shopping areas are seeded or sodded with outdated or cheap turfgrass varieties. The low bid process encourages this unless the improved turfgrasses are specified during bidding.

The scope of commercial jobs also encourages the use of hydraulic seeding with higher seed rates. Hydraulic seeding has grown in popularity as the least labor intensive way to seed all types of lawns. General contractors often want the lawn installation handled quickly and simply. This, however, is not always the best for the site. The owner must clearly specify his desire for quality turf by the best methods available. To achieve a quality lawn, some hand seeding and sodding is usually required. The hydraulic seeder is a great tool, however, research on the use of hydraulic seeding for fine turf is limited.

The health of a turfgrass plant is entirely dependent upon its environment, both above and below the soil surface. Once the seed has germinated, that plant must adapt to its fixed position or die. Man has the knowledge and ability to amend both above and below surface environments so that the turfgrass plant has optimum growing conditions. The best time to make the changes is before planting or sodding. If the basic needs of the turfgrass are provided, the plant will exercise its own ability to adapt to the stress of heat, drought, or wear. Turfgrass selection and breeding have provided turfgrasses that exhibit greater ability to adapt to stress. That does not reduce the need for site preparation in the case of fine turf.

Site preparation can be more than soil preparation. It could include thinning tree cover, installation of irrigation or drainage, filling low spots, changing slopes, installation of anticompaction or erosion control netting, or even installing a sidewalk to direct foot traffic off the lawn. Any change which improves the turfgrass environment is considered site preparation.

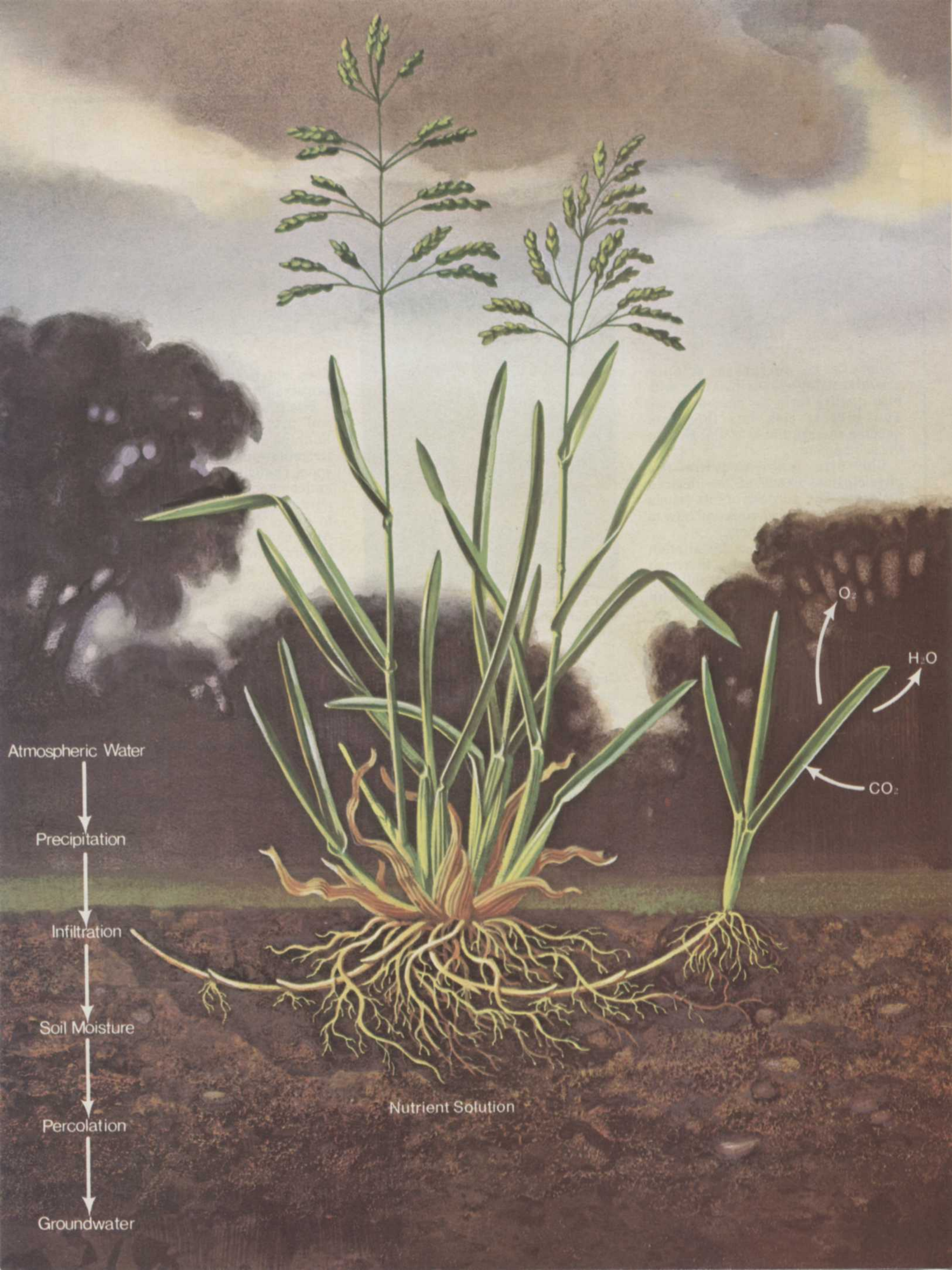
The environment must provide all essential requirements for the life processes of the turfgrass. These include light, water, numerous chemical elements, and air (gases). The environment should also include preventative conditions, such as air circulation, drainage, relatively neutral pH, minimal thatch, and few insects.

All chemical reactions are temperature dependent, require energy, and can be influenced by chemical balances, such as acidity, cation exchange capacity, and the presence of needed elements. Understanding basic chemical reactions of plant growth helps clarify the need for site preparation.

The most important process is photosynthesis. In photosynthesis, carbon dioxide from the air and water are converted to organic carbon compounds which are used in plant growth. Light energy, absorbed by the chlorophyll in the plant, powers this reaction. Lack of carbon dioxide is rarely a problem, but water and light can be lacking very easily. Excessive shade or drought are common problems in turf areas.

The carbohydrates produced by photosynthesis are either utilized to power other growth and maintenance reactions or stored.

One major use of carbohydrates is respiration, in which the car-



Atmospheric Water
Precipitation
Infiltration
Soil Moisture
Percolation
Groundwater
Nutrient Solution
O_2
H_2O
CO_2

bohydrates and oxygen react to release energy and to produce carbon dioxide and water. The plant uses the energy released to power other vital life processes. Respiration is increased by higher temperatures or nitrogen fertilization.

It is important that the plant maintain a reserve of carbohydrates for use when plant needs exceed carbohydrate production by photosynthesis. Excessive respiration, caused by overfertilization can deplete these reserves. Storage is greatest on sunny, cool days, especially just prior to onset of winter dormancy. Nitrogen fertilization at this time is discouraged.

One reason nitrogen encourages respiration is its part in protein synthesis. Nitrogen is a key element in amino acids, a major component of protein. Protein is the structural material of cell walls and the plant's genetic code. Abundant nitrogen stimulates growth and the respiration to support it.

Many other elements play a part in the various biological reactions of plant existence. (See table) They supply needed components for physiological processes. Specifically, potassium and phosphorus are critical for a good seedbed because they effect root health. The ability of rhizominous and stoloniferous turfgrasses to spread is also dependent upon adequate levels of potassium. Low potassium levels encourage carbohydrate reserve depletion. Potassium does leach, especially in sandy soils and needs to be replenished. Phosphorus is relatively stable in soil and is not prone to leaching. Consequently, phosphorus should be mixed with the topsoil.

Other important elements are calcium, sulfur, magnesium and a score of other minor elements. Calcium encourages root growth, effects the cation exchange capacity of the soil, and often improves general soil structure. Sulfur is an important part of protein synthesis, it also can be used to acidify alkaline soils. Magnesium is an important part of chlorophyll and effects the green color of turfgrass stands. It is also part of protein synthesis and influences the use of available phosphorus in the plant.

Minor elements include iron, zinc, copper, chlorine, boron, molybdenum, and manganese. Iron assists in the production of chlorophyll and will deepen the color of turf. Most minor elements can be unavailable to plants if soil is too acidic or alkaline. The role of some of the

Element	Chemical symbol	Importance in plant function
Nitrogen	N	The nitrate form is reduced to amino acids which are used to synthesize proteins, such as the structural protein of cell walls. Important in formation of nucleic acids which control genetic code of the plant. Also important in synthesis of coenzymes, vitamins, hormones, and pigments.
Potassium	K	Important in the glycolic pathway, one of four reaction sequences in the respiration process which converts glucose produced by photosynthesis into plant energy. Functions primarily as an enzyme activator.
Phosphorus	P	Also important in formation of nucleic acids. Is a constituent of phospholipids, which with proteins, constitute membranes which maintain structural integrity of plant cells. Important in organic compounds which provide energy for chemical reactions.
Sulfur	S	A constituent of certain amino acids and protein. Also found in coenzymes for lipid (fat) and carbohydrate metabolisms.
Calcium	Ca	Important in developing cell structure and permeability properties of membranes.
Iron	Fe	Essential for chlorophyll synthesis
Magnesium	Mg	An essential constituent of chlorophyll. Seems to function by binding together subunits which make up ribosomes which synthesize proteins.
Boron	B	Unknown. Suggested that borates prevent excess phenolic acid production. Phenolic acids accumulate in boron deficient plants.
Manganese	Mn	Formation of oxygen in photosynthesis. Specifically required for action of some enzymes.
Copper	Cu	Found in enzymes required for respiration and photosynthesis.
Zinc	Zn	Found in several enzymes essential to respiration and nitrogen metabolism.
Molybdenum	Mo	Found in enzyme for N_2 fixation, and enzyme essential for reduction of nitrates (NO_3) to ammonia.
Chlorine	Cl	Activates oxygen production system of photosynthesis.
Sodium	Na	Required by certain halophytic (salt-loving) plants.
Silicon	Si	Required by some grasses and sedges for cell wall formation.

minor elements is not clearly understood. Sandy and alkaline soils may require addition of minor elements.

The purpose is not to give a lesson in chemistry, but to show those things that a turfgrass plant requires from its environment. The next step is to identify site conditions which either permit or restrict the supply of these needs. Since soil is the medium for most of these needs, it is the best place to start.

Soil

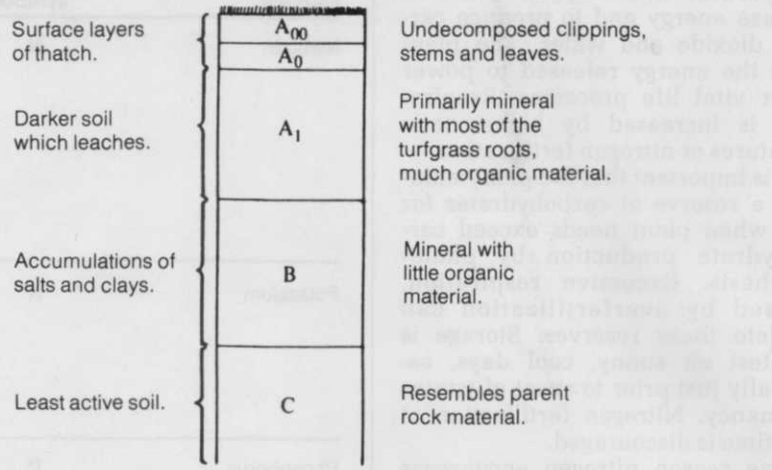
The goal in site preparation is to provide a six to eight inch layer of soil that has desirable texture, structure, and chemical balance. The components of the soil determine these characteristics. Soil amendment may be needed to establish a suitable rootzone for the turfgrass.

Soil is layered. The primary concern is the few inches of topsoil, but lower layers effect drainage, upward movement of water, and chemical activity. Special care to all layers of soil is given during construction of golf greens and other athletic fields. On large areas where lower layers may pose problems but the scale makes changes impractical, special attention should be given to maintenance needs, such as topdressing, aerification, fertilization, and installation of drainage and irrigation systems. The purpose is to counterbalance the effects of an inferior soil.

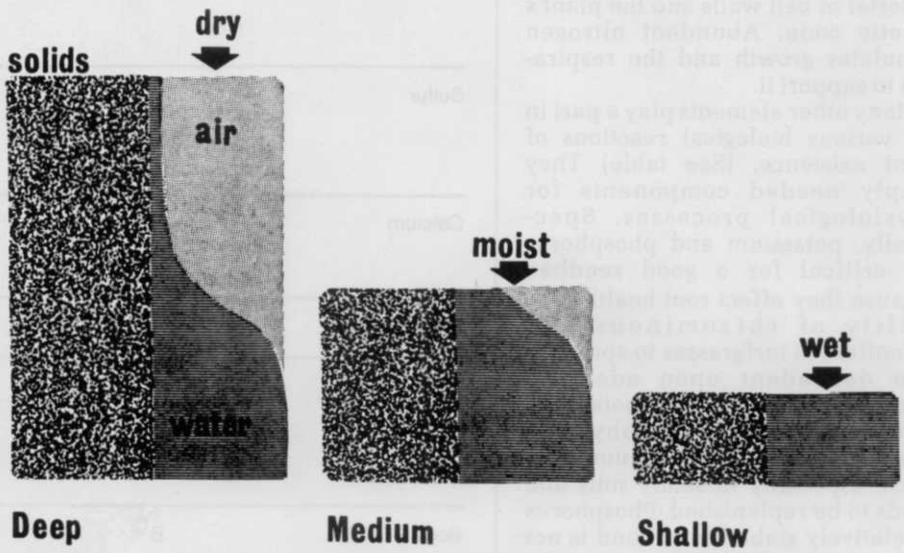
The typical soil of an area is derived from the parent material which may have been the bottom of a lake, a glacier, a volcano, or other mineral or organic material. Other factors influencing soil content are the climate of the area, the period of time during which the soil developed, the vegetation that had grown there previously, and the topography of the area. All these factors combined resulted in the soil characterisitics of any area.

Soils are classified by type or combination of types, including sand, silt, and clay. (See diagram). These identify textural characteristics of the soil. Soils are also classified by structure based upon the shapes of individual groups of particles, or aggregates, in the soil. The size of the aggregates is also a factor in seedbed preparation. Pea-sized aggregates are preferred.

The texture and structure of a soil has a great effect on drainage, movement of chemicals in the soil, upward movement of water (capillary action), rooting ability, and presence



Layers or horizons of soil *The A horizon should be six to eight inches deep and of appropriate texture, pH, nutrient content, and drainage.*



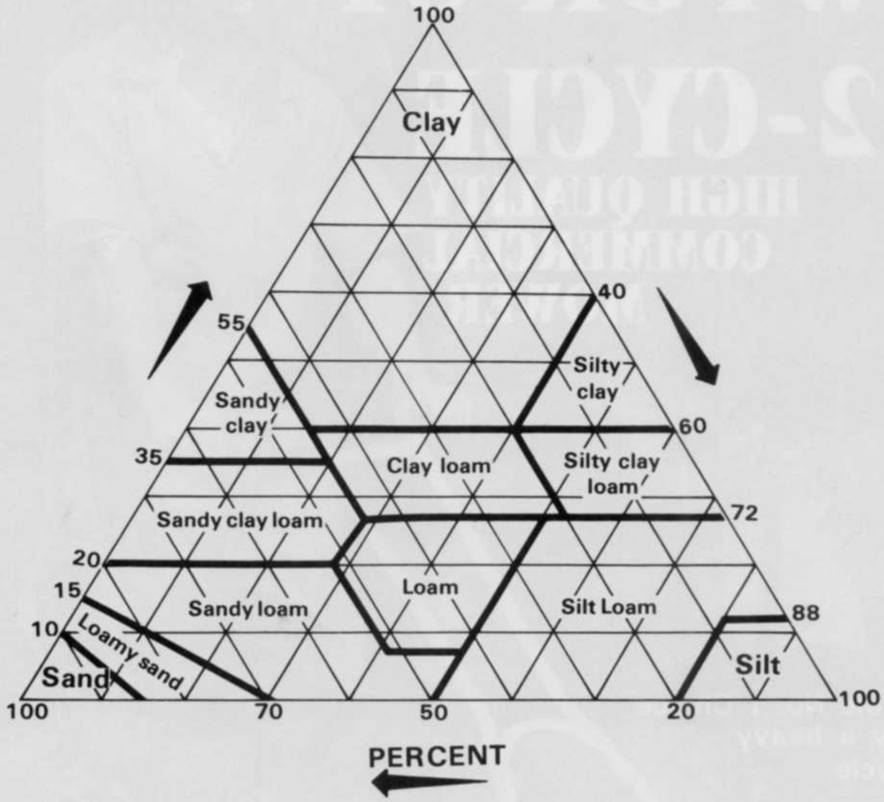
Depth of topsoil affects retention of water *following irrigation or drainage.*

of needed gases in the soil. Loam soil is actually a combination of sand, silt and clay.

Another way to classify soils is as mineral or organic. The organic matter content of mineral soils is less than ten percent, whereas organic soils contain more than 20 percent organic matter. Organic soils are preferred where possible. Michigan sod growers switched from mineral soils to organic soils as part of their growth in the 60's. If the organic matter is only slightly decomposed the soil is termed peat. If the organic matter is well decomposed the soil is termed muck.

Soils with large amounts of undecomposed organic matter need the assistance of bacteria, protozoa, nematodes, algae and fungi for breakdown. Poorly drained soils discourage these organisms from doing their job. These organisms also are essential for thatch decomposition and breakdown. Decomposition is also related to the pH of the thatch and soil. Alkaline or acidic soils can prevent the breakdown of thatch and cause problems associated with thatch buildup.

The composition of the soil effects water accumulation and drainage. Sand soils do a poor job of holding water. However, they have the advantage of aiding drainage when added to other soils. Clay soils hold water but this water may not be available to the plant roots. Silt soils retain water well but also tend to compact easily. The pore space between soil particles determines the ability of the soil to hold and pass water. The organic matter content of the soil also aids in water retention. The ability of the soil to let water in



Texture is measured *by the percentages of the three basic mineral components, clay, silt, and sand.*

is called infiltration. If soils are compacted, pore space is limited and water will not flow into the soil easily. Water can be treated with wetting agents to reduce its surface tension and allow for easier entry.

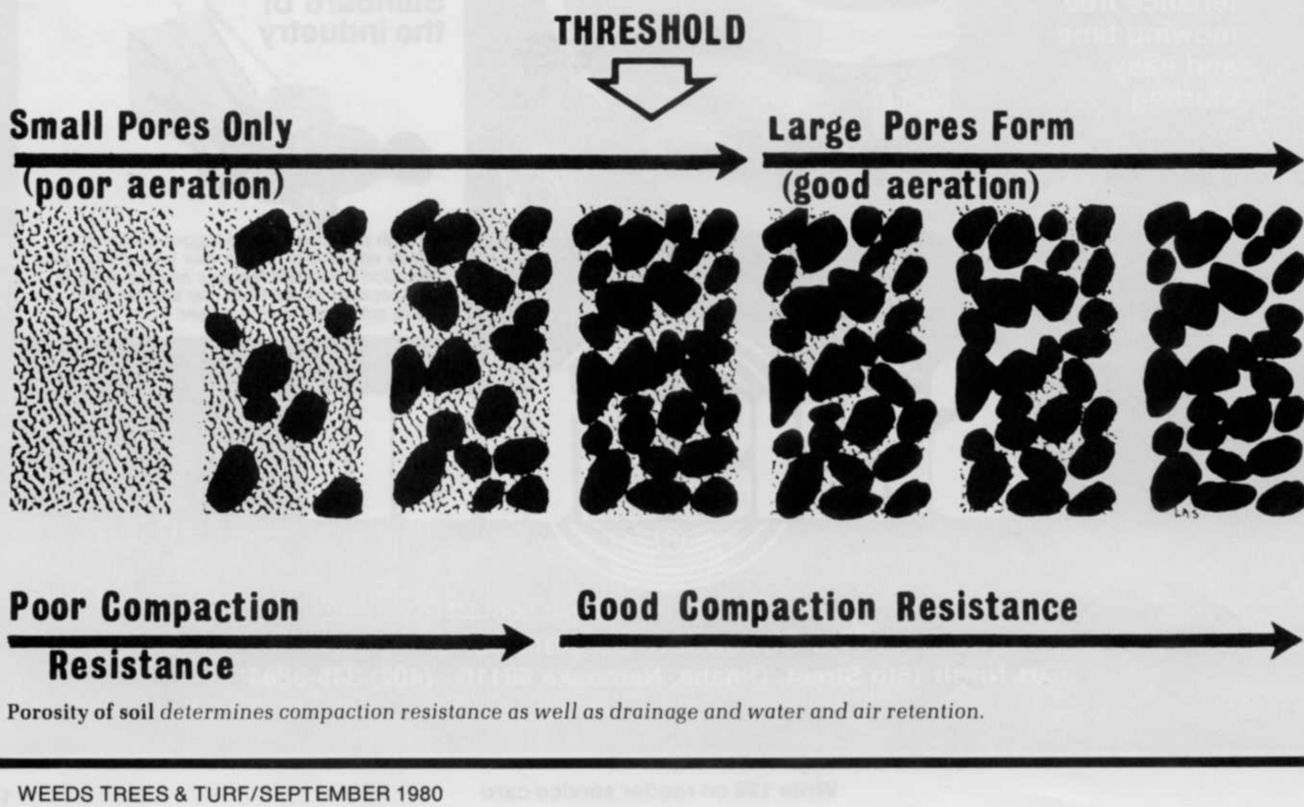
The ability of the soil to allow water to pass through is called percolation. If soil layers are significantly different in texture, water movement downward can be hindered. If surface water is applied faster than the soil can take it in or let it flow through, puddling or runoff will occur.

The ability of the soil to hold water is closely related to its ability to hold needed gases. Many of the things that prevent water retention hinder soil aeration, such as compaction and lack of organic matter.

Water and air compete for the same space at times. Poor drainage inhibits soil aeration if water occupies all pore space. Turfgrass roots need oxygen to carry out respiration. Without the oxygen, the ability of the plant to power essential processes is severely restricted.

One final area of consideration for soils is the chemical balance. This is a more complicated subject concerning pH, cation exchange, and salinity. An imbalance of any of these can hinder the plant's health.

pH is a measure of the hydrogen ions in a solution. The more acid the soil is, the lower the pH will be. The



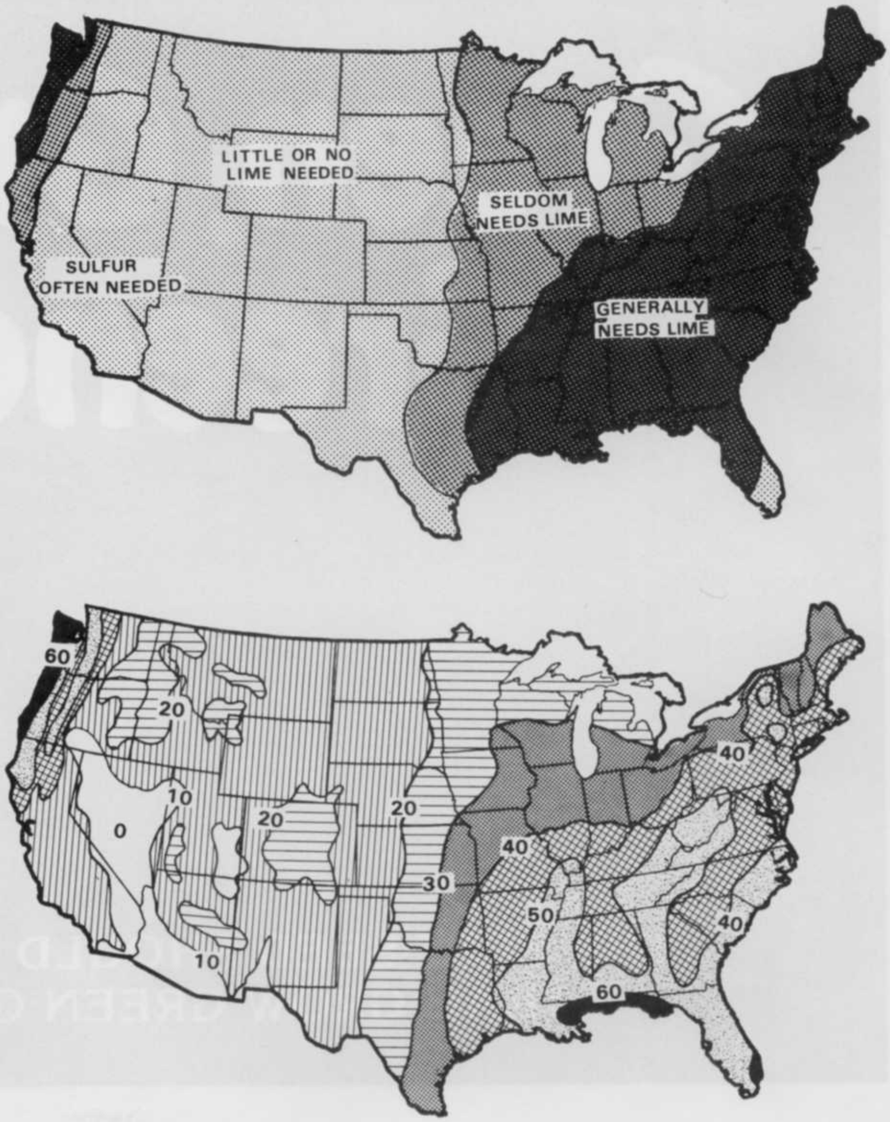
Porosity of soil *determines compaction resistance as well as drainage and water and air retention.*

more alkaline, the higher the pH. The number 7 is considered neutral and is also the optimum pH for growing turfgrass. Many things can cause soil pH to change; irrigation water of a different pH and materials containing sulfur such as ammonium sulfate. Soils containing large amounts of clay and organic matter tend to be acid. Periodic applications of limestone may be necessary for these soils. Excessive acidity reduces the amount of available phosphorus in the soil, reduces the activity of beneficial soil organisms, and increases the ionic concentration of potentially toxic minerals such as aluminum and manganese. Secondary effects include poor rooting, increased thatch accumulation, and reduced turfgrass vigor. Due to the effect on rooting, pH should be checked prior to seeding or sodding and corrected. Acid rain is a possible source of acidity.

Alkaline soils are usually associated with areas that have saline ground water, low rainfall, or are waterlogged. Overuse of lime can cause alkaline soil conditions. Alkaline soils restrict the utilization of iron, manganese, copper, zinc, and boron by turfgrass. Sulfur or fertilizers containing sulfur can be used to neutralize alkaline soils.

Saline soils are associated with areas of low rainfall where soluble salts have not been sufficiently leached out over time. They tend to be present in the ground water making irrigation with it little help. Irrigation with collected rainwater or use of salt tolerant turfgrasses are the only practical remedies. In the same general category are sodic soils which contain high levels of soluble sodium. Sodium has a detrimental effect on soil structure causing the breakdown of aggregates and clay particles. Application of gypsum can improve sodic soils.

The most complicated phenomenon of soils is the cation exchange capacity. Basically, chemical reactions involve the attraction of positively charged molecules (cations) to negatively charged molecules (anions). Plants require positively charged molecules of elements to carry out basic processes, such as calcium and potassium. The plant depends on the soil to hold these cations until it can use them. The ability of the soil to exchange a cation of its own for one of benefit to the plant is termed cation exchange capacity. The type of soil, texture, and organic matter content effect cation exchange capacity. Addition of



Acidity and alkalinity *of regions in the U.S. (top) is closely related to average rainfall (bottom). Nutrient availability changes with soil pH.*

organic matter increases the cation exchange capacity of the soil. The higher the cation exchange the better the soil holds onto valuable nutrients. Leaching is reduced in these soils.

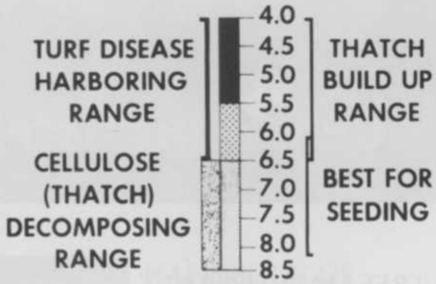
There is no one preferred CEC. It varies according to the type of clay, organic content, and other components. If correction was advised, addition of organic matter would be the likely solution.

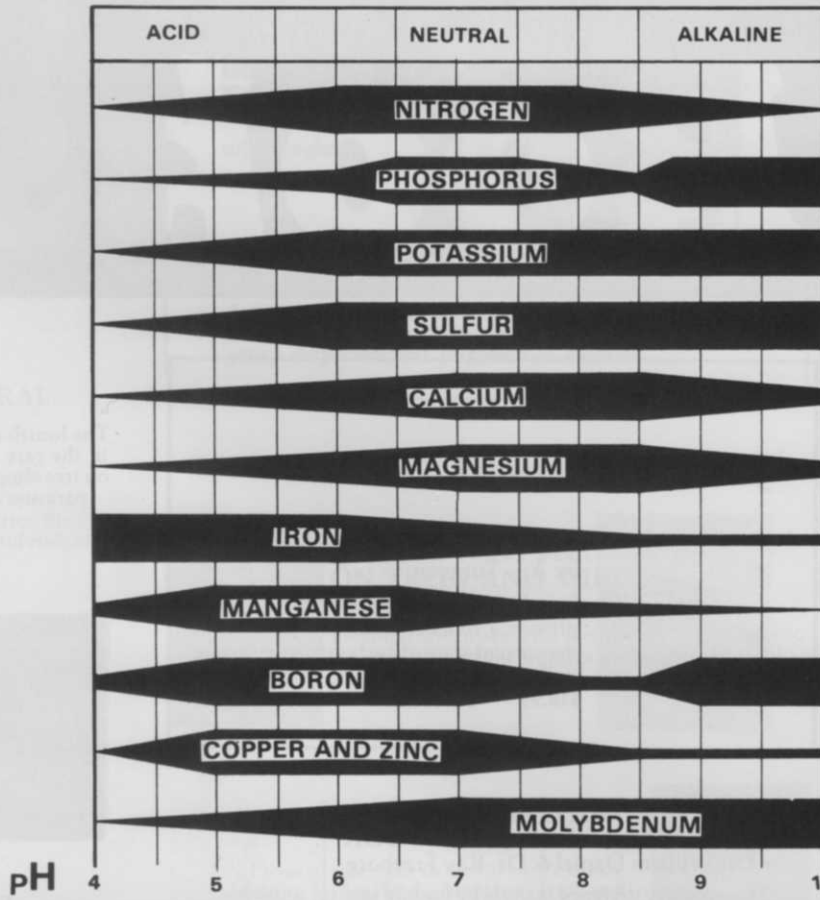
To provide the best environment for seed or for sod rooting the soil should contain appropriate nutrients, be neutral or slightly acid (6.5 pH), have an acceptable CEC, contain aggregates by cultivation and moderating or eliminating sodic conditions, and organic content of at least 20 percent. Best results with sod rooting are obtained by purchasing sod grown on approximately the same type of soil as the site. Most sod is grown on muck soil. Decomposed organic material is preferred for amendment since decomposition of the organic matter consumes nitrogen that could be utilized by the turfgrass. Material should be composted before use.

To improve heavy clay soils, coarse sand can be mixed with the clay and organic matter to lower the clay content to 75 percent if possible. Calcined clay will also contribute to better water characteristics of soils. Sand and calcined clay can improve silty soils as well.

Sandy soils require the addition of clay and organic matter. Clay content of at least five percent is

Disease susceptibility and thatch buildup *can be reduced by adjusting pH.*





desired. Fine sand content should be reduced as much as possible.

The perfect soil has never really been determined. The United States Golf Association recommends that pore space should be in the range of 40 to 55 percent. Since the size of sand, clay aggregates, and organic material varies, arriving at one combination is impossible. California research has indicated a mixture of 85 percent sand (.25 mm and bigger), 7.5 percent clay, and 7.5 percent peat is successful. That is an impractical amount of sand in the case of soil modification.

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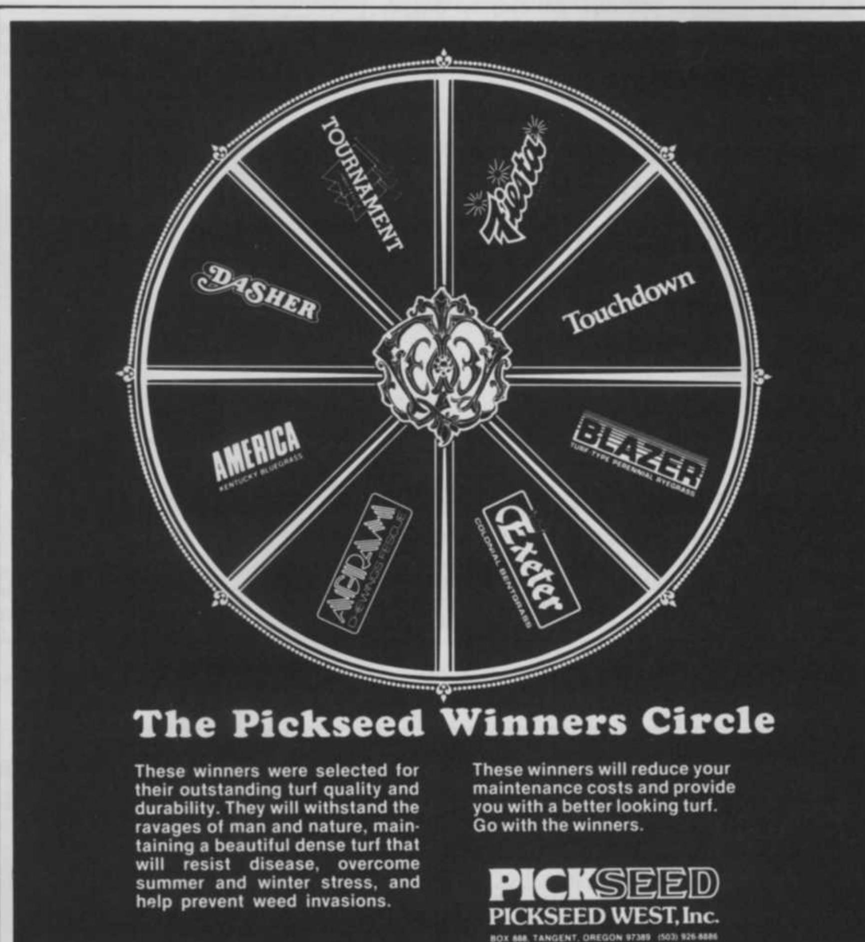


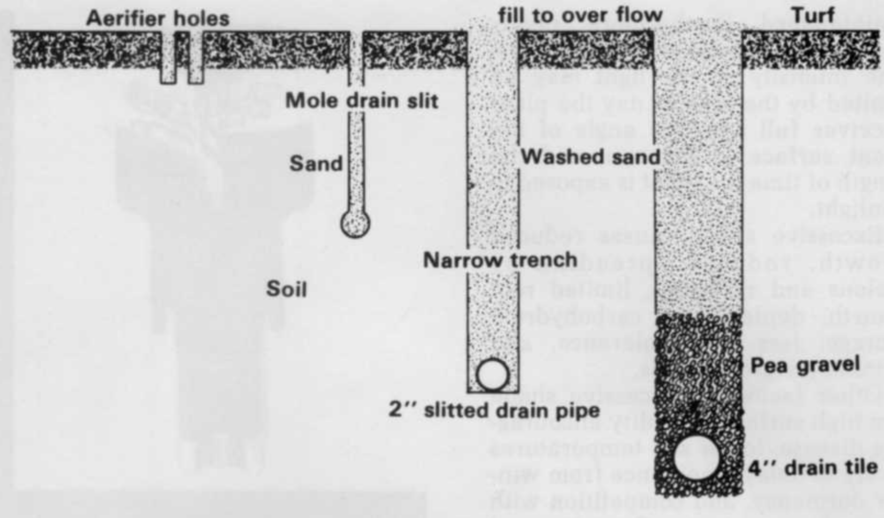
Drainage

Waterlogged or submersed turfgrass can be severely damaged in less than two weeks, longer during dormancy. Standing water should be eliminated by filling in low spots, grading to control surface runoff, or installation of drainage tile. If drain tile is the choice, they should be installed in a branched pattern 15 to 30 feet apart with a minimum slope of .5 to 1 percent, at a depth of two to three feet, shallower in sandy soils. The best backfill is washed sand to the surface. If the subgrade is relatively impervious to water, but lower layers are fine, drilling or shallow slit trenches may solve the problem.

If major modification of the rootzone is planned, subgrades can be sloped toward spaced tile or perforated plastic pipe for even distribution of drainage. Rootzone designs usually call for coarse sand over the tile with a layer of topsoil on top mixed to specified texture.

Drainage may also be impaired by thatch, hydrophobic soils, and hard water. Thatch removal, soil aerification, and water conditioners can improve infiltration. Depth of topsoil affects drainage since shallow layers of topsoil will tend to saturate faster than deeper layers.

For proper surface drainage slopes should be more than one percent but no more than 20 percent.



Types of trenches. *Turf will grow over sand to conceal drainage trenches.*

Shade

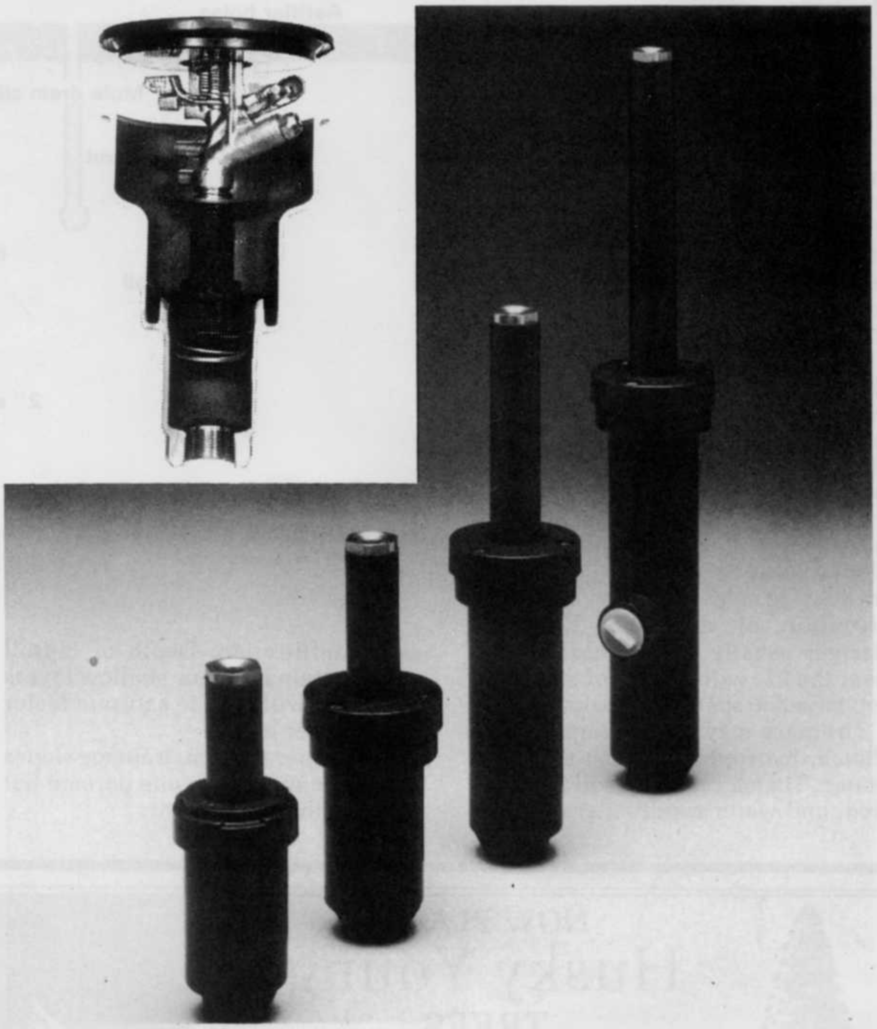
Turfgrass cannot be healthy under conditions of light stress. It requires enough light for photosynthesis to produce the needed quantity of carbohydrates for plant growth and maintenance. Furthermore, plants prefer blue regions of light to others. The intensity of the light may be limited by the time of day the plant receives full sun, the angle of the plant surface to the sun, and the length of time the plant is exposed to sunlight.

Excessive shade causes reduced growth, reduced spreading by stolons and rhizomes, limited root growth, depletion of carbohydrate storage, less wear tolerance, and thinner turfgrass stands.

Other factors of excessive shade are high surface humidity encouraging disease, lower soil temperatures likely to delay emergence from winter dormancy, and competition with trees for nutrients. Creeping red fescue and velvet bentgrass are most shade tolerant of cool season turfgrasses. *Poa trivialis*, creeping bentgrass, and tall fescue have fair shade tolerance. Kentucky bluegrasses are notably shade intolerant, however, some cultivars exhibit improved shade tolerance such as Glade and Warren's A-34.

St. Augustinegrass is followed by zoysiagrass in shade tolerance in warm season turfgrasses. Bermudagrass is also notably shade intolerant.

Removal of lower branches and thinning of limbs is one alternative to removing entire trees to obtain more light. Use of turfgrass in areas of permanent shade is fruitless, such as northeast corners of buildings or walls.



Spray heads *have fewer moving parts than rotary heads (inset) but are initially more expensive.*

Air Circulation

Trees and structures can restrict air circulation over turf areas. Turfgrass releases moisture by transpiration through leaves. If this moisture, heavy dew or moisture from rainfall or irrigation is not controlled, the environment for many turf diseases is improved. That is why morning irrigation is favored over evening irrigation. Air movement helps moderate early afternoon soil temperatures for grasses in full sun.

On the other hand, too much wind can dessicate exposed leaf surfaces, increase the chance of winterkill, and prevent adequate moisture from reaching the soil.

As mentioned earlier, shortage of carbon dioxide on the soil surface is rarely a problem.

Irrigation

If fine turf is the objective, irrigation of some form should be included in the site plan. Discussion with the customer or landscape architect will establish the commitment by the owner for fine turf. Without irrigation the customer can expect periods of summer dormancy, eventual transition to more drought tolerant and low fertility tolerant grasses such as tall or red fescue, and less control over seed germination after planting.

James Watkins writes in his book TURF IRRIGATION MANUAL that the relative cost of irrigation system choices is in a ratio of 4:2:1 (spray systems: rotary systems; and quick coupler systems). He advises that cost is only one consideration and each type of system should be evaluated for a particular site.

At the least, an irrigation design consultant should evaluate site drawings for approximate cost and water requirements. A well may be needed or a pump system for a lake. Today, irrigation installation is considerably less disruptive to a site. Vibratory plows and plastic pipe greatly reduce turf damage.

Drip irrigation is an alternative to shrub heads for some sites. The drip lines cannot withstand surface disturbance. If an underground system is installed for the turf, an extra zone for shrubs may be more practical than a separate drip system.

Extra care during seeding or sodding is required around irrigation heads. Heads should be properly installed to prevent puddling around heads and to assure clearance of turf after installation. Controls, pumps and valves should be secured to prevent vandalism or theft.

The landscape contractor should find a reputable irrigation designer to handle subcontracts. A good relationship will help the installation look its best for a long period of time. The customer must be clearly apprised of the maintenance needs of the irrigation system and the proper use for good turf care.

Soil Preparation

The most common state of a site when the contractor arrives is the topsoil has been replaced and rough graded. It is not unusual for the contractor to see the need for further grading, backfilling curbs, foundations, and perhaps trenches that have settled; and additional topsoil where needed.

If topsoil has not been replaced, the contractor has the opportunity to amend and mix the topsoil to optimum conditions. A soil shredder or mixer can simplify this task. He also has the opportunity to grade the subsoil for improved drainage if necessary.

Musser and Perkins of Pennsylvania State University recommend in TURFGRASS SCIENCE that the topsoil mix consist of one part peat, four parts sand, and five parts topsoil. It should be well mixed and spread to a depth of at least six inches.

If topsoil is already in place, amendments can be added and mixed with a cultivator. Overworking the soil can break down aggregates and destroy the soil texture. Also, soil preparation should not be attempted in wet weather to prevent compaction. Limestone and phosphorus do not leach readily and should be incorporated with the top-

Seeding Rates Recommended.

Type	Seeds/lb. (in thousands)	Seeds/in.	Germ. Rate	Lbs. Seed/1,000 sq. ft. Beard	Lbs. Seed/1,000 sq. ft. Musser
Bahiagrass	170	7-9	80%	6-8	4-8
Bentgrass					
Creeping	7,900	30-50	85%	0.5-1	1-1.5
Colonial	8,750	30-60	85%	0.5-1	1-2
Velvet	11,800	40-80	90%	0.5-1	1.5
Bermudagrass (hulled)	1,800	12-20	85%	1-1.5	2
Bluegrass					
Kentucky	2,200	15-25	75%	1-1.5	2-3
Rough	2,500	18-25	80%	1-1.5	2-4
Centipedegrass	400	10-15		4-6	—
Fescue					
Chewings	546	15	85%	3.5-4.5	3-5
Creeping Red	550	15	85%	3.5-4.5	3-5
Tall	225	10-15	85%	7-9	4-8
Perennial Ryegrass	225	10-15	—	7-9	5-6
Zoysiagrass	1,400	20-30	—	2-3	—

Turfgrass Tolerances.[1]

Type	Shade	Wear	Drought	Cold	Heat	Salt
Bahiagrass	—	good	high	poor	—	—
Bentgrass						
Creeping	good	poor	poor	high	medium	good
Colonial	medium	poor	poor	good	medium	poor
Velvet	high	—	poor	good	medium	—
Bermudagrass	poor	high	high	poor	high	good
Bluegrass						
Kentucky	poor	medium	medium	good	medium	poor
Rough	good	poor	poor	high	poor	—
Centipedegrass	medium	poor	poor	poor	high	poor
Fescues						
Chewings	low	—	—	—	fair	—
Creeping Red	high	medium	good	medium	fair	poor
Tall	good	good	good	medium	good	medium
Perennial Ryegrass	medium	medium	fair	poor	fair	medium
St. Augustine	high	medium	fair	poor	high	good
Zoysiagrass	good	high	high	medium	high	good

1. Rated by James Beard, Texas A & M University, College Station, Texas

Sod Production and Topsoil Loss

The present day concern over topsoil loss to erosion has expanded in some areas to a concern over soil depletion by sod production. If fact, some sod producers claimed soil depletion allowances in 1978 before the American Sod Producers Association convinced Congress that such allowances did not fit the practice of harvesting sod. Had ASPA not obtained this exemption for sod producers, they would have been forced to implement an inventory system of accounting for tax purposes.

Great strides have been made in reducing sod thickness over the last 20 years. Researchers and sod growers have proven the benefits of thinner sod. Thinner sod roots more rapidly and cuts transportation and handling costs. Sod thickness is today primarily a function of sod strength. Knives are set just low enough to prevent scalping on uneven spots in the fields.

Research by Skogley and Hesseltine at the University of Rhode Island has identified harvesting method and the age of a stand as the main factors in sod thickness. Three-year-old sod could be cut at slightly thinner thicknesses than two-year-old sod. The machinery's ability to handle uneven fields can reduce the thickness further.

Actual blade adjustment may seem minute, but a 1/16-in. higher setting could save six tons of soil loss per acre.

Production of sod, as compared to other agronomic crops, actually improves the organic matter content of the soil by two percent per harvest. This is due to the fact that most of the turfgrass roots remain in the soil after harvesting and decompose.

Skogley and Hesseltine found that sod production removed less topsoil than many other crops. Wind and water erosion are greatly reduced by grass cover as opposed to open crops such as corn, soybeans, and cotton. Planting winter wheat often provides farmers with reduced winter topsoil loss.

Topsoil removed *during sod harvesting is less than many conventional agricultural crops.*

soil if soil tests indicate a need. It is also a good time to mix in potassium and minor elements. Nitrogen need not be added at this time.

If there is a delay between rough grading and seeding, weeds will have emerged. Although the process of fine grading will kill most of the weeds, persistent grassy weeds can cause problems later. Most herbicides take two weeks or longer to dissipate after application. Roundup can be used on problem weeds if necessary and will dissipate within three days. Soil fumigants can be used for control of weeds, nematodes and insects if desired. Seed can usually be planted two or three days after fumigation. An advantage of fall seeding for cool-season grasses is the aggressiveness of the turfgrass in relation to broadleaf weeds during cooler, sunny days. Spring seedings face a strong challenge from broadleaf weeds during summer. Spring is often the preferred time for warm season grass seeding.

Just prior to seeding a complete fertilizer should be applied. Approximately one pound of nitrogen per 1,000 square feet can be soluble in form, with the remainder in slow-release form. Enough slow-release nitrogen should be applied to delay a second fertilizer application for six to eight weeks. The starter fertilizer should contain adequate levels of phosphorus and potassium since the seed is close to the surface. The turfgrass won't take advantage of the phosphorus mixed into the topsoil beforehand until it roots. Phosphorus will not leach or move to the surface.

Seeding

Two overlooked factors in seeding are the number of seeds per pound and the difference between spreading and bunch type grasses. One misconception in seeding is the idea that if one rate is good, a higher rate is better. This is related to the idea that seed is cheap in comparison to proper soil preparation.

A good lawn is constructed like a good house, from the foundation up and with good materials. Short cuts in the beginning cannot be overcome later. Constant repair could keep the lawn alive but can easily exceed site alterations or soil amendment in cost.

Assuming the seedbed was properly constructed, the seed rate should be determined by seed count. Seed count varies according to species and cultivar. (see table). Beard in his textbook TURFGRASS SCIENCE AND CULTURE specifies the number of seeds per square inch for North American species. If that number is applied to the total area of the seedbed and divided by the number of seeds per pound, a seed rate in pounds per acre can be determined. Each component of a mixture can be figured by seed count to derive an appropriate rate for a mixture. Lower rates for spreading grasses can be used. Sod producers often use lower rates for Kentucky bluegrass than a landscape contractor would.

For bunch type turfgrasses, such as tall fescue and perennial ryegrass, seed count, adjusted by germination percentage, should be slightly higher than the number of shoots present in a mature stand. This would mean roughly 15 seeds per square inch for tall fescue and perennial ryegrass, which works out to be about eight pounds per 1,000 square feet. Kentucky and rough bluegrass can establish satisfactorily at one pound per 1,000 square feet. Bentgrass will succeed at one half pound per 1,000 square feet.

Higher seeding rates can actually cause the turfgrass to crowd itself and to compete for light and nutrients. Weakened seedlings are more prone to disease and insects than seedlings from correct seed rates. The hurry to establish a turf cover may not be worth the weakened turf caused by higher seed rates.

High seed rates are not insurance. The recommended rate is also the cheapest rate. Excessive amounts of seed discourage the use of improved cultivars due to cost. The cost of tall fescue is not a great deal cheaper when the seed rate is multiplied by the cost per pound.

If erosion by rain or wind is a concern with the seed rate, the correction should be in the method of seeding or in the use of mulch rather than the increase in seeding rate. If slopes are extreme, netting or sod should be considered over standard seeding.

For best germination seed should be covered with one quarter to one half inch of soil. Surface seeding is not as effective. Soil retains moisture better than most mulches and supplies the seedling with water following germination. If a mixture of seed is used, a centifugal seeder will not provide even distribution of all seed types. Drop spreaders or a cultipacker are preferred. The seedbed can be rolled after seeding to improve soil/seed contract.

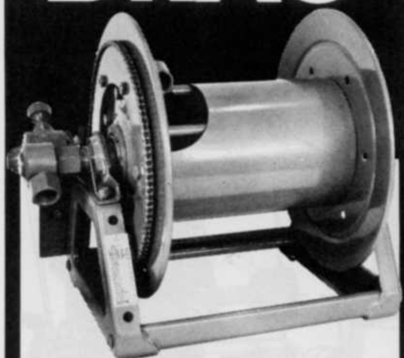
Many types of mulches are available for water retention and erosion control. Rates vary with the product. Straw and an asphalt binder can be used. Clean straw must be used to avoid contamination by forage grasses.

Fall is the preferred time to seed. Rainfall, temperature and other factors cause this to be the best time. Seeding at other times will require backup irrigation, greater weed competition, and higher seedling mortality. Sod may be a better choice for late spring and early summer lawn installation.

Sod Transplant Rooting Characteristics of Several Kentucky Bluegrass Cultivars/(Transplant Rooting Measurements Were Made 21 Days After Sod Placement)

High	Intermediate	Low
Merion	Baron	S. Dakota
Touchdown	Majestic	Newport
Adelphi	Fylking	Cougar
Victa	Park	Delta
Glade	A-34	Galaxy

(Study conducted at the University of Nebraska, R.C. Shearman)



Sod Installation

Sod, the instant lawn, is the fastest method of lawn establishment available. It is also the most expensive.

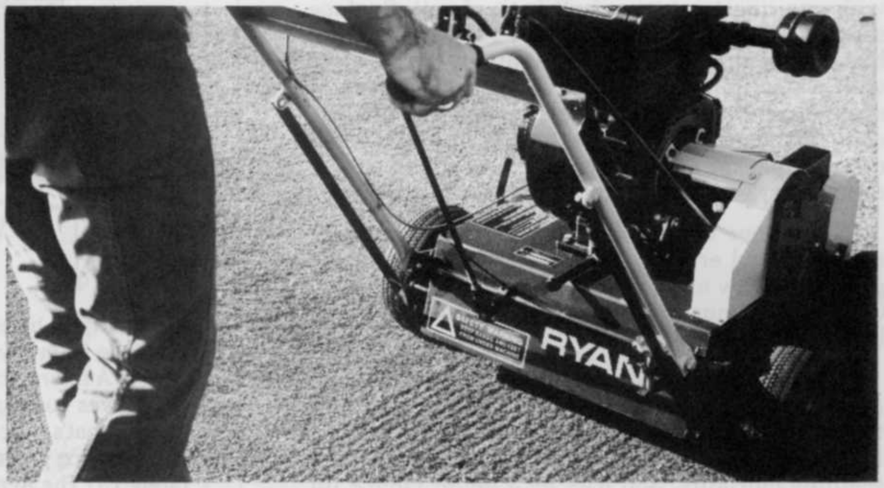
Soil preparation is the same as for seed. Sod must be handled quickly and kept moist. The best sod for a site is one that was grown on soil of the same texture. The soil should be sprayed lightly just prior to laying the sod. After the sod is down and trimmed, it should be rolled and perhaps topdressed at edges and joints if necessary. The sod should be soaked thoroughly two or three times per week for at least four weeks. Some turfgrass sods knit more rapidly than others. These sods should be specified for areas where use is anticipated soon after installation, such as athletic fields or greens.

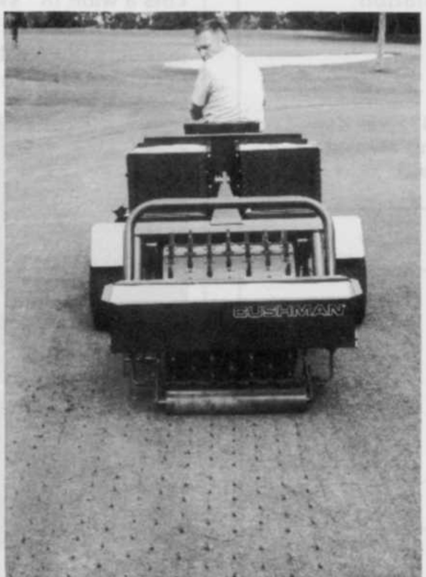
Sod should be irrigated regularly throughout its first season. It has received high levels of maintenance at the sod farm and has adjusted to frequent water and feeding. Sod producers select aggressive cultivars for fast knitting and growth. Like any fine lawn, sod represents a commitment to maintenance and must receive it to remain healthy. Sod in shady areas will take longer to knit than in full sun. Sod for shaded areas should contain shade tolerant cultivars.

Sod can be staked to slopes where erosion and seeding failure are more likely. Ditches designed to carry infrequent runoff may also be sodded.

Vegetative Planting

Vegetative plantings can produce a mature turf stand more rapidly than seeding. They too cost more than seeding, but less than sodding.





Verticutting *(above) is an essential step in lawn renovation to obtain satisfactory seed/soil contact and to avoid seed germination in the thatch layer.*

Aerification *(bottom) improves drainage and air penetration and reduces the chance of compaction by traffic. One extra step is to sand topdress into holes.*

Labor needs are greater than seeding.

Once again, site preparation is the same as for seeding. Sprigs are planted in 8 to 12 inch rows in three-inch deep slits. Two to four bushels of sprigs are needed for each 1,000 sqaure feet. Stolonizing involves broadcasting stolon segments onto the prepared seedbed. The stolons are then topdressed with fine soil of the same origin as the seedbed. Broadcast planting takes five to ten bushels of stolons per 1,000 square feet.

Plugging is a third alternative. Like sod, best results are obtained if the soil in the plugs is similar to the seedbed. Rows 12 to 16 inches apart are planted.

Shade, lack of moisture, and inadequate fertilization will slow the spread of the vegetative material. Warm-season grasses have the advantage of remaining aggressive in comparison to many weeds during warm months. Vegetative plantings are monostands. Stolons of other grasses can infest a planting, especially in broadcast planting. Nurseries are certified by many states to assure that vegetative material is only of the desired type for the particular job.

Renovation

Renovation is becoming more popular as a method to improve existing turf stands. Roundup has shortened the process with its near lack of residual activity.

It is done either by seeding or sprigging into existing turf stands that have been treated. Soil improvement is limited to aerification and topdressing if done. Thatch should be removed with a thatcher or verticutter. Cores should be broken up and a starter fertilizer applied. Seed is applied and brushed or rolled to assure surface contact. If preferred, the seed could be lightly topdressed.

The area should be watered just as a normal seedbed following seeding. The existing vegetation provides some protection against erosion but does restrict full light from reaching the seedlings. Shaded areas may not respond to renovation. Soil is not appreciably better than before renovation either. It is a partial solution and may not reduce maintenance levels or correct basic soil deficiencies.

Overseeding

Overseeding for winter transition or turf improvement is perhaps the fastest growing use of turfgrass seed. It is renovation without killing the existing turfgrass.

Cool-season turfgrasses are overseeded into warm season grasses as they go dormant in the winter. Turf texture and color are retained throughout the winter months. Upon return of warm weather, the warm season grasses come out of dormancy and dominate the cool season turfgrass.

Overseeding with similar turfgrasses is also feasible. Thin stands of Kentucky bluegrass can be verticut, closely mowed, and seeded with improved varieties. This is a less expensive way of adding disease or shade tolerant cultivars to older bluegrass stands.

High rates of seed are used in overseeding. Mortality is higher for seedlings in overseeding. Seeding rates double that for regular seed establishment are common. Seed can be lightly topdressed. Traffic should be restricted in the area if possible. In some cases fungicides are applied soon after overseeding to improve germination and survival.