1969

TURF CONFERENCE PROCEEDINGS

Sponsored by the

MIDWEST REGIONAL TURF FOUNDATION

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PROCEEDINGS OF THE
1969
MIDWEST REGIONAL TURF CONFERENCE

The 56 talks includes in these Proceedings are condensations of talks by speakers before sections and divisions of the 1969 M.R.T.F.Conference. We appreciated the willingness of the speakers to participate and prepare material for your reading. Proceedings of each annual Conference since 1948 have been prepared. A limited number of 1962, 1963, 1964, 1965 and 1966 Proceedings are available at $ 1.00 per copy.

A copy of these Proceedings were mailed to:

The 770 attending the 1969 Midwest Turf Conference
One person of each member organization within the Midwest Regional Turf Foundation not represented at the Conference
List of those in educational activities

Additional copies are available at $ 2.00 each from:

W. H. Daniel, Executive Secretary
Midwest Regional Turf Foundation
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Lafayette, Indiana 47907

For Lawns - first see articles starting on pages -
20, 27, 28, 73, 75, 79, 81, 82, 91, 101

For Sod Production - first see pages
5, 8, 10, 11, 28, 73, 75, 79, 81, 82, 84, 85, 86, 91, 101, 105

For Golf Courses - all including
Soils 3 - 28, promotion 31-51, Management 52 - 109.

MIDWEST TURF FOUNDATION TODAY

W. H. Daniel, Dept. of Agronomy, Purdue University,
Lafayette, Indiana

A statement in your program welcomes the speakers, challenges you as listeners to critically hear and repeatedly question the ideas they present. It is your best compliment to this Conference to listen intently, and to question for your reception as a listener here this is equally important to the presentation of the 53 speakers scheduled.

Today Midwest Turf Foundation is going well - not real well. However, those of you from other states knowing of your state's program and the progress they are making, can appreciate total developments within this region. At least five years ago interest in adjacent states and their individual programs boomed upward, and this has wisely continued. As a regional membership in Midwest Turf we have just held our own - around 365 members per year.

Now, this could be much more, and many of you as registered were given membership ribbons. Please wear them, please advertise, and please help share the information you can through this act. It is not a protest - it is a proposal for. To those of you not wearing member tags we would invite you to join for the support of research and the exchange of ideas. And, we would also encourage you to join your own state organization so that maximum support is achieved and maximum advancements are made. You are encouraged to join Midwest Turf while here, or to pick up application forms and take them with you for your organization's action. Mrs. House will be glad to help you at the Registration Desk.

As you registered many of you met Mrs. House who continues as secretary in the turf office. Her long term association and conscientious work is most appreciated. At the greenhouse on special trips to see things many of you will meet Bob Seager. His continued devotion to work makes for easy operations. We are fortunate to have these dedicated people.

Excellent cooperation continues with the administration within the University. The departmental and Experiment Station people have been most co-operative. Again this makes the work more productive and more pleasant.

Do be alert to those things that may make Midwest Turf Foundation more productive, more efficient and of most value in Turf Management for all of us.

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THE ARCHITECT VIEWS HIS CHALLENGES

Ferdinand Garbin, Golf Course Architect,
Export, Pennsylvania

The American Society of Golf Course Architects held its 23rd meeting in Florida, February 14 - 17, 1969. The membership, after several years of deliberation, has prepared for publication the following definition of a golf course architect:

"A member of ASGCA is one who, by virtue of his knowledge of the game, training and experience, vision and inherent ability, is in all ways qualified to design and prepare specifications for a golf course of functional and aesthetic perfection. He is further qualified to execute and oversee the implementation on the ground of his plans and specifications to create an enjoyable layout that challenges golfers of all abilities and exemplifies the highest standards and traditions of golf. He will counsel in all phases of the work to protect the best interests of the client. Each member of the ASGCA is engaged full time in golf course architecture."

Now that we have the definition we must decide its meaning. How do we expect a definition to further golf course architecture or golf itself? How will the publication of a definition affect contractors and builders, superintendents, golfers and golf course owners?

Our definition contains several carefully selected terms and words:

a. 'Knowledge of the game' - There are many practicing designers who have never hit a golf ball. Some do not have a thorough or even a slight knowledge of the rules of the game, and many have no idea of shot placement or shot value.

Our game of golf is not merely hitting a ball. We have over 9,000 golf courses in existence. The public will not participate on a poor layout, or on a poorly maintained course. Steep slopes, severely undulating putting surfaces, greens with too few cupping areas will appeal to few, if any, golfers. Why didn't you investigate the architect's background before he was hired? His work should have been checked by inspecting several courses he designed. Then his knowledge of engineering principles necessary to produce plans and specifications and his agronomic ability necessary for the production of fine turf and maintenance of the finished product would have been apparent. Don't let an amateur practice with your funds.

b. 'Training and experience' - Each applicant to the ASGCA must produce evidence of six years experience in golf course design and supervision of construction, or at least six years association with a recognized golf course architect. Why should you settle for less when you hire an architect to design your course?

c. 'Inherent ability' - The members of the ASGCA believe the ability to design a golf course with artistic interest, coupled with engineering principle, is an inherited trait. It is generally agreed that the inherent ability, plus training and experience, are absolutely required to set oneself out as a professional person.

d. 'Vision' - You cannot use guesswork in designing a golf course - neither is it pure artistry nor engineering. It is a combination of all these things. The architect must SEE the golf course in the forest long before the plans and specifications are completed. Vision is acquired from experience in the field.

The definition explains what the architect is. It tells you that he can do his chosen task when the opportunity is presented. He can produce a fine product if conditions are optimum.

Let us suppose that the conditions are not optimum. Golf courses are owned and paid for by people. People form clubs for social reasons, for profit-making ventures, and to provide municipal recreation facilities. These same people divide themselves into committees to speed the project. Now the fun begins.

First we purchase the cheapest, most run-down farm, or deep woods available close to the population center. Then we gather all the literature available from the universities, the golf magazines, the local green superintendent, the local four handicap golfer, and fertilizer and seed salesmen. Then we shop around for a golf course architect. Don't look at his work - hire the lowest priced man. Can you imagine what the course will look like?

This picture is not far-fetched, and is often close to the truth. The greatest challenge we architects meet today is created under conditions such as these. We seldom have the opportunity to select the land we will use. We meet with groups who have pre-conceived ideas of how the course will be built, how much it will cost per hole regardless of the condition of the site.

The greatest harm done to golf today is through half-education. The chairmen of the construction committees attend conferences, read literature disseminated by golf organizations, and listen at length to professional people about installation and maintenance of golf courses. Much of the information is quite technical for their backgrounds, and the more important issues are discounted.

In plain English, there is too much general information passed on with good intentions, but s~~o~~often already out of date. I find clients reading about chemical treatments and fertilizer techniques which were outmoded years ago. Once they have formed ideas, the battle becomes intensified and the task becomes next to impossible. The architect enters this situation and has much to overcome before he can get to the real issue. This means re-education, not only by me, but by the local County Agent or the Extension Agronomist, or other agencies which may have the information required.

I have not discussed the individual challenges encountered in design or construction because it seemed important to publicly state the American Society of Golf Course Architects' definition of the golf course architect.

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WATER MOVEMENT AND EVAPORATION

Jerry V. Mannering, Dept. of Agronomy, Purdue University,
Lafayette, Indiana

The soil consists of solids (inorganic and organic matter), water and air. The relative amount of these three components affect both water movement and water storage in soils. The inorganic fraction is composed of three principal particle sizes, sand, silt and clay (texture), which are largely responsible for the rates and amounts of water momvement and storage. In order to discuss how texture produces these effects, we need to definie some terms.

Saturation - condition when nearly all pores are filled with water. (Zero tension).

Field capacity - condition occurring after a thoroughly wetted soil has drained for several days. (1/3 atm. or 50 cm. tension).

Available water - to plant - water held in the soil between 1/3 and 15 atm. tension.

Wilting point - condition at which the ease of release of water to plant roots is just barely too small to counter-balance transpiration loss (loss of water through leaves). Represented in practice by 15 atm. tension.

The influence of texture on available soil water can be illustrated by thinking of soils as storage barrels. A coarse sand, for example, might be made up of 65% solid soil and 35% pore space. When fully saturated this pore space might contain 25% excess,or gravitational water, which is of little use to plants because it percolates through the soil in a very short time, 5% unavailable water or the water content at the wilting point, and only 5% (0.6 inch in 12" soil depth) available water.

A finer texture soil, such as a sandy loam, might have 54% solid soil,24.5% excess water, 10.5% unavailable water, and 11% (1.3" of water in 12" of soil) available water.

Table 1.

Texture	Volume		Water by weight			Inches Per foot
	solids	pore space	unavailable	gravitational	available	
	%	%	%	%	%	
Coarse sand	65	35	5	25	5	0.7
Sandy loam	55	45	10	24	11	1.3
Silt loam	48	52	14	20	18	2.1

An even finer textured silt loam soil might have 48% solid soil, 20% excess water, 14% unavailable water, and 18% (2.2" inches of water in 12" of soil) of available water.

Soils that are very fine textured, that is high in clay content, will have an even higher total water holding capacity, but the available water will be less than that of a silt loam soil. This is because the water content at wilting point increases more rapidly than the total water holding capacity. This effect is shown in Table 1. Water holding capacities of soils greatly affect many management decisions such as amount and frequency of irrigation, fertilizer application, trafficability, etc.

Water used in plant growth moves primarily in the liquid state, although there is appreciable movement in the gaseous state near the wilting point. Water in the liquid state moves out of coarse-textured soils very rapidly because they contain a preponderance of large pores, and the influence of tension in holding water in large pores is quite low. This is why coarse-textured soils are ideal for parks, playgrounds, etc.

Two major forces move liquid water through soil pores - gravity and adhesion (capillarity). Gravity is the most important in saturated soils. It causes a downward force on water. When the large pores are filled, water moves rapidly through. When a soil is not saturated, the larger pores are empty and contribute little to flow. Under these conditions adhesion and cohesion, which cause water molecules to hang together and be attracted to the soil particles, makes water move through the finer pores. This is the same force that causes water to rise in small (hair size) capillary tubes.

Water moves until the forces balance, at which point water films on soil particles are uniform in thickness throughout a uniform soil. If the soil is not uniform, those portions of the soil with the finest pores retain water more strongly.

In stratified soils (soils with layers) the size of the pores in the strata affect water flow. Layers with very fine pores restrict water movement, although the water in the wetting front does continue to move. If the wetting front encounters coarse material, water movement stops until the soil becomes nearly saturated. Stratified soils also tend to hold more water for plant use than uniform

soils since the different layers slow movement of water, more remains in the root zone. Organic materials, such as straw plowed under in a band, also form barriers to water movement very similar to a layer of sand or coarse aggregates. In turf work it may be beneficial to form layered systems in order to provide a better environment for plant growth.

Let us now briefly consider soil water loss. We have already suggested that gravitational water percolated through the soil and was of little use to plants. The loss of plant available water on the other hand occurs through (1) evaporation from the soil surface and transpiration from plant leaves. These two terms are usually combined and referred to as evapotranspiration (ET).

Work in Illinois showed as much as 50% of the total available soil water loss could occur through evaporation. This work was done on row crops, however, where appreciable energy (sun) reached the soil surface and the soil surface was also very wet. Iowa workers reported that 19 days after maximum leaf area development in corn, evaporation accounted for 24% of the water loss. Kohnke reported that water loss from a soil surface can actually exceed that from an open water surface if the surface is wet and exposed to bright sunlight. Usually, however, this condition lasts only a brief time and evaporation from the soil surface is much below that of a free water surface.

When working with turf, where full canopy cover is generally experienced, except during establishment, evaporation losses would be relatively low. Transpiration, therefore, under full canopy is largely responsible for atmospheric loss of water. This is illustrated by the fact that in this latitude under similar atmospheric demand, much greater water loss occurs under a full canopy of corn than when the corn is small and doesn't have the soil covered.

Atmospheric demand greatly influences water use, and this demand changes with the season and the weather as illustrated by the following table.

Table 2. Daily Evapotranspiration during

	Dull cloudy weather	Normal weather	Bright, hot weather
April or September	0.07	0.11	0.14
May or August	.09	.13	.19
June or July	.13	.17	.23

When the plant's plumbing system, the roots, cannot supply sufficient water to meet the atmospheric demand, the plant wilts. This can occur even above the wilting point moisture percentage on high demand days since the capillary movement to the root area is slow and cannot keep up with the demand. This is why it is important to have vigorous, well-distributed root systems so soil water has only a short distance to move to get into the roots. Also, irrigation systems should be designed to meet the requirements of a high demand day if it is essential that plants do not suffer from inadequate water.

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INFILTRATION AND PORE SIZES

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Infiltration is the entry of water into the soil. Continued infiltration is possible only when the water percolates through the soil. More than this is run-off or ponded.

On a golf course a high rate of infiltration is desirable so that rain or irrigation water is promptly removed. A continued infiltration rate of 13mm/hour (1/2 inch/hour) is satisfactory.

Pore sizes can best be classified according to their equivalent hydraulic diameter. Since every pore has irregular shapes, it is difficult to express its size in an actual diameter. Therefore, the behavior of water in soil pores is compared to that in cylindrical pores.

The total pore space in compacted soils varies between 25 percent in sands mixed of several size fractions to 70 percent in a muck soil. In most cases it is between 30 and 45 percent of the total volume.

The rate of infiltration depends not so much on the total pore space as on the distribution of the pore space sizes. The larger the pores the faster is the potential rate of infiltration. Pores of over 0.06 mm diameter take up water very quickly. Pores between 0.01 and 0.06 mm diameter still allow water to enter at a fair rate, but pores smaller than 0.01 mm diameter soak up water extremely slowly. A classification of soil pores according to size and their hydraulic functions is presented in Table 1.

Table 1.

Equivalent Pore Diameter	Pore Size Designation	Dominant Pore Function	Water Movement
Larger than 0.06	Large pores	Infiltration Drainage Aeration	Rapid movement, gravitational flow predominant
0.01	Medium pores	Capillary Conduction	Slow capillary rise, of slow gravitational flow downward
0.0002	Fine pores	Storage of Plant available water	Attraction of water in liquid and vapor form
and smaller	Hygroscopic surfaces	Hygroscopic water unavailable to plants	No liquid movement, only vapor movement

Two forces are involved in causing infiltration of water into soil: gravity and the attraction of the soil for water. Gravity is always active, but water may not be able to follow gravity because of an impervious layer. The rate at which water that fills the pores will move downward is proportional to the fourth power of the radius of the pores. This means that doubling the radius of a pore causes a sixteenfold increase in percolation rate.

The reason for this extraordinary difference is the so-called "Stationary Boundary Layer." This is the very thin (0.0001 mm) layer of water nearest the soil

particle that is held so tightly that under ordinary circumstances it does not move. Therefore, it restricts the flow area in the pores. Percentage-wise it restricts the flow area of very small pores much more than larger pores. Pores of 0.0002 mm diameter (twice the thickness of the Stationary Boundary Layer), therefore, do not allow any movement of liquid water.

Table 2 shows the relation of pore diameter to the percentage of effective flow area.

Table 2.

Pore Diameter mm	Effective flow area of total cross-sectional area %	
.1	99.9	large pores
.01	96.0	medium
.001	64.0	
.0005	36.0	
.0002	0.0	hygroscopic

In practically all cases infiltration rates are large at the beginning of a rain or an irrigation, and then gradually decrease. The reason for this is that in a dry soil both the large and the small pores are free of water and allow rapid water intake. Once the pores at the surface are filled with water, the soil can take up water only at the rate it percolates to make room for more water above. Some of the soil crumbs break down and the sloughed-out particles settle in the pores, decreasing their sizes and consequently their percolation rate. The same slowdown of infiltration results from the swelling of the soil colloids.

Infiltration rate is also affected by the wettability of the soil. Some of the organic compounds and hydroxides of iron are difficult to wet once they have been thoroughly dried out.

How to get large pores that permit water to infiltrate rapidly?

Nature has devised methods to enlarge the pores of a soil: freezing and thawing, wetting and drying, and the opening of the soil by animals and by plant roots. All these methods are very effective but are counteracted by compression from above as it occurs when men or machines move over its surface.

Another method to have large pores is to select a sand of the proper size (medium to fine sand) that contains no or practically no very fine sand, silt or clay. Such sand, when compacted, has pores that are large enough to allow rapid infiltration. Generally speaking the effective pore diameter in a very uniform size of sand is about one-third the diameter of the sand particles. Thus, compacted fine sand above plastic to maintain uniform wetness being researched at Purdue offers much in pore size.

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CLAYS AND THEIR ACTIONS

Joe L. White, Dept. of Agronomy, Purdue University
Lafayette, Indiana

Soils are usually classified on the basis of texture as a sandy loam, a silt loam, a clay loam or some similar designation. This classification simply has to do with the size of particles and the proportion of the various sizes - it says nothing about their composition. In general, as you go from coarse to fine particle size the surface activity increases very greatly because the surface area of the finely divided material becomes greater; thus, the properties that have to do with adsorption, swelling, plasticity, etc., increase very markedly as particle size decreases.

If one takes a chunk of soil and treats it in such a manner that it can be sliced into sections sufficiently thin to permit examination in transmitted light under a microscope, it can be seen that the soil is made up of particles cemented together by organic matter and clay arranged in such a manner that there are many openings or pores. These pores may be small or large, depending upon the proportion of different particle sizes in the soil. The pores may or may not be connected in a continuous manner. The size and distribution of pores control the movement of liquids and vapors in the soil.

If we take a sample of a well-aggregated soil and place it in a container of water and agitate vigorously, we can break down the aggregates and cause the soil to separate into individual particles. These particles range in size as sand (2.0 to .05 mm), silt (.05 to .002), to clay (less than 0.002 mm). When we examine the various particle-size fractions with an ordinary light microscope, we can easily see the sand and silt particles, but the clay particles are too small to be resolved by the light microscope.

In order to examine the nature of soil minerals in the clay fraction, the particles must be magnified thousands of times. This can be readily done by the use of the electron microscope. It can be shown by micrographs of minerals, such as kaolinite, that minerals are well-crystallized and occur as thin platelets.

The organic fraction of the soil plays a very important role in determining the physical and chemical properties exhibited by the soil. Soil organic matter is a very complex substance and relatively little is known about the detailed composition of the material. However, it appears that many of the groups, such as carboxyl groups and amino groups, can react with nutrients as well as with pesticides and cause them to be adsorbed.

In the case of reactions in solution, the rate and extent of reaction is proportional to the concentration of the reactants. When a solid is involved in reactions with compounds in solution, the rate and extent of reaction is proportional to the surface area of the solid. In addition to the amount of surface area, the nature of the surface is also of considerable importance. Features affecting the nature of the surface include:

1. The electrical field emanating from the surface, i.e., whether it is charged or neutal, and
2. The kind of chemical groups which make up the surface, i.e., whether it consists of oxygen atoms, hydroxyls, carboxyls, amino groups, etc.

The clay-size minerals exert a great deal of influence on the physical and chemical properties of soils due to their large surface. The silicate minerals

consist primarily of two building blocks namely, four oxygens at the corners of a tetrahedron usually with a silicon atom in the center, and six oxygens and/or hydroxyls at the corners of an octahedron, often with an aluminum ion at the center.

Layers of tetrahedra and octahedra may be combined in several ways, but two general groups are generally recognized. In the first, one tetrahedral layer is fused with one octahedral layer, giving a tetrahedral-octahedral layer ratio of 1:1. This group is known at the KAOLINITE. Minerals of this group are normally non-swelling.

In the second major group, the MONTMORILLONITE group, one octahedral layer is fused between two tetrahedral layers to form a mineral having a tetrahedral-octahedral layer ratio of 2:1. An unusual variation of the 2:1 group occurs in the mineral attapulgite. Ribbons of the 2:1 tetrahedral-octahedral units alternate with voids in such a manner that a cross-section of attapulgite resembles a checkerboard. Water and organic compounds can occupy the channels bounded by the ribbons of the 2:1 units.

Let us first consider the amount of surface area. The surface area of a non-swelling clay, such as kaolinite, is about $15 m^2/g$. In comparison, a swelling clay such as montmorillonite may have surface area of as much as $800 m^2/g$. Soil types may have a surface from 2 up to $50 m^2/g$.

Clay minerals have surfaces consisting almost wholly of oxygens or hydroxyls. These surfaces normally have a net negative charge. The magnitude of this negative charge, often expressed as cation exchange capacity, varies from about 5 milli-equivalents per 100 grams for kaolinite (a non-swelling clay), up to about 100 for montmorillonite (a swelling clay). The broken edges of the clay platelets may have a very small number of positive charges. The planar surfaces will tend to attract positively charged ions and repel negatively charged ions.

The clay surfaces just described have, in addition to the cations associated with the negative charges, water molecules strongly bound to them. Because of the strong attraction between the water molecules and the clay surface, there may be competition between molecules of compounds added as fertilizers or pesticides, and water molecules for adsorption sites on the clay surface. In addition, water molecules in the electrical field of the cations and the clay surface may be dissociated to a much greater extent than ordinary water. Thus, the pH of the surface of a clay particle at low moisture contents may be 3 or 4 pH units lower than that measured in the bulk of the soil by means of a pH meter equipped with a glass electrode. This "surface acidity: may be very significant in the interactions between soil clays and fertilizers and pesticides.

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PEATS IN PROCESS

Gene Holder, Millburn Peat Company, Inc.
Otterbein, Indiana

During 1968 there were 128 active peat producers in the United States. These operations vary in size from one acre to 3000 acres. Our operation is approximately 200 acres in size. All are small compared to some of the Canadian producers. Last August I visited the Premier bog in Riviere Du Loup, Quebec. It was 7 miles long and 2 miles wide. They employ 750 laborers. At the peak of our season we

employ approximately 50, and in 1968 we were third largest among the domestic peat producers. Of these 128 producers the majority are supplying the 3 most common types known to all of us - peat moss, reed sedge peat, and humus. All 3 types are useful and none is completely superior.

Peat and peat moss, which terms shall be used only with respect to organic matter of geological origin, principally originating from dead vegetative remains through the agency of water in the absence of air and occurring in a bog, swampland or marsh, and containing an ash content not exceeding 25% on a dry weight basis.

MOSS PEAT is that type which has been formed principally from sphagnum, hypnum and other mosses. This type is the least decomposed of the various peat types. It is light tan to brown in color, light in weight, high in moisture holding capactiy, has a high organic content and low in ash.

REED SEDGE peat. This type is formed principally from reeds, sedges, marsh grass, cat tails and other swamp plants. Usually brown to reddish in color, more decomposed and heavier in weight than moss peat.

HUMUS is peat that is in a more decomposed state in which the original plant remains are not identifiable -- usually black in color, the heaviest of all in weight, and has the lowest moisture retention capacity.

When buying, the most important thing is the type of peat and not the place of origin. Peat is often sold by weight, and often the moisture content will run as high as 75%. Regardless of the type of peat you are buying, your best buy is in volume - not weight. Though we are all striving for the same results, we all have different methods. Some machines that are useful in some operations are worthless in others.

Ditching is the one problem we all have in common. The better drainage you have, the more efficient the operation. There are various ditching machines used throughout the industry. In this New Jersey operation, they use a crane and drag line, and ditches drain into a lake area. We are not so fortunate in Otterbein as we are pumping from our main ditch into a dredge ditch, which tends to overflow during the spring rainy season.

Clearing of brush, which is very shallow-rooted, is fairly easy to remove. A bomardier Muskeg with a mounted winch is used for pulling. Clusters of swamp maples are removed by a backhoe to loosen the root system, then the Bombardier Muskeg winches out the cluster and removes it to the outer edge of the bog, where it will eventually be bulldozed into a pile and burned. After the area is eventually cleared, a drag line is used to clear off the topsoil and remaining roots. This is all waste material and must be hauled away.

At the Anderson bog in Imlay City, Michigan, wood and roots are removed in a screening process, then on into the bag plant for packaging. In Sandusky, Michigan - a copy of the original in use at the Millburn bog with dual tractor tires for flotation purposes. As in most Michigan operations - at the Huber operation - sticks must be removed.

At the Millburn bog we have drainage ditches every 150 feet. The bottom of our ditches are constantly oozing up. To maintain our ditches with comparative ease, a large machine with a scraper wheel spins in the ditch, throwing the sludge and water out on the bank. It is then picked up in scraper wagons such as these. We also use these wagons for clearing our bog. An ordinary rotary hoe is used for flaking the top layer of fiber loose. After it is allowed to dry for a few hours,

an Irish harrow is used to turn the material over. After lying in the sun for a few hours, it is then ready for harvest.

Our harvesting machine was built in our workshop under the supervision of Henry Frenzer at a cost of approximately $ 25,000. If you will note the huge flotation tires on the rear, they cost approximately $ 1300 each.

Our wagons haul between 12 and 15 cubic yards per load. No other machine is used in stock piling. These wagons dump from the bottom. A heavy plank between the rear wheels levels the load and the next wagon will pass over the same path. This procedure is followed the entire summer. Each of our stock piles will contain approximately 30,000 to 40,000 cubic yards. It takes approximately 5 minutes to load each wagon. Only 3 wagons are needed to keep up with harvester.

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CALCINED AGGREGATES

W. H. Daniel, Dept. of Agronomy, Purdue University
Lafayette, Indiana

In 1952 calcined aggregates were first used as a rootzone modification under turf conditions at Purdue. Now, seventeen years later, we have a history of numerous products being observed. Of these five have come to the fore in the market with four having major sales.

Basically any fine material, such as clays or shales, which has been crushed to smaller aggregates, then run through furnaces that remove the bound water and partially change their natural structure, could be fired. However, those that have been called calcined usually are accurately treated; for example, twenty minutes at 1800°F.so that the product is mechanically stable. By this the particles, being composed of solids and very small pores created within each aggregate, are stabilized and the weight is lessened so that materials may weigh 35 pounds per square foot.

Every material may differ in source, amount of heat, amount of crushing and color. Also, some materials are calcined different than others. The attapulgite clays may be different than the arcillite clays. Obviously the diatomaceous earth is also different. More obviously the shales are again different.

Lu-Soil, Turface, Terra-green and Prep are well-known as is Dialoam. Companies making these make numerous fractions of specialty materials for insecticides, herbicides, filters, etc. Incidentally they also make some soil amendments.

Prices are very competitive. Research has been limited in some cases, and the explanation of the materials has limited their sales at times. We know of many golf greens which, having been repeatedly topdressed with calcined clays along with repeated aerification, have greatly improved, and the results have been most favorable under most conditions.

Our research program has maintained turf outside on pure calcined materials under weather, wear and management since 1958. Plots now ten years old still show the individual granular aggregate character evidenced by the original. Initially some of the plots did absorb 1 inch of water per minute (not hour), and ten years later still retained very high infiltration rates. Normally we do not recommend

pure calcined aggregates for although they work well in summer, their best benefit seems to be as additives to sand, or additives to soil, thus giving faster infiltration, better aeration and better water management.

We can expect continued use of the calcined aggregates as especially prepared rootzones are considered. Fortunately they are weed-free, easy to spread, easy to use at light rates when used straight. In one experiment, by repeated application, we could apply to putting green turf 25 pounds per 100 sq.ft. and build up 1 inch of material within one year by repeated treatments.

Although the calcining destroys much of the normal base exchange capacity of the clays, there is some storage of materials and ions in the small cavities and broken bond edges. The storage capacity of the calcined clays as normally tested, may equal that of some ordinary soils.

There is the problem that the available water fraction held by the calcined material is low. What does not drain out (quickly) is rather tightly held so the available fraction is small - minimal, less than most soils.

Percentages of 25 - 60% in the upper 2 inches can often modify enough so the SOIL effect no longer predominates. In sands the 10 - 30% in upper 2 inches may improve minor element storage (along with peat or vermiculite).

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SPONGE RUBBER

W. H. Daniel, Purdue University

In the Ten Ways to Build article (in Proceedings) we point out four ways to build greens without soil. Now, without the fines so characteristic of soil, there are many new possibilities. For example, how about using ground sponge rubber in sand to improve resiliency? How much? What size particles? How deep? How long will it last?

We know if the particle of sand or soil is smaller than the openings in the rubber, this particle moves into the openings and the mass becomes near solid. So, if sponge rubber is to be used it must be resilient, must keep the pores open, i.e., stay free of soil or fine sand.

Our biggest experiment so far is less than 1,000 sq.ft. - where we used 100 pounds of rubber per 1,000 sq.ft. mixed into the top inch. We assumed this was approximately 10% rubber by volume. There is another 10% peat by volume in the same plots. Between these two we hope to have improved resiliency. Time will tell.

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ACTIVATED CHARCOAL

W. H. Daniel, Purdue University

Activated charcoal offers the potential of holding organic compounds or certain ions which may modify tolerance, availability, or storage. Many industries use activated charcoal, then discard it because it carries a certain amount of organic matter. Such could be desirable for turf. What particle size? What percentage? What fineness? How long will it last? Is it effective once it gets a full charge in the soil?

In the greenhouse we took charcoal from a starch processing company, used 0 to 50% by volume, found it would grow excellent turf at all conditions when adequately fertilized. We know that strawberries dipped in a slurry of charcoal can be planted into areas already treated with herbicides and the charcoal will filter out herbicide before it reaches the roots when used as a slurry covering at planting time.

Again, having given up on soil as a rootzone media, the question merely just raised - can activated charcoal do something to improve rootzones?

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ROOTZONE OBSERVATIONS

David Ralston, Graduate Res. Assistant, Purdue University,
Lafayette, Indiana

The underlying theme for our rootzone research at Purdue is effective water management. Various materials and methods for construction are under study to investigate ways to effectively remove excess water rapidly but still retain adequate water for the turf needs. Rapid removal is desired so that standing water does not interfere with play or weaken the turf. Porous materials, such as sand and calcined aggregates, can be used to give the desired drainage so the problem then becomes one of retaining enough water so that a drouthy condition is not created.

Two methods of retaining water in the rootzone are currently being studied on the experimental green. One is to place a plastic sheet as an impermeable barrier to stop the downward movement of water. Then, moisture stored above the plastic can become available to the plant through wick or capillary action.

The second method is to vary the depth of the rootzone material above the subsoil. A shallow rootzone will retain more water than will a deep one, thus more water for the plants. The depth needed is entirely dependent on the material used.

Mixtures of sand, calcined aggregates and peat are being studied both in plastic lined and unlined plots. Soil was not included in the rootzone mixtures because of its structural instability and great variability. Soil serves two main purposes in a greens mix: 1. water holding capacity (fine pores retain water which can become available to plants), and 2. nutrient retention. The problem arises when the soil mix is compacted and will not drain, creating a headache for both the superintendent and the golfer. We are studying ways of retaining water and nutrients without the use of soil.

Variable Rootzone

In the fall of 1967, plots were built on the south side of the experimental green to study the effect of varying the depth of the material on moisture holding capacity and root quality. Four inches by volume of 25% peat, 25% calcined aggregates and 50% sand was mixed and compacted. Under this from 0 - 6" of washed sand was compacted over the subsoil, which varied 4, 6, 8 and 10 inches below surface. The overall depth of the drain line was varied 10, 13, 16 and 19 inches. Measurements taken during 1968 included root depth, moisture content (surface neutron meter), wilt susceptibility and infiltration rate.

Root depth for the Penncross was measured at monthly intervals on all plots from May to November. Roots were found in the subsoil for most of the 4 inch plots and some of the 6 inch deep rootzones. Root depths tended to be deeper in the 8 and 10 inch plots with the majority of the roots within the top 5 inches,and the deepest roots about 8 inches. The difference in root depth was not reflected in the vegetative part of the bentgrass. A shortening or die-back of the roots was not observed for the bentgrass during the hot summer months for this first year of establishment. Bentgrass rooting depth for the silt loam soil in the center of the green, ten year old turf, had few roots below 2 inches throughout the summer.

Infiltration rate was measured using the standard double ring infiltrometer. Rates varied from about 6 to 20 inches per hour with most of the plots between 12 and 15 inches per hour. The hydrophobic nature of the turf seemed to be the limiting factor for infiltration.

Moisture stress was measured using the surface neutron meter and wilt ratings. Percent moisture by volume ranged from 17 to 23 percent for most of the plots depending on the state of dryness. The easiest method to determine which plots were showing moisture stress was to watch the early morning dew pattern. Little or no dew is a good indication that the turf will be under stress in the afternoon.

During the last two weeks in August, wilt ratings were made for both the plastic lined plots on the north side and the variable depth plots on the south side of the green. The accumulative evapo-transpiration for the two week period was 2.3 inches of water, indicating a fairly hot and dry period. Plots were rated from 1 to 9 where a rating of 1--2 was normal growth, 3--5 showed footprinting, 6--8 was blue wilt, and 9 was severe wilt and had to be watered.

The soil in the center of the green had to be watered on the fourth day after the 2 inch rain which was used as the starting point for the study. Most of the plots of the variable rootzone in the south side of the green showed signs of wilt after 5 days and had to be watered on the 6th day. On the north side most of the plastic lined plots made it through the two week period between rains without requiring additional water. Notable exceptions included the coarsest fraction of the dune sand and the high percentage calcined clay plots - 100% at 4 days, and 80% and 20% peat at 5 days. The Dialoam plots and some mixtures of sand, calcined clays and peat did not require watering for the two week period.

In summary, results indicate that moisture can be retained to a limited extent by using a shallower rootzone,but more effectively by placing an impermeable barrier below the rootzone to store more water which, by wick action, serves evapotranspiration needs.

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USE OF ION-EXCHANGE RESINS IN FERTILIZATION OF TURFGRASSES

Melvin Robey, Graduate Research Assistant
Purdue University, Lafayette, Indiana

In the past few years an interest has developed in using artificial rootzones for putting greens. Artificial rootzones are usually composed of sand, peat and calcined clay, with no soil added. Without soil the exchange capacity is lost which presents the problem of maintaining a fertility level which will satisfy the grass needs. Some base exchange capacity is added by the use of peat and calcined clay. Another way could be the use of cation and anion exchange resins.

These exchange resins have an exchange capacity which is 5 to 10 times greater than that of mineral soils in Indiana. The cation resins have an exchange capacity of 1100 m.e./100 grams, and the anion resins have an exchange capacity of 560 m.e./100 grams. Since there are ways of adding cation exchange capacity by the use of peat and calcined clays, the application of anion resins is of more significance. With the use of anion exchange resins in artificial rootzones, the loss of nitrates by leaching can be reduced to a minimum.

The use of cation and anion exchange resins as a way of storing nutrients in artificial rootzones is a new concept which is now being studied here at Purdue. One test was run in which 5 different rates of anion resin loaded with nitrate was applied to three (3) different artificial rootzone mixtures. The three (3) rootzone mixtures were (by volume):

1. 100% sand
2. 80% sand - 20% calcined clay
3. 80% sand - 20% peat

The five levels of anion resin added (by volume) to each of these rootzones were: 0%, 0.1%, 0.5%, 1.0%, and 4.0%. The amount of actual nitrogen this is equivalent to, in pounds of nitrogen per acre, is: 0, 29, 146, 292, and 1,168, respectively.

The pots were seeded with Oregon fine-leaf tall fescue, and upon germination the grass was allowed to grow three (3) inches high. At this time, the grass was mowed for the first time. From this point on the grass was mowed every week. The clippings were saved each week, and at the end of 4 weeks time they were dried and weighed. This procedure was continued for a period of nine months. The chart below shows the five rates of anion resins used, the nitrogen equivalent, and the dry weight of the grass clippings for the third and ninth month.

% anion resin/pot	Lbs.N/acre	Yield/pot (mgms.) 3rd month	9th month
0%	0	18	96
0.1%	29	179	83
0.5%	146	201	94
1.0%	292	278	87
4.0%	1168	2167	321

At the end of the third and ninth month it can be seen that the most growth was coming from that pot with the highest level of anion resin. At the end of the third month there is a gradual increase in dry weight as the amount of anion resin increases. This column then shows that the nitrate is still being released from

all of the resins at the end of three months.

At the end of the ninth month it can be seen that at the highest level of anion resin the grass was still being supplied with an ample amount of nitrogen, whereas in the other four levels the nitrate has been released and used up, and all the pots were yielding about the same amount of dry weight. The indication is that the anion resin can hold nitrate and release it for plant growth over a long period of time. It also shows that the nitrogen concentration can be applied at extremely high rates (1168 pounds of actual nitrogen per acre) without killing the grass.

It was evident throughout the tests that one of the three rootzones was superior as a growth medium over the other two rootzones. For the nine month period the 80% sand--20% calcined clay yielded the most dry weight material. At the end of each month there was approximately twice as much clippings from these pots than from the other two mixtures. This was probably due to potassium, phosphorus, calcium and minor elements which are trapped in the clay when it is baked. The calcined clays also have a base exchange capacity which would regulate the release of the cations. It would appear that the addition of calcined clay to artificial rootzones is desirable.

Since the use of synthetic anion and cation exchange resins as a means of supplying nutrients to grass is a relatively new idea, there are several points which need to be studied. I have listed 6 of these points, which need to be answered before these resins may be used:

1. Can the exchange resins be reloaded while in the rootzone without killing the grass?
2. How long will the exchange resins last in the rootzone before disintegrating?
3. What particle size of exchange resins should be used?
4. What percent of the rootzone mixture should be exchange resins?
5. Which is the best exchange resin on the market for use in artificial rootzones?
6. At what depth should the exchange resins be incorporated into the rootzone?

Just what use these ion exchange resins will have in the future in artificial rootzones is not known, but with their high exchange capacity it seems obvious that they offer an excellent way of storing and releasing nutrients.

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SAND AS A GROWTH MEDIUM FOR ATHLETIC TURF

Condensation of a paper by
D. E. Bingaman and Helmut Kohnke
Purdue University, Lafayette, Indiana

Why not soil? When frequently watered and subjected to much traffic, soil loses its large pores because its structure depends on maintenance of aggregates. Compacted soil is poorly aerated.

The sizes of pores in compacted sand depend on the size and shape of the individual sand grains. Generally pores are one-third the diameter of particles forming them. Sand is poor in its capacity to hold plant nutrients and water. Frequent fertilization can take care of the one handicap. Impervious material (a plastic sheet) placed below a shallow layer of sand can take care of the other.

Sand as a growth medium can provide the right pore space and has these requirements:

Pore Space

1. Over 30% total pore space. This is needed to provide the desired amounts of air and water for the plants. Range 25 to 38 found in sands.

2. Over 15% available water in the top 15cm. This will guarantee 2.25 cm water in the immediate vicinity of the active roots, enough as a "cushion" for a dry spell.

3. Over 10% air-filled pores at 10 cm depth. This provides enough oxygen for the roots.

Water movement

4. Over 50 mm/hour saturated hydraulic conductivity. This allows all but the heaviest rains to be absorbed as they fall.

5. Over 2.5 mm/hour capillary rise rate. This is needed to replenish the water lost by evapotranspiration.

6. Range of 30 - 50 cm drainage depth. 30 cm is the minimum sand layer needed to maintain a satisfactory amount of air. (See 3 & 4). More than 50 cm is not required for the purpose. Most sands that have the other desired properties would dry out too soon if the water level is much deeper than 50 cm, and wick action (see 5) would be inadequate.

How to Judge Sand?

The properties of compacted sand that affect amount and size distribution of the pores are its finer particle sizes, its degree of mixing of finer and coarser particles, and - in a minor way - the shapes of the individual particles. The following parameters are used to express these properties:

1. Mean Weighted Particle Diameter (WPD_{50})
   Dividing all the particles of a sample into two equal parts by weight into large and small particles, the WPD_{50} represents the diameter of the particles at the boundary between the two groups. This can readily be obtained from a mechanical analysis curve.

2. Gradation Index (GI)
   It is a dimensionless numerical value representing the degree of gradation or sorting of the sand material. It is the quotient of the diameter corresponding with the 95% by weight value of the sand's cumulative mechanical analysis curve, divided by the diameter corresponding with the 5% by weight value of the same curve. A Gradation Index of 1 represents a sand of all the same size particles. Higher Gradation Indices represent sands of mixed sizes. Several other parameters have been developed for the study of the behavior of water and air in sands. However, these are not needed for the practical selection of the sand. They include the "Weighted Volumetric Pore Diameter," the "Large Pore Index" and the "Pore Size Index." These values are calculated from desorption curves. A carefully selected sieve analysis using all practical screen sizes available is required as basic. The finer fraction predominates and coarse particles just occupy space.

How to Select the Right Sand

This investigation has shown that washed fine and medium sand can serve well as a growth medium for athletic turf. For complete success it is necessary to

specify the sand quantitatively so that it meets the requirements set out above.

The sand should have a "Mean Weighted Particle Diameter" between 0.2 and 0.4mm. Most of the particles should be fine sand size between 0.1 and 0.5 mm. Clay and silt should be absent. Expressed quantitatively its "Gradation Index" should be between 3 and 6. Whether the sand is rounded or sharp is of minor importance.

Field experiments have shown that on such sand a sturdy sod of bentgrass develops which will develop deep roots and can withstand normal traffic.

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SUMMARY OF TEN WAYS TO CONSTRUCT HIGH USE TURF AREAS EXPOSED TO COMPACTION, PURDUE

There's ONLY one way to build a house! No! A well-built house does CERTAIN things - handles excess water promptly, has ample storage, insulation and activity areas,etc.

Likewise, GOLF GREENS and COMPACTED AREAS when WELL-BUILT must do CERTAIN THINGS -Remove excess water promptly, have ample nutrient and moisture storage and availability, have resiliency for play, texture for firmness, etc. In varying degrees the ways below contribute to the desired uniform result.

Due to fines present SOIL PREDOMINATES

1. ANY SUBSOIL - mud in - shape to grade - and LEAVE as soon as paid!
2. TOPSOIL ONTO TOPSOIL - avoid any subsoil - avoid working when wet
   - carefully conserving what's good can save funds
   - can do for sandier soils, a low budget installation
3. SUBSOIL UNDER TOPSOIL- plus deep tile DRAINAGE - pea gravel backfill over tiles
   - more desirable where major fill is required
4. Above plus SAND (60%) and PEAT (20%?) mixed into top 2-3-6-10 inches in hopes of better water movement and less compactability.
5. VERTICAL POROUS STRIPS-to remove excess surface water promptly (from any source)
   Use as CORRECTIVE where better drainage is needed
   -NARROW TRENCHES - above tile - into pea gravel, in low spots,between tiles,across tiles,2-3" wide & 12-30" deep. Backfill with pea gravel.Cap with sand or calcined aggregates
   -SLITS - surface and downward - 1/2" wide x 10" deep
   GROOVES -8" apart,3" deep;fill with sand or cal.aggregates
6. INTIMATE TOP MIX - mixed off-site - U.S.G.A. spec.
   10" - 14" settle top mix over
   2" washed sand over
   4" pea gravel over
   4" field tile drainage
   Follow exact laboratory spec. based on samples submitted
   This system gives low tension at gravel "dump action of excess water"

POROUS TEXTURES PREDOMINATE (no soil)

7. THIN ROOTZONE - on any subgrade - into shallow narrow trenches (frequent)
   Place small 1-2" plastic pipe with slits cut into pipe as drains
   Backfill with coarse sand to overflow trench
   Place sand layer 3 - 4" for fast lateral INTERNAL drainage
   Have top 3-6" maximum surface storage mixture of peat, calcined aggreg. & sand
   Compact and plant.
8. IMPERMEABLE LAYER - giving ZERO TENSION - plastic sheet follows contour
   For drains use slitted plastic pipe laid onto plastic sheet
   Depth (12-20") based on texture - porosity of stable materials used (SAND, CALCINED AGGREGATES)
9. RESERVOIR POOLS - Use WICK ACTION - the PURR-WICK SYSTEM
   Place plastic sheet FLAT, LEVEL with upturned edges to form shallow pools
   Make tiers of pools as contour dictates. Keep surface UNIFORMLY MOIST.
10. Above, plus sub-irrigation by FLOAT valve for each tier. Adjust level for varying wetness.
    Could add SOIL SENSING probes for dryness before recharging by float.

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SYSTEM 9 - THE PURR-WICK SYSTEM

As used for an experimental green
As constructed at L & N Golf Club, Louisville, Kentucky

5000 sq.ft. 72 x 72 ft. practice green
Four tiers, 6" each, plastic under compacted sand
3 ft. change in slope, 2 ft. E & W
2 ridges for 1 ft. N & S
4 topdressing plots replicated N & S
half stolons - half seed for observation

A. Six cooperating superintendents spent 40 hours
W. H. Daniel and Dave Ralston spent 39 hours each
Superintendent of L & N spent 42 hours. These total 160 (no charge)

B.	Equipment rentals - D-8 loader, tractors, ditcher		$ 280.00
C.	Laborers time - G.C. workers - shoveling, raking, rolling		324.00
D.	Materials -		
	4 rolls 100' x 40' of .006 plastic	$ 150.00	
	6 rolls 4" x 40' corrugated edging	10.00	
	400 ft. 1-1/2" plastic pipe (slitted,drains)	120.00	
	200 ft. 1-1/2" " " (water,irrig.)	60.00	
	Snap-on valve & fittings	50.00	
	Sand - 425 tons including hauling	1410.00	
	Calcined aggregates - 2 tons	120.00	
	Peat - 10 cu. yds., bulk	140.00	1960.00
E.	Planting -		
	1/2 seed - 5 lbs.	32.00	
	1/2 Evansville stolons, 25 bu.	105.00	
	16-3-9 & Milorganite fertilizer	6.00	
F.	Mulch - Famcomat 5000 sq.ft.	150.00	293.00

TOTAL COST as constructed at Louisville prices..... $ 2857.00
Some materials furnished by cooperators but listed regular price here.

Procedure Used

A. Remove sod, shape 4 level tiers, dropping 6" between each. Place and compact soil around edge of green to desired final grade. Confirm level subgrade with transit to less than 1 inch variation. Place 4" aluminum edging. Then compact a 4" soil berm at interior edges of tier to provide reservoir. Trench into berms for drains to extend out of edge and for water to come into center of green.

B. Spread plastic double thickness. Insert 1 - 2 ft. fold of one sheet into split of former sheet. Use trimming for additional sealing as needed around pipes with mastic. Keep edges up to surface between sand and soil.

C. Lay pipe with slits cut with coping saw (1/3 of diameter and 6 - 8 inches apart on each side) in each tier.
Arrange outlets of drain lines in pits. Have each outlet level with its tier. Use threaded tee as terminal with plug in end (for complete drainage when removed), and on upright add 2 inch nipple (for added pool reservoir when inserted).

D. Bring irrigation through edge and above plastic to center valve. Also have valve outside green for use.

E. Spread coarse sand over drain pipes (to make filter).
Dump, spread, compact and water-settle fine sand to final contour 13 - 19 inches deep.
Spread fertilizer.

F. For 2 or 8 plots mix and spread calcined clay, peat, ground rubber and sand.
do spread calcined clay and peat
do spread peat and sand
do add nothing to sand
Work moist, compact; plant and mulch

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PRINCIPLES FOR ANY GREEN

Wayne Morgan, Kellogg Supply Company
Wilmington, California

"How do you build a golf green?" If this question were asked of Dr. W. H. Daniel of Purdue University, he would probably first answer by in turn asking a question, "How do you build a house?" Other questions to follow would be, "What will be the condition of use?" "How much storage do you wish to build into the house?" How much money is available to build the house?"

These same questions can be related to building golf greens. Concerning the last question pertaining to costs, there is usually one of two ways this is done. The first and best approach is to determine what your requirements are, budget to meet these needs, and then build. Unfortunately, all too many turfgrass superintendents are forced to try and maintain a golf course where specifications, especially for greens and tees, are reduced to meet budget limitations. This is being "penny-wise and dollar-foolish," for building a golf course is no place to try and save money. In doing so, the conditions for use are usually much less than desirable and INCREASED maintenance costs soon more than consume any savings realized in COMPROMISED building costs.

Let us next consider each of the essential requirements that a soil must provide: support --nutrients--air--water.

Support. Not only must the soil provide a favorable medium for plant roots to grow in, the soil must also be able to withstand abusive compaction inflicted upon it, while retaining a playable surface with sufficient resistency to hold a golf shot.

Nutrients. Plants require essential nutrients which they used to help produce food and energy for their growth. The soil must provide these nutrient elements in forms available for plant absorption and in quantities sufficient to meet the plant's needs. These nutrient elements must also be present in the proper ratio, one to another for effectiveness.

Air. By air, for plant growth, what is principally referred to is the oxygen CONTENT of the soil atmosphere and the freedom of MOVEMENT of the oxygen

through the soil. More important than the actual quantity of oxygen present in the soil is the speed with which it can diffuse to the roots when needed. Oxygen moves QUICKLY through air, but extremely slow through water. The higher the temperature rises, the more critical is the need for rapid movement of oxygen to plant roots.

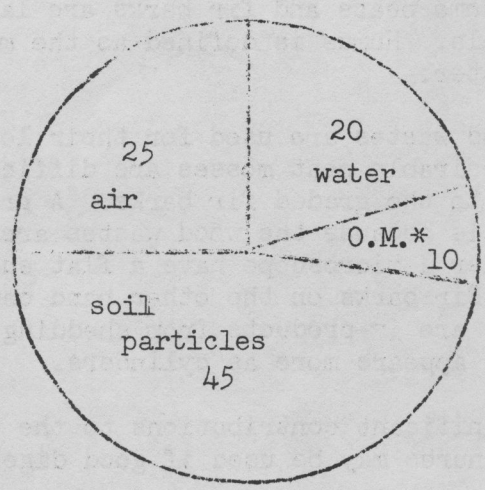
Another consideration in soil air is the exchange of gases in the soil and surface air. Carbon dioxide in the soil can become toxic to plant roots, so there must be sufficient channels to allow oxygen to enter the soil and carbon dioxide to escape.

Water. The role of water in plant growth can never be underestimated. Almost all plant nutrients enter the roots in solution with water. Water movement through the plant and lost in transpiration serves as a means of cooling the plant. Many parts of the plant consist primarily of water and the metabolic processes within a plant require the presence of water. It is essential that the soil contains sufficient available water to satisfy the demand of the plant. It is also important to provide for adequate drainage of excess water from the soil.

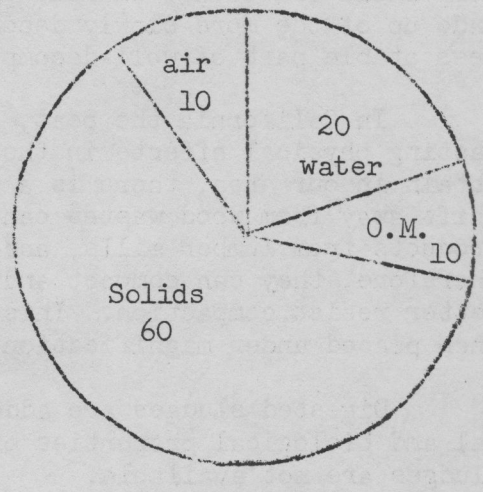
Some information on how roots grow can next be added to aid in our understanding of the role soil plays in plant growth. Roots do not grow into soil particles - they grow in the air spaces surrounding the soil particles. As we do not enter a room through walls but by means of doors, there must be sufficient air channels in the soil for roots to grow in. Research has shown how root growth can be restricted by physical inpedance itself. It is these channel-ways that also serve for air and water movement into and through soils.

Roots do not grow where it is too dry. Neither do roots grow where it is too wet. Contrary to many popular beliefs, roots do not seek water. ROOTS ONLY GROW where there is a FAVORABLE SOIL-NUTRIENT-AIR-MOISTURE relationship.

What happens to these volume relationships can be seen from the following illustrations.



"Ideal" soil
*=organic matter



Soil compaction

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HUMUS AND SAND GREENS - WESTERN STYLE

Wayne Morgan, Kellogg Supply Co.Inc.
Wilmington, Calif.

BUILD SOILS TO MEET NEEDS!

A mixture of organic matters is being used with sand to build soils for greens in Southern California. By building golf greens of sand and organic matters, the requirements of providing what is necessary for a soil to supply is satisfied. A good playing surface with the desired resiliency is also obtained. Contributions of organic matter are numerous including:

1. Added nutrient holding capacity
2. Added water holding capacity
3. Makes nutrients available
4. Favors natural chelation
5. Builds soil structure
6. Makes soils more resistant
7. Builds active micro-organism population

Organic matter is principally composed of -

Fractions	Their rate of decomposition
Carbohydrates	Fast
Crude proteins	↑
Hemi-celluloses	↑
Celluloses	↓
Lignin	Slow

Manures, hardwoods, and many moss peats are mostly composed of the more readily decomposable fractions, whereas the soft woods, some peats and fir barks are largely made up of the more slowly decomposable materials. Humus is defined as the more or less stable part of well-decomposed organic matter.

In California the peat, fir bark and wood wastes are used for their long-lasting physical effects in the soil. Since desirable peat mosses are difficult to obtain in our area, there is a gradual turning to the graded fir barks. A gradual shift away from wood wastes can be seen. This is because the wood wastes are by-products from lumber mills, and when placed under a microscope have a flat surface. Therefore, they can compact and layer easier. Fir barks on the other hand can better resist compaction. This is because they are by-products from shedding, and when placed under magnification their structure appears more as cylinders.

Digested sludges are added for their significant contributions to the chemical and biological properties of the soils. Manures may be used if good digested sludges are not available.

So far the western usage on several courses has been basically:

Tile drainage system
Under pea gravel blanket 4" deep
Under sand 2-6" variable
Under mix of 6 - 12" variable

Some used are

	%	%	%
Uniform medium or fine sands	60	60	70
Peat moss or birch bark or wood wastes	30	25	20
Digested sludge	10	15	10

A final point of consideration that must be stressed is uniform mixing. On-site mixing seldom provides uniform blending, so it usually pays rich dividends to obtain off-site mixing. The materials [illegible] cannot blend together well when in a dry condition so it is recommended that some moisture be added before mixing.

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TOPDRESSING AND CULTIVATING FINE TURF

Lee Record, Mid-Continent Agronomist, USGA Green Section
Chicago, Illinois

Topdressing during the 1920's and 1930's was the hard and fast rule of its day. The professional secrets of greenskeeping, as it was referred to during this era, centered around topdressing. In the '40's a general de-emphasis of topdressing with limited labor, budgets and availability of materials began a new and different era of turf management which remained through the early 1950's. But, during the late 50's and early 60's traffic and demands from memberships - to have outstanding playing conditions at all times - stress the importance of a sound topdressing program.

Topdressing intensively-managed turf areas (putting greens) is almost as essential as watering or mowing. Topdressing is two-fold in that it not only improves and adds to the enjoyment of golf by playing on a smooth, resilient putting surface - its true value is in respect to soil-plant relationships.

A complexity of life processes exist which are inter-dependent of each other for continued life or death. Photosynthesis is carried out by green leaves which are being walked on, sprayed and mowed. Plant responses are related to fungicides for disease control, herbicides for weed control, nematicides for nematode control, insecticides for insect control, fertilizers for growth and salt index accumulation, and a host of other chemicals. Decomposition of animal and plant tissue will be determined by mirco-biological population, which increase or decrease as cultural programs and weather change. These, along with other life processes, must be adequately maintained to insure healthy turfgrasses.

Topdressing contributes to these soil-plant relationships for optimum response as follows:

1. Added support of plant under compaction.
2. Buffering agents between plant and chemical being used.
3. Dilution of mat or thatch accumulation, improving passage of water, air, nutrients, etc.
4. Improves soil friability and porosity
5. Builds up the soil reserves.
6. Adds micro-organisms which can decompose thatch. It may also be rich in plant food with favorable acidity for thatch decomposition. An example:

if ground cyanamid is used as the soil sterilant, the amount of lime and nitrogen added is significant. One quarter yard of topdressing per 1,000 sq.ft. with cyanamid will yield approximately 1½ pound of nitrogen and 3 pounds of limestone.

Frequency and amount of topdressing material to be applied at a given time will depend upon time of season and type of turf. Penncross being more vigorous requires more topdressing than Seaside or velvet bentgrass. Early spring topdressing should not take place until natural heaving of the soil from frost action has taken place and settled. Spring and fall applications may be applied at heavier (1/3 cu.yd./1,000) and more frequent rates than what you would apply during summer months. Summer topdressing, if used intelligently, may help reduce-or recover-from damage.

A light, uniform thickness of topdressing if applied correctly filters down through the thatch providing more support for grass plants which will firm up the sod for resiliency with speedier, truer putting. As low spots or depressions are filled with soil mixtures, surface drainage is improved. When damage occurs topdressing every seven to ten days aids in healing turf. This is also true when a new green has been stolonized, and you are bringing it into play.

Thatch, which is controlled by the process of topdressing, must have an optimum soil, water-air relationship for healthy turf. Thatch is not controlled by topdressing alone. Aeration, vertical mowing, brushing, fertilization programs, liming, watering, etc., contribute within a sound balanced cultural program.

If the present soil in greens has been successful, continue to use the same or similar composition of material. Topdressing following aeration of the soil is one means of changing surface soil texture. (Complete reconstruction of a green may be the real need). Changing soil texture by this means is a slow process which will take several years to provide better growing conditions. If you find it necessary to alter the mix, a physical analysis should be made of those materials intended to be used.

Before topdressing can be applied to a green, it should be sterilized and composted. Several sterilization methods would be the use of Vapam, steam, methyl bromide, calcium cyanamid, etc. Topdressing should be composed for preferably a year before use, with a two year supply stored in a soil shed, kept dry to assure free-flow of material. Topdressing and cultivating fine turf requires advanced planning and organization. Begin or step up your topdressing program this season. Your success may well be the strength of your topdressing program.

(Editor's notes by W. H. Daniel

The above ideas embracing standard, repeated use of soil-peat-sand mixture are well stated. There are some possible uses of equipment and calcined aggregates, peat, sand - for special reasons - unusual conditions.

For example, a heavy clay soil - with "slick" ball marks - can be Greens-aired, then spread straight from bag calcined aggregates; then break up cores. Repeat as playing conditions permit until ball marks and playability are as desired.

For example, a new sandy, hard green - Greens-aire and spread mix of 50% peat and 50% coarse (No.4) vermiculite, break up cores and mat. Repeat as playing conditions permit. Thatch will soon do similar thing.

In other words, change the surface inch by repeated applications of needed ingredient when combined with vertical cultivation. However, rebuilding to get the desired base should be even better than just surface changes.)

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SOFTENING HARD SOIL AREAS

Robert Feindt, Supt. Otter Creek Golf Club,
Columbus, Indiana

When Otter Creek was built six years ago, there was the concern to retain a good architect and follow his recommendations. Also, it was of concern that the greens were built properly, and the United States Golf Association recommendations were followed. We know it was important that tees be graded so they would have surface drainage and made large enough to handle large crowds of golfers. Much though was given to the irrigation system, both in design and installation. It was made certain that when topsoil was removed from an area it was replaced. One phase that I now realize six years later that is very important - that no one was too concerned about during the time of initial construction - is soil types and drainage of fairways.

During the spring and summer our course is often closed because of wet conditions. Last July we had 9.2 inches of rainfall for the month, along with high temperatures and humidity. Our soil could not hold this much water nor could this much excess water drain from the fairways or rough areas fast enough. Unfortunately much turf was lost. I feel a major factor was the heavy soil and poor drainage. When wells were drilled logs indicate heavy soils to a depth of 70 feet before reaching any sand or gravel.

Climate

Rainfall ranges from 40 to 45 inches, with more than is needed in the spring. During July and August there is usually less than the average monthly precipitation, which combined with high temperatures and evaporation may result in a drouth condition. The golf course is swept by a prevailing southwest wind.

Otter Creek Golf Course has four soil types:

Eel silt loam	-	usually in low narrow swales poorly drained.
Fincastle silt loam	-	also called clay land - our principal soil
Genesee silt loam	-	found along the poorly drained flooded valleys of streams
Russell silt loam	-	on moderately sloping land and along streams

These soils vary in organic matter content - in reaction from very strongly acid to neutral, and in productivity from very low to very high. Some of these soils, because of their position make it almost impossible to obtain adequate fall for artificial drainage, and when wet all seem inadequately drained for that day's golf.

Attempts to Correct Hard Soil Problems

Where water seeps from hillsides during the wet spring months, drain tiles are installed and pea gravel is placed over the tile up to the surface; then sod is placed over the gravel. In many areas we installed vertical trenches.

On small areas we just dig these trenches 36" deep by 3" wide and have run them into the rough. In other areas these trenches were connected with tiles or run into a stream bank. We have tried the vertical trenches placed 12 feet apart as a means to keep heavy traveled approach areas to a green loose and pliable. So far most results have been encouraging.

Aerification of heavy soil areas, using the Ryan Monarch aerifier and the Rogers 580 Aerator -- during the spring (April, May and June) and again in the fall (Sept., October and November) we open these areas quite severely, but during the hot summer months we usually just spike.

Dethatching of fairways is practiced yearly. Of course, this does not open the heavy soil to any depth - it is mainly to prevent a buildup of thatch and reduce other problems.

Use of Soil Conditioners

In some small hard areas calcined clays at 1 lb./sq.ft. have been disked into the soil to a depth of 3 to 6 inches, just to determine results. Costs will be prohibitive in large areas.

Ground corncobs have been tried in a hard approach area to a green at the rate of 3,000 lbs. per 10,000 sq.ft. area. These were disked into a depth of 3 to 6 inches; then new sod placed over the area.

Wetting agents have been tried on some high knolls, but at present we are on no set program.

These are some of the methods we have tried to loosen hard soils. How successful they will be we should know this coming season.

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TURF - BASIC PRINCIPLES OF NUTRITION

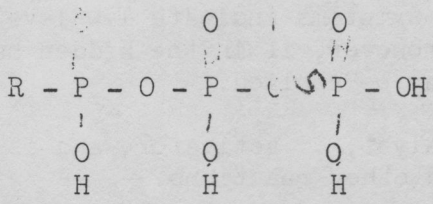
J. H. Jordan, Chief Agronomist
Borden Inc., Chemical Division, Smith-Douglass
Norfolk, Virginia

The nation's superintendents and professional turf managers have an increasingly important job in maintaining a durable turf. The influence of adequate recreation on mental health has been recognized for some time, and the need for recreation increases as our population grows and as our society becomes more complex.

In order to maintain greens, fairways, and turf in good condition, many essential elements are necessary. Water, CO_2, N, P, K, Ca, Mg, S, B, Cu, Fe, Mn, Mo, Zn, and even Cl are necessary in proper amounts and balance.

Nitrogen is essential, primarily from the standpoint of stimulation of vegetative growth and its association with chlorophyll production, protein levels, and water use efficiency. Grasses can absorb N in the nitrate and ammoniacal forms, and products formed from N are nucleic acids, amino acids, and many enzymes which contain protein.

Phosphorus has been called the workhorse in plant nutrition, since it is essential for cell division and growth, photosynthesis and most important, the energy transferred from two compounds. These two compounds are ATP (Adenosine Triphosphate) and ADP (Adenosine Diphosphate). ATP has three phosphate bonds, as shown in the following sketch. The phosphorus (P) comes from fertilizers added to the soil.



The third phosphate bond, P-O, represents a high-energy chemical bond. This bond holds energy and releases it wherever necessary, to drive lifegiving energy reactions within the plant. If it were not for P and this high-energy bond, all of the potential energy, when released from the breakdown of carbohydrates and other bonds, would be released immediately in the form of heat. The phosphate bond carries energy in small packets and transfers it to sites where needed.

A grass sod without this reaction can be compared to a car without someone to depress the accelerator and turn on the ignition. There would be no movement or no reaction to drive the wheels and start the car. In other words, P high-energy bonds supply the driving force of chemical reactions within the plant.

During photosynthesis the green portion of the plant absorbs light energy from the sun and transfers it to stored chemical energy (sugar) within the plant. Also at the site of the transfer of energy are the chloroplasts, where the two chemicals mentioned previously, ATP and ADP, are released as the sun's energy is transferred into stored carbohydrates. ATP is also produced from ADP during reactions between some organic compounds; Mg, K, and other elements are also necessary to drive, or catalyze, some of these reactions.

It can readily be seen then, if P is lacking or in low supply, slow growth occurs, turf will be less vigorous and less resistant to diseases and traffic. Visible evidence of a poor growth of turf can be seen where P is omitted. However, some greens are so high in P following the continuous application over the years that if soil pH is high then Zn tieup and deficiency may well occur. Also, in some locations, Poa annua is associated with high soil phosphorus.

Potassium influences over 41 enzymes in plants and animals, and this element has been called a chemical policeman and regulator, and activates or starts many reactions within the plant cell. The reactions, which K either influences or controls in the plant, are numerous. Among the reactions are some in which P is also active, such as carbohydrate use, plant protein synthesis, chloroplast pigment content and many others, i.e., photosynthesis, translocation of sugar and starch within the plant, drouth resistance, regulation of respiration, prevention of energy loss, increase of root growth reserves, and retardation of diseases and winter-hardiness.

In summary, K is a chemical regulator and is free to move within the plant. Nitrogen is the building block of protein and as such is incorporated into plant tissue. Phosphorus has an important role, and one of the most significant is the conservation and transfer of energy.

Magnesium, Ca, and S are also used by grasses. Magnesium is the only metallic ion in chlorophyll. It is also necessary in many reactions occurring within the plant. Calcium has a direct influence on the makeup of the cell walls which govern the intake of nutrients and the availability of all other nutrients. Sulphur is a constituent of the plant tissue and is contained in many essential amino acids and proteins.

The micro-nutrients, B, Cu, Fe, Mn, Zn, and Cl are also needed in small amounts. They serve as "spark plugs" and activators in many plant processes.

Whenever micro-nutrient deficiency symptoms indicate low levels of any nutrient, we add the element in large amounts, however, if in the hidden hunger zone, smaller amounts of the deficient element may be applied.

Manganese is used as a catalyst, or activator, and is also necessary in chlorophyll formation, photosynthesis and other reactions.

Boron aids in sugar translocation and helps maintain correct water relationships within the plant, and is involved in other plant biochemical reactions.

Molybdenum is the only micro-nutrient which becomes more available if soil pH is raised. Molybdenum is necessary for NO_3-N use within the plant. Without Mo, nitrate N taken up would not be acceptable by plant tissue. Molybdenum also seems to assist in disease resistance of the plant, and is necessary in N fixation.

Iron is also necessary in chlorophyll formation, and is a constituent of some plant enzymes. Iron is also used as a catalyst, along with Mo, in the reduction of nitrate for incorporation into plant tissue.

Zinc is a necessary part of several enzyme systems. It is essential for auxin formation. Auxins are necessary for enlargement (growth) of plant cells.

Copper helps regulat the functions of several plant nutrients, and also may be active in the intake of other nutrients. It is also necessary for catalyzing reactions within the plant.

A proper balance of all these elements is necessary for proper plant growth and function. Proper balance of cations in the soil can, to a degree, control uptake of the various ions or elements, such as Ca, Mg, and K. It has been shown that a plant will take up only a certain quantity of nutrient elements. If the content of one nutrient in the soil is too high (out of balance) the plant will absorb more of this element than needed, and too little of other elements. This is the reason that balanced fertilization is so important, especially on greens where control of growing conditions and plant nutrition is maintained.

The availability of plant nutrients is influenced by the amount and balance of other elements in the soil. However, physical and chemical conditions in soil environment also affect nutrient uptake. Some factors which influence nutrient availability are:

1. Soil aeration
2. Soil compaction
3. Soil moisture
4. Soil temperature
5. Soil pH, and
6. Balance of other nutrients (as previously mentioned).

Since nutrients are taken up through the plant roots, anything that restricts root growth or activity will reduce nutrient uptake. Disease damage, root pruning, soil compaction, insect damage, low soil temperature and low oxygen supply, often induced by poor drainage, cause nutrient imbalance or deficiencies.

In studying the principles of plant nutrition, one important point which is occasionally overlooked is the efficiency (percent recovery) obtained from the addition of N-P-K fertilizer. For example, during the first year, only about 30 to 70% of N, 5 to 30% P, and 30 to 70% K applied will become available. Even smaller amounts of micro-nutrients applied, from .01 to 0.5%, will become available the first year. This inefficiency is caused by several factors:

1. Leaching
2. Fixation within the clay lattice
3. Precipitation with other elements
4. Use by micro-organisms

There are three ways in which plants take up nutrients:

1. Roots intercept (grow towards) nutrients throughout the soil
2. Water soluble nutrients are brought to root surfaces by capillary action and upward water movement
3. By diffusion

Diffusion is the movement of nutrients, such as P and K, from an area of high concentration to an area of low concentration. The principle of diffusion could be demonstrated by filling a balloon with smoke and permitting the smoke to escape and fill a large room. After a period of time the smoke particles will have diffused throughout the air in the room. Nutrients which move only slowly and diffusion are P and K. For this reason, P and K have to be placed deeply (in the rootzone). N and other soluble nutrients can be topdressed.

Roots may also attract nutrient ions to their surface by exchanging some of the H+ and other cations on their root surfaces for nutrients on the surface of clay particles. This mechanism is called ion exchange, or contact exchange.

In turf nutrition programs, soil testing should be used, but as a guide only. The experience of the manager and history of the area should always modify and complement soil test data. Plant analysis should accompany any complete soil testing program in order to obtain information on actual uptake of fertilizer nutrients. Soil testing and plant analysis go hand-in-hand.

When basic principles of nutrition are followed and the experience of the professional turf manager is coupled with experimental data and scientific information, a strong, healthy turf can be maintained.

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GARDENING - 600 B.C. to COUNTRY CLUB ROAD

Warren Bidwell, Supt., Philadelphia Country Club,
Gladwynne, Pennsylvania

Psychologists tell us that man has, from the very beginning of time, given his best performance when adequately motivated; that his greatest motivation has been directed towards staying alive, as a matter of necessity, finds acceptance in our time. Originally, everyone was a gatherer or hunter of food, both meat and vegetable. This was a total effort that involved every member of the tribe or family, and often the entire community.

Ornamental gardening, as a motivation of desire, is rarely mentioned in ancient writings until about the time of the Pharaohs. As man became more intelligent, and his belief in his various gods more pronounced in his dealings with his fellowman, so did his power as absolute ruler, in many instances, to the extent that the head of a tribe became prince or king. This gave him devine right to enslave others to do his every bidding. This directive power was used in the crea-

tion of the beautiful so that he might enjoy and impress upon those who passed his way of his total enjoyment of life.

World scientists provide us with tangible evidence that there was the age of the dinosauers; that the land lifted and eroded into great oceans. As the land dried and vegetation appeared, man made his entrance. Since man was the defender from wild animals and his own species, the little woman is credited for deliberately planting the first food grains, berries and roots to avoid the daily search out in the wilds for food for the family.

Since the dawn of civilization, when God expelled Adam and Eve from the most famous of all gardens, man has multiplied his kind and wandered over the face of the earth. Always in search of a better life, peace on earth, and one God for his religious belief, he has met with a multitude of frustrations.

Unfortunately, his desire for peace has been found only during brief periods of history. His way of life is still in the so-called progressive stage, and his religious beliefs are, even today, being revised by clergy and laymen alike in an attempt to provide a more modern concept to his thinking of dissent and social revolution in our age.

Gardening, as you and I have come to accept it, has come down this same path called progress. It is exemplified in the life we know today at the country club, the view from the terrace of a fashionable estate, or the small flower box outside a window down in South Philadelphia. All of these humble beginnings had origin back in the days of the Persians, Greeks or Babylonians. As his civilization rose from the dust of the plains and tribal living, so has man's dependency upon plant life increased. His spiritual values have been enhanced, for in the flowering of this multitude of plant life, man has found a perpetual and living expression of that mystery of all mysteries - the eternal.

Song of Solomen:

"For lo, the winter is past,
The rain is over and gone.
Flowers appear on the earth,
The time of singing is come,
And the voice of the turtledove
Is heard in our land."

Long before Jesus reminded his questioning disciples that the lillies of the field neither sowed nor reaped the harvest; yet, King Solomon in all his glory was not arrayed like one of these. Man has tilled the soil to provide food, and has raised beauteous things for his pleasure.

Thus, gardening has become one of the most ancient and honorable of all professions, for it was in the Garden of Josephus that Mary mistook Jesus for the gardener, not knowing that He had risen, that man might live to enjoy many another garden over the face of the earth.

And, Emma Lazarus' writings on the Statue of Liberty stir me with these words -

"Give me your tired, your poor
The huddled masses yearning to breathe free
Send these, the homeless, tempest tossed to me,
I life my lamp beside the golden door."

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THE GOLF COURSE LANDSCAPE

Warren Bidwell

Allow me the privilege of delving into the abstract for a moment - a brief look back - into history - and a visit into the so-called Outer Limits, there to ponder a question with you based on the imagination.

The rise and fall of each civilization is a matter of record by one nature or another. Man has recorded the events of his life on stone or the printed page for some five thousands of years - a mere drop of water in the great ocean of time. Much earlier evidence of man's progress toward becoming civilized has been sifted from the ruins of the past.

With each civilization man has devised many means of recreation or amusement for himself and those about him. Some, as in the days of the Egyptians and Greeks, were hard and downright cruel, wherein man was pitted against the wild beast in the public arena. Others, as in the days of the Romans, were a combination of cruelty and what might be called sportsmanship.

In our civilization there are more particpating sports that combine sportsmanship and recreation for the individual with little or no deliberate cruelty involved. It is generally accepted and my own personal belief that the game of golf has a special place in our society - a society that is gradually turning from the agrarian pursuits to a dominantly urban life wherein man works at a feverish pitch for periods of time. Here he is surrounded by noises, thoughts and counter-thoughts of his fellowman in which tensions can build up to a point where relief is desirable or even necessary if he is to continue at his accelerated search for better and faster ways of betterment for his community of man. The game of golf offers the individual the opportunity to participate with the challenge of self-control, turning tensions into pleasure, thereby using the game as his own personal relief valve.

Man's progress has been a combination of the backward glance, whereby the profits from the mistakes of the past and of his ability to look forward, wherein he uses his imagination and projects his thoughts into the future. Thus, has it been with the game of golf from the time of the hardy Scots to our own modern golf course landscape where you and I have seen great technical advances during the last forty years.

In America, the ruins of these three Indian civilizations in the four corners region of our southwest, described by present day Hopi and Navajo tribes as having been the ancient ones dating back only 1400 years, left the European white man, who pushed westward a little over a hundred years ago, no written records of their having been there, their habits or games. However, when the archaeologist excavated the regions they found one thing to have been common - the circular pit, known today as the Kiva. Some students believe this feature of their civilization to have been used for ceremonial purposes; others that perhaps it may have been used for inter-tribal games; the reasoning behind this thought being based on the finding of crude rubber balls within the circles.

Projecting our thinking into the so-called Outer Limites for a moment, what will we, the descendants of the European white man, leave as evidence of our game called golf? Perhaps in another 1400 years or so, will some light beam controlled machine excavate a former golf course reservoir, exposing Wilson or Spaulding golf balls? Or, will the set of Hogan irons that were noted being dumped into the reservoir on the Muny Course in Cincinnati eighteen years ago be brought to the surface,

there to be examined with as much curiosity and leaving unanswered the many questions as did the crude rubber balls.

Today we are concerned with the golf course landscape that provides recreation for the city businessman who seeks diversion from his five day week, and at the same time keeps him in touch socially with his community. That it takes you and me seven days of our efforts to provide him this specialized piece of real estate for his pleasure is of little or no concern to him. In passing, I might add that some of the younger generation of superintendents coming up the ladder are beginning to question the wisdom of this long work week. From those of us who have sparse hair that has turned from dark to ten shades lighter over the years without the use of detergents - we can only say show us.

Aside from a few basic standards, the approach to maintaining the golf course landscape is as varied as the men who practice the profession of golf course supervision. This is recognizable since the climatic and geographic locale dictates, to a certain degree, the different approaches or proceedures involved. Likewise, the basic education or practical experience of the individual superintendent, his native horse-sense to do a golf course job well, and his degree of interest in his job and personal betterment are all a part of the overall picture in making a success or failure of his responsibilities. This degree of interest, the management of funds allocated, the supervision of labor and his ability to use to full advantage the tools of the trade, including chemicals as well as machinery, are usually reflected out on the course.

We expect to hear comments from our own members on course conditions. Naturally, we much prefer to hear, "Gee, you sure have things in great shape" rather than, "I see you didn't get the traps fixed from last Sunday's downpour yet, how come?" While some clubs are more tolerant of a labor shortage, bad breaks, mismanagement or outright sloppiness on the part of their superintendent than others, all seem to have their limitations. This statement is borne out of the occasion wherein nine jobs were placed on the wanted list in a large metropolitan area last year between June 1 and December 1. Some of the occasions were done under the table, but others were quite open about their procedures of securing a superintendent whom they felt could do a better or a more efficient job. And, as might be expected, there were cases where the chap on the job didn't know what was underway until he was notified that his services were not needed in the future.

"How," you may ask "does this fit into the discussion at hand?" As a golf course superintendent, I believe we should practice the principle that we are responsible for the BROAD SPECTRUM MANAGEMENT of everything outside the clubhouse door; that we are the guiding hand that keeps the golfers active; that it is our sole responsibility to provide the membership with a golf course landscape from which they can take pride and certain pleasure, one that is a credit to the community in which it is located.

Before viewing some of the golf landscape scenes and their particular application for a specific area, let us think for a moment of some of the diverse and interesting people who frequent these specialized areas called golf courses. Those who make a study of the outdoor recreation industry forecast a tremendous expansion for the game. All indications are that course building will continue at an accelerated rate and that by 1970 there will be 11,000 courses to accommodate the twelve million players anticipated. While the headline players will continue to make the big money from the game and occupy the limelight, it is the cross-section of our society that will sustain the game, and many will inspire others to participate and enjoy the fruits of being outdoors and keeping in touch with Nature.

Since golf is people and for each and every round played an individual is represented, let us take a look at this cross-section. Some have done great things for golf, while others have done great things for their fellowman, while still others are lovers of the game as such. Eisenhower, a man of much fame and great respect, after repeated surgery walked out of Walter Reed Hospital with a promise that he expects to be back at his golf game. He has done much to encourage others to continue, or to take up the game in the late years of their life.

Once I had a Christmas card from Burt Musser, after his heart attack, with a note attached saying that he will be back enjoying the game again. It is good that a man who has contributed so much to the improvement of golfing turf will be out walking on the course again. My good friend and past president of the GCSAA, Roy Nelson, while in the hospital recently, hastened to assure me that golf will ontinue to be a part of his way of life, and eventually his doctor wishes him to walk about five miles a day. This prompted an immediate thought on my part - Why so many golf carts on the American golfing scene?

A year ago this month we paid our final respects to a short, almost rotund man of world renown - a man whose two stubby fingers held high in the form of a V for victory, gave the people of his island and of the world courage during the trying days of World War II; a man whose passing was reason enough for personal pilgrimages of kings and ambassadors. Yes, Sir Winston Churchill and his darling Clemintine were frequent players in his earlier days on the links of England and on the Scottish clubs along the North Sea.

In this final analysis of the people who form a cross-section of the participants in the game of golf, I was intrigued recently on hearing a doctor of the ministry say, "Where else in life can a man get eighteen fresh starts in a single afternoon?" I think it fair to assume that those who play the gave have more reason than just the physical exercise to be had. The way golfers are taking to carts we must believe there are other,perhaps more compelling reasons; that there is an aesthetic force that beckons them to come close to Nature wherein lies some unlabeled factor that is good for the soul and worldly tensions that seemed mountains a few hours ago suddenly become the smallest of ant hills. Thus, my superintendent friends, I believe that your job and mine in dealing with the golf course landscape is more than growing a few acres of grass, or maybe a few flowers.

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MAN AND HIS GOLF - A NEED FULFILLED

Warren Bidwell

As far back into history as we can research, man has always used games to develop his physical and mental skills, skills that have assisted him in adjusting to his ever-changing environment. In a broad sense, we of today call this recreation - that intangible - somewhat likened to a bank account from which we make an occasional withdrawal for the renewal of our own inner resources, forever making sure of our personal reserve from which we draw our strength. On most occasions the games man has elected to play have been performed in the spirit of competition - a rather true form of recreation. At other times these games have been in preparation for combat, as in the days of old, while still others have served as a source of diversion - an escape from the ordinary - a change from the everyday events of one's life.

One hundred million Americans use some form of outdoor recreation. The fact that the game of golf has a following of eleven million participants on nearly 10,000 courses in all of our fifty states, that the international scope of the game is indicated by the exposure now being experienced on all continents of the globe does not surprise us. The vital statistics of golf are indeed impressive, and quite sufficient to establish factual, economic soundness that reach far beyond the luxury image, which once held forth in the late 20's - when I entered the caddy ranks in Cincinnati while golf was in its infancy.

Since 85% of all golfers use municipal or other public courses as their "home" club, this provides the clue that golf is available to everyone for the purpose of personal recreation, skill development and fellowship. In reality then, golf as a game is a need fulfilled for man in the pressure environment he has created for himself in our time -- a time when, in the future, the proper planning for the use of leisure will be of equal importance to the planning for education and productive work.

To justify this statement I need your indulgence while you allow me the privilege of delving into the past for a moment; a return for a brief look at history; a bit of evolution that began with pagan man himself - there to observe the needs of man as he adjusts to his particular environment, and perhaps draw the conclusion that, indeed, golf has become a need fulfilled. The rise and fall in the span of man's history is a matter of record by one means or another. He has recorded the events of his life on stone or the printed page for some five thousands of years. Much more evidence of his progress toward becoming civilized has been sifted from the ruins of the past.

Private clubs are nothing new. With each civilization man has devised many means of recreation for himself and those associated with him. The Assyrians and Persians formed their own exclusive hunting clubs for the princes and military in the eighth century B.C. When game on these private preserves became scarce they simply moved farther away from their towns and turned the former locations over to their slaves and peasants who used them as a public park.

Horoditus, the Greek historian, set the date of the first Olympic Games as beginning in the year 776 B.C. Such were the entry requirements that he had to prove his own Greek birthright before he could participate in the foot races. King Xerxes of Persia, who was about to go to war with Greece, was much impressed with Greek sportsmanship when he learned that the first prize for any of the many games being played was only an olive wreath. His captains had little respect for these boys' games upon learning that there was no money at stake. (Indeed, these captains of Xerxes would be most pleased with our Westchester Open where the total offering is a cool quarter of a million, wouldn't they?)

The games people played in the days of the ancients were not always within the realm of our idea of sportsmanship or recreation. Some, as in the days of the Egyptians and Roams, were a combination of cruelty and murder. When the Roman Coliseum was inaugerated in the first century A.D. lasting for 108 days, over 5,000 wild beasts were killed to amuse the guests. Before the end of the second century the first Roman citizens to embrace the christian faith were murdered in this same arena as a public event and often to the amusement of the non-believer pagans.

After the fall of the Roman Empire and the end of the dark ages, man set out once again on the road called progress towards an even higher goal we experience today as civilization - a civilization where atom bombs and golf are seemingly quite compatible - where, on the one hand, one is quite capable of shattering all hope for mankind - on the other hand, the other, as a form of recreation,

is an instrument wherein man can be helped to continue as his own successor and survive his greatest scientific discovery. With the limited stability man now was experiencing in Europe at the close of the dark ages, he began to have leisure time at his disposal. It was during this period that a game was accidentally born on the sand dune, Seaside Country Club of Scotland.

Golf, as we know it today, eventually evolved from a game of crooked sticks and a "ball" of bound feathers to have a purpose and objectiveness, and be played as "regulation." This game became so popular with the hardy Scots that the Scottish Parliament decreed its banishment thirty-five years before Columbus discovered our America, on the grounds that far too many of the archers were devoting so much time to the improvement of this new fancy that their archery practice was being neglected. Since archery was their chief defense weapon, their duty to the Crown was being sorely neglected. Needless to say, the game survived and King James VI became such an addict that he decreed that golf could be played on the Sabbath. Thus, a new religion was formed with par and strokes being a new sort of worship - where the money changers wait at ever tee and the collection is made after the eighteenth hole is completed.

Golf was introduced to America by a man of Scottish descent, a Mr. James Ried, in March of 1888 at Yonkers, N. Y. The most influential man in golfing circles in those early days was another Scotchman, Mr. Charles MacDonald. While being educated in Scotland he played the game on the St. Andrews links and carried his enthusiasm for golf back to Chicago where he designed the first 18-hole course in America, the Chicago Golf Club.

American golf took its first giant step forward in the person of Francis Ouimet, a caddy from the Country Club of Brookline, Mass., when he beat the famous British pro in the 1913 Open. He was the first golfer in America to make national headlines. This popular surge of interest in golf was repeated during the depression days of the 30's when Bobby Jones made his Grand Slam Tour of American and British golf playing as an amateur.

But really, golf in America could not completely fulfill the need as a recreation medium for men of all walks of life until after World War II, when the worth and consideration of the working man was fully recognized by providing him with leisure and an escalating income. Now he belonged to the total society of mankind. This combination gave him every opportunity to seek regular outdoor recreation of his economic choosing with the assurance that the time was his to allocate to his best interests. At this point T.V. became the greatest medium any sport has ever experienced in the acceleration of its importance as a way of life. To adopt a popular phrase - from this point on, "anyone could play," the boom in golf we are experiencing today was launched.

Golf will never appeal to everyone. We, who are closely related to the business, should not expect this. There are those who have a warm interest but remain on the sidelines with the inevitable question. Why golf? Golf is hardly a religion, although some use it as such. It might be looked upon as a doctor of the ministry once did when he quipped, "Where else in life can a man get eighteen fresh starts in a single afternoon?"

Psychologists take a bit different view from that of the minister. Man, as a being, was a hunter first and a tiller of the soil for eons of time before he became a city-dweller with non-agrarian occupations. Even in our day of depleted forests and diminishing game supplies, seventeen million Americans pay a round figure of $ 5 for a hunting license that is good for about a week so that their heritage of long ago can be satisfied. This is but one of man's inherent characteristics that

prompts him to continue his interest in the out-of-doors.

It is generally accepted, and happens to be my own personal belief, that the game of golf has a special place in our society - a society that is rapidly turning from the Agrarian pursuits of our forefathers to a domiantly urban life wherein man works at a feverish pitch. Here he is surrounded by noises, air pollution and traffic jams. These are but a few of the frustrations that contribute to his tensions. Each year he tries to out-perform his accomplishments of the previous year by producing more consumer goods, at a lower cost, with less time and manpower.

Add to this the competition that may possibly produce a similar or better product at even lower cost and you come to realize that man is forever in competition with himself. This is the technological corner that man is painting himself into. Ironically encugh is the sign that is posted way back in the depths of this corner that reads in small but clear print, "Hurry up and wait." Hurry up and get the job done, then wait until the nerves calm down; then give it another try, only this time do a better job.

This accelerated, merry-go-round world of"Hurry up and wait"is being brought into focus for many thousands of business and working men and women who use the game of golf as an intermediary to keep them in touch with Nature while enjoying their sport. In this world of community effort to exert pressure for desired objectives it was interesting to learn recently that the public golfers of Cleveland have organized to present their wishes to any and all who deal with public golf facilities.

I like to believe there is that certain necessary aesthetic value to be found on every golf course that has an interest for all far beyond the par value of a hole, the hazards that must be overcome or the species of grass being crown. Man, as a being and as a species, needs constant reminding that there are far more important things in life than the gross national product, the latest Parisian styles for the jet-set, or who is going to succeed Joe as shop steward at the plant when he retires next fall.

I was especially interested in the carefully chosen words of the minister who delivered the funeral eulogy of the late Marshall Farnham, a past president of GCSA. He acknowledged that Marshall understood the resurrection of life because, as a golf course superintendent at Philadelphia Country Club he experienced it every spring with the greening of the grass, the flowering of our dogwood, and the leafing of the trees. This, he said, was a reminder of life eternal. Thus, with golf acknowledged as a true instrument of man in our society and its role in Nature, do I believe the game is, indeed, a need fulfilled.

As a supervisor of this estate called a golf course, you and I serve a kind of stewardship in providing this particular need fulfilled for our fellowman. In so doing we must overcome our own frustrations when man and Nature are seemingly against us at times. Should the occasion arise when you feel that you have lost your perspective, renew your own strength, that inner-self, and reflect on the part you play in this need fulfilled, and walk in dignity as you remember Him who said - "Let the earth be covered with grass."

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THE PROFESSIONAL APPROACH

Howard R. Taylor, Jr., Taylor & Associates,
Cleveland, Ohio

Let's profile the present day golfer in the United States.

Golfer No. 1. He is a bailer in a steel mill in Warren, Ohio, making $ 11,000 a year plus bonus. He works the night shift; he is 55 years old, a bachelor, playing to a 6 handicap. He plays a minimum of 4 times a week, has participated in five public links' tournaments, including the State Championship. His "home course" is 36-hole public complex owned and operated by the Chamber of Commerce. Green fees for 18 holes are $ 4.00, with season pass of $ 125.00 if purchased before January 15. Right now profile No. 1 is in Pinehurst, staying at the Holly Inn and playing 36 holes a day on the famous No. 2. His golfing partners at this golfing mecca are 19 other golf nuts from Warren, half of whom belong to the city's only private club. He is playing Pinehurst with a new set of aluminum clubs purchased for $ 375.00 from his home pro in Warren.

Golfer No. 2 is a dock supervisor for a Pacific Northwest trucking company in Tacoma, Washington. Like the steel worker from Warren, he has a high school education, his salary $ 18,000 a year. He is 48 years old, married,with four children. He belongs to a private country club with annual dues of $ 400.00. He has a 12 handicap, plays four 18-hole rounds a week. His irons and woods are from Sears, Roebuck, and his Atlantic golf bag was purchased at the neighborhood discount house. He pulls his own cart. His wife doesn't play, but his kids are just taking up the game in the club's junior program. Because of the moderate climate and recreational facilities in the Pacific Northwest, his family sports include: skiing (both water and snow), fishing, boating and tennis, and he is beginning to devote more and more time to these other sports.

Golfer No. 3. He is a black doctor from Chicago with a practice which produces a personal income of over $ 150,000 a year. He is looking forward to his second season of golf, having started last June. He has never played the game before, but felt he should take up the game to improve his social image, not so much to others but to himself. Wanting to avoid any problems ir embarrassment by trying to play at a private or semi-private course in the immediate Chicago area, he went to a new public, but expensive resort about 60 miles north of Chicago. After a $600 outfitting by the resort pro, he signed up for a series of lessons and started to work himself down to a 25 handicap. On his fourth trip to the resort, he was accompanied by his wife who, after a $600 outfitting, went out to play her first round which ended abruptly at the seventh hole when the doctor and his wife drove their golf cart into a lake in front of the green. Her $600 outfit is still in a closet at their Highland Park home. However, the doctor continued to play every week with a foursome of professional friends from Chicago, and next week will be leaving for a golf junket to Florida where he hopes to get his handicap down to 22 before the season opens in the north.

Profile No. 4 is really a twosome, a husband and wife, who represent the traditional golfers of the U.S., but who, perhaps, are now in the minority as far as numbers are concerned - the country club husband and wife. The husband, with an annual salary in excess of $ 50,000, plays every Saturday with his foursome, every Wednesday afternoon with customers, and Sunday with his wife and another couple. His wife plays every Tuesday - Ladies day, again on Wednesday, Thursday and Friday with the gals, and on Sunday with her husband. They take a golfing vacation every spring or fall, playing every day for 10 days at the finest golf resorts whether it

be in the Carolinas, California, the Carribean, or now Spain. At this moment they are looking forward to this spring's trip to include a two-day stop at Pinehurst to play the same No. 2 where this week the steel bailer from Warren is playing.

Our four golfers have two things in common: first, they are a statistic; and second, and most important, they are people. They are a statistic 1, 2, 3 and 4 of the ten million who pay 15 or more rounds a year on over 9,000 golf courses. They are a statistic that the golf equipment manufacturers total up in their annual sales reports of golf equipment. But, they are people when sharing the apprehension about whether to buy steel or aluminum, or wait for titanium; and they're people when eager to buy a ball with the advertising claim that it won't cut, lose its shape, and last a full season of play. They are people desirous of facing the challenges of exctic golf courses designed by the most publicized golf architects, courses noted for the most treacherous hazards and impossible shots. They are people, not statistics, when they spend up to five hours on a course, engaged in mental torture, trying to emulate the pros they see on television. And, they are people, when following their round, they rush through a quick beer or gin and tonic while settling their dollar Nassau bets before rushing home for a tardy family picnic, or gulping down a chicken sandwich and a glass of iced tea to make the garden club tour at 1:00.

Golfers are people, people who many of us - whether we are golf course superintendents, club managers, golf course owners, or country club trustees, have filed as statistics. And, if golf as a business is to continue to reap the rewards, financial and otherwise, we have to look at golfers - those males and females of all ages whose deovtion to hitting, chasing after and finding that little white ball is now a billion dollar business - we have to look at golfers through People Glasses.

There has been too much emphasis on golfers as statistics. I know it's important that at the end of the season you can sit down and add up that your golf course played 18,950 rounds in 1969 up from 17,722 rounds in 1968. But what really is most important is - why did these rounds increase or maybe even decrease? If we look at these golfers as people, perhaps we can learn why they came to your course, or even stay away. They come to your course, whether it's a private club, a semi-private club, or a public layout to have fun - to enjoy themselves. What are you going to do to enhance their fun?

First of all we have to know what the golfer wants. Here's a good check list to start with:

1. Convenient parking, close as possible to the pro shop and the first tee.
2. A practice area for all clubs from the drive to the wedge, plus a practice putting green.
3. Conveniently located toilet facilities, adjacent to the first tee, if possible, if it's a long way from the locker room.
4. If a public or semi-public course, he wants a golf club or country club atmosphere in the bar and food service areas, with food and drink at popular prices.
5. The golfer of today wants good turf, and expects it. If due to weather or other conditions the turf is in a deteriorated state at the moment, our golfer deserves and will appreciate an explanation why!
6. Because of the great competition for man's free time, and we don't have much, the golfer wants to play faster despite the fact that he will continue to take precious seconds and even minutes lining up and hanging over a 3 ft. putt.
7. He wants a clean, well-manicured course - housekeeping par-excellence. If this is what he sees at the first tee he will do his part in maintaining that apperance. If not, he will contribute his litter to the unsightliness of the course.

8. He wants his hazards clearly defined, and the hazards within the confines of the hole cleaned so he can find that precious, premium, no-cut ball.

For all of this, and more, he is willing to contribute to a more profitable operation of a golf course in the form of higher daily greens fees or monthly dues, and an increase in the price of his post-round drink and sandwich - if you can contribute improved professional management.

The agenda for this year's Midwest Turf Conference covers a multitude of subjects that will enable you as managers to make management decisions leading to developing a better product, to satisfy the demands of your customers or members. How profitable this product will become is up to each of you as managers. And, I cannot stress enough how vital management is. And, it is in the field of MANAGEMENT that I believe golf course owners, operators, trustees, clubhouse managers, greens superintendents and golf pros must advance their thinking.

The operation of a golf course complex involves three professiona; areas - turf, pro shop and clubhouse. These three professional areas must each contribute to a successful and profitable operation. Each of these professional areas has the same two basic problems to challenge management:

1. Rising personnel costs, coupled with a shortage of trained manpower
2. Evaluating and applying new techniques and ways of doing things

Available to each of these professional areas - turf, pro shop and clubhouse - are outside professional agencies, ready and willing to help you as managers to make professional decisions which, with your professional management, can only result in a professionally-run operation - and only a professionally-run golf course complex can be a profitable one.

Those of you who are affiliated with a proprietary operation, whether a public, semi-private or private golf complex - a complex owned and operated for profit by an individual or a group of individuals, are in the most enviable position. 100% profit-motivated companies and syndicates involved in golf course complexes respect and demand professional management. Those of you who are managers within a membership-owned golf complex, generally the private club, have a greater challenge in exercising your management function because you are face-to-face with a membership and its Board of Trustees who, though professionals in their own business area, repeatedly - though with good intent - apply amateurism to decisions which require professionalism. The United States Golf Association in its manual says if private clubs' trustees ran their business the way they run their club, many of their businesses would surely fail.

We all have seen so many instances in the operation of golf course complexes where the amateur approach to situations demanding a professional decision has led to a sub-standard result -

. . . the new green "designed" by the club champion rather than a qualfied golf course architect.

. . . the new mixed grill "designed" by the president of the Board of Trustees, a successful electronics parts manufacturer, rather than the club manager in consultation with an experienced clubhouse or restaurant architect.

. . . a turf renovation program dictacted by the Greens Chairman, a prominent auto dealer, rather than by the greens superintendent in consultation with the state's turf agronomist.

. . . the new pro shop "designed" by the club's golf committee in consultation with the architect who just designed the committee chairman's house, rather than by the golf pro in consultation with an experienced golf clubhouse architect.

It is the obligation of the various professional agencies and associations in golf to assist you in being recognized for your professional management in each of your respective areas. The Greens Superintendents of America, the PGA, the Club Managers Association, the American Society of Golf Course Architects, the USGA, the many state and regional turf associations all must take up the banner - THE PROFESSIONAL APPROACH IS THE ONLY APPROACH.

Last fall the Cleveland District Golf Association sponsored a Professional Approach conference on turf for officers, trustees and greens committee members of its 43 member clubs, featuring leading turf authorities. Gratifying results are already beginning to show. And for next fall, the Cleveland District is planning a Professional Approach conference on clubhouse operations.

This is our challenge - and if the record attendance here this week is any indication, the PROFESSIONAL APPROACH to the many problems in the operation of golf course complexes - private, public or semi-private - is being recognized as the only way of doing business.

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THE PUBLIC FEE GOLFER

Harold W. Glissmann, Harold Glissmann, Inc.,
Omaha, Nebraska

"Effective Techniques" Characterizing the Public Fee Golfer is the way this talk should be titled due to the Conference theme. I assure you there are many effective techniques. I have looked at and served the Public Fee Golfer since 1925, when my family took our modern dairy farm and built an 18-hole public golf course on it, cost of approximately $ 10,000 and a lot of hard work, using our dairy barn for the so-called Club House, building the course with teams and slip scrappers, used pipe for water system, no peat moss or sand for the greens or tees, and wild ducks to puddle the lake to keep it from leaking.

Par, according to today's standards, would have been about 68. However, I believe the scorecard read 70 or 71. Green fees for week days were 50¢ for all day, and 75¢ Saturday, Sunday and holidays. Total club sales during a season would amount to several hundred dollars, not including the trades. My father was an old horse trader, and that's the truth. He would really deal with those city slickers, grown men in knee pants and nothing to do but chase a little ball around a patch of green grass. He enjoyed this business very much and before long we had two 18-hole courses and three 9-hole courses under our management. Green fees have advanced from 25¢ to $ 2.25 for 9 holes, and no discount for additional rounds, to investing a quarter of a million dollars in a fine 18-hole course, land cost not included, and $ 6.00 fee for 18 holes. So, I am sure I can characterize the Public Fee Golfer for you - that is since 1925.

Golf was once a simple pleasure. A fellow with a couple of hours to kill could take a canvas bag with five or six sticks out to the public links and have a fairly pleasant time whacking the ball around. Then the game fell into the clutches of the Organization Man with matched sets of clubs, electric carts, mustard slacks and dozens of other silly accoutrements. In logistics and equipment, playing golf today is roughly comparable to mounting a polar expedition, and the courses are overrun with fuss-budgets.

I am sure that most of you have a different idea of him, the fee golfer, than I do, or did have when I started in the business. The 1925 public golfer was glad to just to be able to pay and did not care too much what he played with, or on what size course, or how it was maintained - just so he could find his golf ball and enjoy himself.

Soft goods sales were practically nil. About all that was sold were balls, tees, after we quit using sand for tees, and a few clubs, and they were mostly used-clubs bought from the country club Pro. Such is not the case today. If a goodly portion of your net profit does not come via the clubhouse, snack bar or starting pavilion, someone is missing the boat.

The 1969 Public Fee Golfer is a new breed and he will become more so as time goes by and leisure becomes more a part of life. Leisure is what we should dwell upon for a few minutes.

Leisure, as defined by Webster's New Dictionary, is free, unoccupied time during which a person may indulge in rest, recreation, etc. The public fee golfer is a part of the leisure market. Leisure in America as observed by Max Kaplan is a leisure in which all men find their wants met.

According to a study by National Industrial Conference Board, 67% of a surveyed group gave their workers a maximum of four weeks vacation in 1965; 31% gave employees eight part holidays. The recently enacted Monday Holiday Law will give many millions of workers longer weekends and more leisure time. Starting in 1971 Washington's birthday, Memorial Day, Columbus Day and Veterans Day will become three-day holidays, along with Labor Day, making five long weekends per year for certain.

Fortune Magazine's study says that the greatest increase in family income will be in the $ 10-15,000.00 class. The survey also shows that the best consumers and buyers are among this same group; also that the total number of families with good incomes will jump from 34% of the market today to 56%. This can only help the fee golf business. The nation's 9 million golfers are spending 250 million dollars for equipment, and that is expected to increase 13% in 1969 and 70. Every kind of sport and recreation will enjoy this great increase. The owners and operators of fee courses that are ready will reap the harvest.

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PROMOTING GOLF NATIONALLY

Peter Miller, Supt., Firestone Country Club,
Akron, Ohio

Many of you are familiar with the Firestone Country Club, having either been to the golf course personally or through the many television shows that have been presented since 1962.

Firestone built the present championship 18 in 1929, the designer being the late Bert Way. Since that time the golf course has gone through many changes from a fine industrial links to one of the finest championship golf courses. To give you an idea of the magnitude of the national coverage afforded Firestone, a bit of history is necessary.

The first national tournament held was the Rubber City Open. This tournament drew nationally-known golfers from 1954 until 1959. In 1960, Firestone hosted the PGA and also extensively altered the golf course by adding 50 traps around the greens and fairways, two lakes on #3, and #16, two new greens #3 and #18, plus 16 relocated or enlarged greens.

The length of the golf course was also changed from 6,306 yards to 7,180 par 70. Robert Trent Jones did the design work and a very good job at that because since 1960 in eight 72-hole tournaments there have been 3,078 rounds of golf played, and only 176 of these have been sub-par rounds, 163 par ounds, and 2,739 over par rounds.

The Rubber City Open dissolved into the American Golf Classic, a regular stop on the pro circuit, nationally televised since 1961 and still continuing. In 1962, the World Series of Golf started (winners of the PGA, Masters, U.S.Open and the British Open), and this is a nationally televised program.

In 1962, Firestone hosted All Star Golf, a 13 series winter show, and in 1964 and 1965 televised Big Three Golf. 1965 also brought the thirteen-show series of Golf with Sam Snead. The PGA again appeared at Firestone in 1966. 1967 started the CBS Golf Classic series that you see throughout the winter. At this point we are nationally televised through the American Golf Classic, the World Series of Golf, and the CBS Golf Classic, 22 hours a year through all three major networks, tieing the golf course up for 33 days. I don't think you will find another golf course in the world with this type of exposure.

Firestone is well-qualified for this. The tournaments are run very capably by service organizations in cooperation with the Firestone Tire and Rubber Company, the proceeds going entirely to charity. The Clubhouse has all the facilities necessary, press rooms, service rooms, cart storage, television facilities, etc. Parking is available for 12,000 cars within walking distance of the Clubhouse and course. The golf course is also well-qualified besides being a battlefield for the pros - it is a good spectator course. Areas are available throughout the course where a person can watch the action in a number of locations.

There are six leader scoreboards scattered throughout the golf course to keep the spectators well-informed of what is happening on other areas of the golf course. The course is underlaid with 250 miles of telephone wire, providing instand scoring and communications between each green on the course, the press area and leader scoreboards. Switchboards are provided in the clubhouse for a very efficient outside telephone network and all facilities are provided for AP and UPI. The television networks are tied into downtown Akron by a micro-wave relay system,and depending on their mobile unit location are afforded the use of 27 miles of buried coaxial cable networks.

All power for equipment is readily available on the golf course. With the many years of experience working with television, the PGA, and the many facets of running a national tournament. Firestone is well-qualified to be hosting such tournaments.

We maintain our golf course like most anyone else, aerifying the greens and tees spring and fall, with topdressings during the year, one, two to three weeks before the first tournament of the year. The greens and tees are a combination of Nimisila bent, an old South German mixed bent with a liberal sprinkling of Poa annua; the greens and tees being fertilized in a 3-1-2 ratio, with the N approximately 6#, the majority of this being organic, either UF or activated sewerage sludge. The greens are cut at 3/16 and the tees at 1/4.

The fairways are aerified spring and fall with a slicer, with at the same time some potash being put down. Poa annua is the predominant grass and cut at 1/2. We use primarily activated sewerage sludge on the fairways with a quarter of the 6# of N put on in a readily available source. Our biggest problems on the course are the fairways. The subject this year seems to be Poa annua.elimination, but this is a bit difficult to do when you have a televised tournament in August, September and October. We live with the Poa, as little water as possible, very judicious use of fertilizer, with a very good fungicide program thrown in. We are aware of the thin thread we are walking on, but in some instances the situation dictates the solution.

The overall maintenance of the course is such that the tournament does not place a great deal of strain on us. The Firestone Tire and Rubber Company uses the golf course as a guest facility, and with the reputation we have developed, every day seems to be a special day to someone.

We are very proud of our new facilities that will be put into play this year. In 1967 construction started on a new 18 holes north of the present 18. This course designed by Robert Trent Jones will certainly enhance the area, and also add a tremendous challenge to not only the professional golfer but the low handicap golfer as well. The course, a par 70, 7,095 yards, has ten of the 18 holes built around a reservoir. Holes such as the 17th, 221 yards par 3 over water to a peninsular green 65 feet wide, should provide all the excitement needed. The course was constructed with USGA greens (sand and organic matter) and tees, Nimisila bent on the greens, and Penncross bent on the tees, with the fairways a Seaside-Astoria mix. The course has a complete automatic irrigation system as does the South Course.

With the maturing of the new North Course and the continued excellence of the South Course, we believe we have what Robert Trent Jones says is "the finest golf facilities anywhere in the country." Here's hoping that for many years you will see the Firestone courses promoting golf nationally.

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PROMOTING TURF AND PROMOTING GOLF

Keesling and Street, Oaklandon Development Company, Inc.,
Indianapolis, Indiana

Out of respect for Dr. Daniel and in appreciation of the many bits of wisdom and knowledge made available to us in the past by you and your associates, we accept the opportunity to contribute in some small way our interpretations of "Promoting Golf through Promoting Turf." Our goal has been, and shall remain, to provide fine playing conditions for the golfer throughout the entire season. Keeping our players informed of anticipated changes in the course helps to make their time spent with us more enjoyable.

In order to make this goal possible, we needed two basics, namely: 150 acres of gently rolling ground, an architect and builder. We feel these needs were met after having acquired the acreage and having hired the Maddox Construction Company. The Company, in turn, came up with a plan for a modern golf course designed for machine maintenance. Our tees average 9,000 sq.ft., and are maintained by the same tractor-drawn units as our fairways and areas around the greens. The fairways and greens are trapped to catch the poor shot of the better golfer. Our C-15 bent greens average 8,000 sq.ft., giving us an assortment of pin placements and, just as

important, helping to eliminate compaction from the steady traffic of players that would have to take place on smaller putting surfaces.

Our man-made pond of some 50,000 sq.ft., fed by two deep wells, plus being in a natural watershed area, enables us to use our single line watering system with manually regulated sprinkler heads to a good advantage in maintaining our turf.

Our yearly fertilization plan calls for approximately 8 lbs. of N per 1,000 sq.ft. for greens, 6 lbs. of N per 1,000 sq.ft. for tees, berms and fairways, and 2 lbs. of N per 1,000 sq.ft. for the roughs. We are also firm believers in aerification for all of our turf, as well as a program to eliminate clover, broadleaf weeds and doing everything we can to keep Poa under control over our entire course.

Our tree planting program has enabled us to beautify our course by the many varieties used. However, a more important phase will develop as the trees outline the fairways and provide protection to golfers from misplaced shots. At the same time we are well aware of the fact that Old Oakland has a long way to go before it satisfied us completely. The welcome sign is out at Old Oakland!

In closing, we would like to tell you something of our policy as related directly to the golfer. Each person is interviewed and briefed on what they can expect at Old Oakland and what we anticipate in return -

1. Reserved starting times up to 5 days in advance
2. Ettiquette, with emphasis on a reasonable playing time for 18 holes
3. Private lessons by appointment
4. Merchandise sold on quality basis, stressing the importance of merchandising and how it fits into our overall picture
5. Electric cart reservations, with emphasis on where they may be used on the course.

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PROMOTING GOLF AT THE GOLDEN TEE

Jeffrey Mays, Golden Tee Golf Center
Cincinnati, Ohio

The Golden Tee Golf Center is a family recreation center. We cater to all age groups. We have a lighted par-3 golf course, which includes two par-fours, a 65 tee driving range, two 18-hole miniature golf courses, and another 18-hole miniature course under construction, a 17-table billiard lounge, a game room for the kids and the adults, which includes bowling machines, pinballs, a hockey machine, and a periscope machine. We also have a well-stocked pro shop of golf equipment, and a coin-operated snack bar for sandwiches and soft drinks.

Ninety percent of our traffic comes through the pro shop entrance. This way the customer is always exposed to our golf merchandise, and the one main entrance and exit gives us control. The billiard lounge has made our operation year-round. It helps maintain our traffic flow, and enables us to keep our key staff through the long winter.

On the patio, which leads to the driving range, the par-3 and the miniature golf courses we have tables, chairs and umbrellas in the summertime.

The wire screen on the right side of No. 1 tee protects the Holiday Inn guests parking from erratic golfers.

For night lighting we use regular incandescent bulbs to light most of the center. Our back nine holes is lighted by mercury vapor, which gives a bluish cast, but is more economical to operate.

Our location is at an exit north on Interstate 75, right next to Holiday Inn, which gives us a lot of transit trade, particularly in the summertime. This is a view of our maintenance barn taken from the miniature course. The putting green is to the left of the fence.

Our new 18-hole miniature will encircle the present two miniature courses. We are going to call it "Around the World and each hole will be unique in that it will represent a differerent country. We have a gradener who spends all his time on flowers (special) and trimming and manicuring the miniature.

Our 65 tee driving range includes 20 tees on the upper deck. The younger people always go to the upper deck. The side walls of 20 enclosed heated tees for winter driving come down when the weather warms up. We had 3 electric heaters on each tee before, but not enough to keep the golfer warm. Now with one infra-red gas heater and the dividers you can keep warm with a sweater or windbreaker on with the temperature near zero.

Our ball picker is hooked on the front end of a Ford tractor, which has an enclosed, screened, heated cab for the driver's protection which people are driving. We do need a piece of equipment to pick balls when the ground is too wet to run the picker. Having 5 or 6 men hand-picking becomes very expensive. Maybe some type of a vacuum system that could be mounted on the front of a Cushman Truckster would be the answer. Maybe the manufacturers and the engineers can come up with something.

In summary, we promote golf at the Golden Tee by treating the customer with the highest level of courtesy and offering him the services he desires. We also keep our recreation center clean and neat at all times to present a most enjoyable atmosphere. We advertise daily on the radio and weekly in the newspaper.

To sell our golf equipment we have three golf professionals giving lessons and advice to the customer. We advertise the point that "we have a golf professional on duty at all times to custom-fit your golf clubs." If a person is going to spend $ 200 to $ 300 for a set of golf clubs, he wants the club that is best suited to his swing and type of game he plays.

We hold annually a "Beat Richard King" golf cournament. Richard King is a local disc jockey, popular in the Cincinnati and surrounding area. It is strictly a handicap tournament that lasts for a week and we give away $ 1,000 worth of golf merchandise prizes. All the customer has to do is pay a greens fee, beat Richard King with an adjusted handicap and he can win a prize. These are ways we create traffic by operating a family recreation center with golf as the principal activity.

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PROMOTING PUBLIC GOLF COURSES

John Raber, Raber's Golf Course
Bristol, Indiana

Every promoter hopes for a winner. A winner must have the physical requirements as well as a natural aptitude, and this goes for a golf course if it is to be a winner or successful.

Before any course is built a full survey should be taken. First, determine the population of the area; then the availability of public golfing. If this suggests a good opportunity, then the location is most essential.

The cost of the land is last in importance. It must be easily accessible, preferably on a state road, centrally located in the population area to be served. Three phase electrical service should be available along with plenty of water for irrigation. Land should be chosen on which a good course can be built at a minimun cost. Such characteristics as drainage, minimum cost of clearing, availability of greens building material, state of fertility of soil,and land not too rolling as to make maintenance too expensive.

Today there are many industrial workers who wish to play, but do not wish or cannot afford to belong to a country club. We have built our business on this premise. We had industrial leagues from twenty factories using our course last year. This year we turned away many because we are full. For this reason we are building another nine this year, making 27 holes. We have three leagues already booked to use on our new nine in 1970. These players insure our overhead. Weekends they come out to play on the course that they will be competing on during the season.

I feel we have something very unique. We have the name and mailing address of every person ever to pay a greens fee on our course. We have no membership of any kind, and everyone is treated the same. Each player is presented a postcard which he is to address to himself and on the other side is the statement - "You were drawn to have a free round of golf any time you choose in 1968 as one in a foursome." These cards serve as a register for the day. At the end of the week we simply throw out every tenth, fifteenth or so card and mail it. This gives them the feeling of winning, but to win they have to promote by bringing three other players. We then file all the cares in alphabetical order which gives us a good mailing address of every golfer in the area. Can you imagine the value of this to the pro shops in the promotion of sales? By this communicaton the golfer has a feeling of belonging to the institution much as a country club member.

Green fees should never be high enough to discourage would-be golfers. Therefore, the cost of maintenance is of most importance. Labor is the major cost; consequently, labor saving is the most important object in making a successful business out of ownership of public golf courses. The selection of the site and the architectural plans are the most important management decision in the life of the course.

Our course was built on 135 acres in a R 1 residential area adjacent to the St. Joseph River on state road 120. The soil was in a high state of fertility, having been in corn continually for 20 years. It is gently rolling, varying only 13' from low to high point. There were no buildings and only a limited number of trees. The soil is naturally drained, not a tile or ditch any place. The topsoil is perfectly constituted to use for greens and tees. We simply stripped 4 inches of soil off the roughs with pans, and built all the greens and tees for $ 2500.00 of earth moving.

The architect made large and long tees so the range of 62 to 7250 yards make a course tough to par. No sandstraps as yet - to save labor. All fairways are mowed with a nine-gang mower, and all tees are mowed with the same mower. All greens are automatically watered. Seldom, if ever, do any players see anyone working on the greens, tees or fairways. This makes playing enjoyable and progressive. We do most of the maintenance work at night and we consider it successful.

The greens are watered just as the course is closed. At 11 o'clock the night man comes to work and puts out 18 sprinklers on one nine. He then proceeds to mow the other nine. Our tractor is equipped with a 110 volt generator and has a tower of 12 flood lights. He mows with the 9-gang for 1 hour, then stops and uses a cart for travel, moves the sprinklers. In 8 hours he has one side watered and the other mowed. The next night he reverses the order. The two green mower operators come at 4 and have the greens mowed well ahead of any players. This way no laborer is detained from work at any time by players. The greenskeeper comes early ehough to inspect each green,and move cups makers before players see him and, in so doing, makes the decision as to whether spraying or other preventive measures must be taken during the day. By this method two men and two boys keep our couse beautifully manicured.

We did plant some 600 trees with modern planting equipment. It is cheaper to plant the trees where desired than to clear undesired growth when building. Our slogan - "A HAPPY GOLFER IS OUR BEST PROMOTER."

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PROMOTING GOLF

Wm. E. Lyons, Sr., Pres., Lyons Den Golf, Inc.
Canal Fulton, Ohio

There are four classes of golf activities to cater to the wishes of the public to enjoy during their leisure time -

1. The strictly fee course that sells only golf and a few side items such as snack bar, with the prop shop to meet the daily needs for balls, gloves, tees and a few rental clubs.
2. The fee course, selling cheap memberships or season passes as an attraction to their bar, restaurant or large pro shop.
3. The country club, strictly private, with all types of activities,with golf just one of several.
4. The commercial club, a glorified fee operation, in which the member or employee holds no stock; operated by a corporation as an employee activity or an advertising promotion deal, such as bachelor clubs.

Lyons Den Golf is a class 1 operation. We have to depend strictly on greens fees. We have no memberships or season passes. As one of my neighbors says, "Sell passes and cut yourself out of one-third of your revenue." We think we have just as good a product to sell as Standard Oil, my grocer or the baker. When asked about season passes I tell the customer that whenever Standard Oil starts selling season passes to their gasoline pump we will sell season tickets at the Lyons Den.

Did you ever analyze the mind of a golfer? He or she lives in a dream world all day at their job. They picture that trip from home or office to the course, possibly picking up one more of their foursome for a bit of conversation on the way to the course. Where will I have to park tonight? Down at the end of the lot, or will their be a spot open on the 50 yard line? Will I get there in time for a cart, or will I have to walk and carry my clubs? Will there be flowers in bloom? Will Bill be there to greet me, or will Sarah be taking my greens fees? Hope she has some good coffee and a quick sandwich with a smile. Will all my lies be on perfect turf and my putts run true? Yes, our golfers are dreaming birdies, pars and eagles all day long. He or she dreams a happy, leisurely few hours in a dream world. When one sells only golf then we have to pretty much meet the expectations of our golfers dreams or they will not return.

To get material for you today I went to a supplier of Pro Shop merchandise, a good golfer. He travels the state of Ohio. I asked for his opinion why one course will get more play than another. He sayd, "I'll tell you why Lyons Den is heavily played. When I come to your course and park, I am greeted by an urn (2 ft. tile) of flowers right in front of my car. Before I open the door those flowers told me 'this is a nice place.' Somebody cares about me. I am important to them.

"As I walk to the clubhouse past more flower gardens and the martin houses on polies, you laid out a rubber walk to ease my tired feet. Again you make me feel important. You are an owner of the place, yet you are there instead of hiring someone who is not interested in me.

"You charge me a high price - the highest in Stark county for the shortest course in the county. It satisfies my ego to pay it. They tell me you charge everyone, even your own preacher. You have no members or season ticket holders to make me feel unwelcome.

"Yet, I know you could not charge those high fees unless you were willing to give me the best possible playing conditions. I appreciate the courtesy green at #1 tee so I can test the speed of the turf and get in a few practice putts. You call my name on the P.A. system, telling me that I will be on the tee in just 7 minutes. They you call me a second time to take my turn. By that time I have heard my name so often (you inflated my ego) that I can't think a good swing. You have never been more than 7 min. late getting us on the tee either. We know we are scheduled for our second round in just two hours.

"You also told the slow playing foursome ahead of me one day that they were 2 holes behind schedule when they got to the 5th tee. They got nasty and suggested you refund their money. Without a word - just a smile - you gave it to them. News gets around the way you operate." Our thanks to Mr. Larry Kemper for that part of this story.

When we opened Lyons Den eight seasons ago (1962), we charged only $ 1.00 per 9; $ 2.00 for 18. Mr. Jim Holmes, former Director of the USGA Green Section, known to most of you, came by one summer to check on our modified soil greens (actually soil-less). This was the first set of these east of the Mississippi River. After eight years we now get $ 2.25 for 9 and $ 4.25 for 18. The Lyons Den is a direct result of applying researched ideas from Turf Conferences and "Cheese Bars."

The turf promotes our golf course. We do spend money on all the local programs and yearbooks the kids peddle. These are considered community donations. They help a little in goodwill.

Placemats with the design of the course have been worth their cost in new

customers. We put out 25,000 annually to restaurants. The best promotional gimmick we use is the punch card. We have 3,000 people carrying punch cards. We punch the card with a letter "L" for each round played. The 11th round is on the house. Then we take the signed card and deposit it in a local bank with our daily deposits. On November 1 each year we draw one card and give the name on that card $ 200.00. We get the person's picture and use it for publicity.

Something else we do is to help people with their lawn problems. We sell more fertilizer at a better profit than golf merchandise. We get them to apply pelletized plant food once each month at the rate of 5 lbs. per 1,000. We wear out about 3 cyclone spreaders a year as a goodwill gesture.

As years go along and play has increased, we have had to enlarge our tees. Now we are building just like our greens - with lots of drainage.

Our new maintenance building is attracting much attention. Our regular customers like to show it off to their friends. One of our tractors is older than Bill, Jr., yet it will go on the course looking and sounding like new this spring. We are charging the first class rate and we want to look the part. It works.

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PROMOTING GOLF - MY IDEAS

Bill Duwe, Duwe Golf Course,
St. Louis, Missouri

I. Basic Premise: Make it easy for golf "customers" to do what you want them to do. Most important - you want them to play consistently as many rounds as practical.
   A. Make it easy for golfers to find you.
      1. Supply maps and other good directions whenever you can.
      2. Road signs and markers (billboards if you can afford them).

   B. Make it easy to park. Not just possible, but easy.

   C. Make it easy to sign up to play and certainly easy topay the greens fee.
      1. Internal directional signs, neat, attractive, simple.
      2. Conversely, make it difficult to go the wrong way.

   D. Now you have the golf on the first tee, your promotion has been successful, it only remains to make it easy for him to enjoy the round.
      1. Question the players. Ask, "are you going away with a pleasant feeling - glad you came out." Every person as he leaves your course must have so concluded.

II. Specific, tangible ideas for golf promotion.
   A. Promote yourself in the off-season. Don't let people forget you during the winter.
      1. Try a Newsletter - not new, but effective. It has to be good - worth reading.
      2. Christmas cards. We've done this for many years and believe it has been valuable. Try for something of lasting value - photo of course, etc.

3. Have a good Hole-in-one promotion. Get it in the newspaper. Give an award with your c. . name on it. Keep and display an up to date Hole-in-one roster.

4. Use some score card attachments, special flyers stapled to each card, about improvements on the course, standard rules, etc. Make it simple and try to include an illustration.
5. Scoring pencils - no charge, but with the name of your course.
6. Call in winners to papers and sports news media.

III. Another idea is to use as much as possible the people and organizations that are "going your way."
   1. National Golf Foundation, U.S.G.A., P.G.A., Golf Course Superintendents Association, Jaycees and others. They often have the same goals you have.

IV. There are many good ideas for promoting golf, but one stands out as the most perfect. One "idea" that does more than all the others - that is the golf course itself.
   1. The "growing things" - trees, shrubs, flowers.
   2. Most of all the Turfgrass. All other promotions are helpful and desirable, but the turfgrass is essential. Turfgrass is the big idea in your golf promotion.

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THE HOW AND WHY OF NIGHT MAINTENANCE

William E. Lyons, Lyons' Den Golf, Inc.,
Canal Fulton, Ohio.

Several years ago one old timer was heard to remark, "I've mowed grass in daytime for 30 years and I am not going to change now." This man, perhaps, had no need for a night maintenance program; or, the need was there and he wouldn't change his thinking to face up to it; or, he failed to recognize the agronomic merits, safety, efficiency and goodwill that modern night operations offer. On the other hand, two days later I visited an owner of a fee course. The first thing he proudly showed me were the new lights his crew had put on their machinery. To him it was pay dirt. He had the need and had put the idea to work.

This paper is not meant to tell you all the steps in how to maintain a course at night. All I hope to do is point up the need for doing it and suggest the jobs we have found best for a night program. Of course, you probably can improve on this and use better tools than we have had.

A president of a large corporation was once heard asking the chairman of his board. "How do you account for the outstanding success Mr. Smith has had with his program? "Genuine enthusiasm," was the chairman's answer. I hope to encourage you to be enthusiastic about your programs. All indices show that golfers are increasing as are the number of rounds; faster than playable courses are being built. I prefer the term ENJOYABLE courses.

THE Golfer, Our Guest

More golfers on fee courses and more family participation at the club make us wonder when we are going to get our work done! The daylight hours belong to the golfers. (Some night hours too on lighted courses). We are forever in their way. Let's treat every golfer as we would a guest in our own home. What would you think of a woman who timed her home management so that the day you arrived as a guest she was removing the rug from the living room or painting the guest bedroom? Yet you and I have been guilty of just as much by having greens torn up, or doing any one of a dozen other operations to the course during play.

Since work is the thing a golfer is trying to get away from, why do we have to remind him? Would not his game be a happer experience if he saw no one working? No noisy tractors, trucks, mowers, etc., to distract? Aside from improving our relations with the golfers, there are agronomic reasons for a night maintenance program.

Advantages to the Grass and the Crew

A study of heat, light, humidity, soil temperature in the grass rootzone and several other factors was conducted on the experimental green at Purdue University under the direction of Dr. William Daniel. As I recall it, the study showed the soil temperature begins to rise rapidly about two hours after sunrise, reaches a peak about three hours later and holds this range until about four hours before sundown. Then it declines quickly, reaching the morning's status quo about 2 A.M.

Years before this study was made, many of you observed turf wilt about 11 A.M. Did you ever have turf killed by mowing during severe wilt? Learning the hard way, we made it a standard rule to stop mowing fine turf about 11 A.M. Not being able to keep our courses in "par" condition on such a short mowing schedule, it seemed that a night mowing operation was the answer.

It began with one of our operators who loved fine turf. He asked me if he could try night mowing to see if it would improve the turf and also satisfy the golfers with shorter cut fairways. He sold us on his idea and for a test we bought him: 1 headlight, 2 side lamps beamed to follow the edge of cut, 2 small lamps for rear gang, 1 rear lamp the same as a headlight, 4 switches, and 1 variable regulator for the generator. This system still serves. It is surprising how much mowing can be done at the correct slow speed with one seven-gang, push-type unit "lamped up" as described.

Being able to see better the operator will do a more efficient job at night than in daytime. When the rear lamp is turned on he can actually see, without getting off the tractor, which unit is slightly out of adjustment. The factor of crew safety when mowing at night is worth the effort to change our thinking. It's cooler at night, thus more pleasant to work, less wear and tear on both man and machinery. Then, too, the grass has a chance to recover before sunrise from the shock of mowing.

Starting after the last group leaves the first or tenth tee, holes can usually be mowed before the dew brings on those piles of clippings that kill turf. If your golfers demand a 3/8 to 1/2 inch cut fairway then mowing at night is much safer.

Less Wind at Night

There is also less chance of wind drift at night when spraying for diseases, insects and weed control. Lime spreading is an easy night job. Pellet fertilizer

is spread more uniformly when a little dew shows tracks. In renovating, clipping and leaf control, or any other, we did not find a fairway job that could not be done better at night.

To spray greens as night, build a safe platform on the rear of the sprayer. Mount the generator on it. Then use the two bank light system. Night spraying reduces the hazard of chemical burns.

The superintendent of a municipal course in a large midwest city told me in 1958 they had so much play they could not even mow greens from Thursday until Monday. I understand a Florida operator, who had a similar problem, put lights on his greens mowers.

Here's another idea: Make up a portable lighting system. Bolt a 600 to 1200 watt gasoline-driven generator to the bed of your pickup truck. Assemble two banks of three lamps each. Use outdoor type flood lamps. One set stays on the truck on a 6 ft. piece of pipe. The other set should be set 7 to 8 ft. above the ground and anchored some 50 ft. from truck to cross angle the lighting. All jobs on tees and greens, except topdressing, can be done better at night.

A green mowed at night is better than one that is not mowed from Thursday to Monday. Our golfers advised us that greens mowed at night were too slow by 6 P.M. the next day so we had to go back to a dawn mowing schedule so we could be out of the way of the 6 A.M. leagues.

Even stolons planted into greens or tees at night are noticeably better - less chance of dehydration and quicker establishment. Night operations can help you get more use from limited machinery supply, or allow you to condition the course on time for tournaments. Now, night maintenance requires a radical change in your thinking and is work - and work is that "bad" word. Just remember that someone else has met the challenge.

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SPECIAL AND NIGHT MAINTENANCE

Bill Duwe, Duwe Golf Course, St.Louis, Mo.

1. When else?
2. Why not?
3. What specific operations?
4. Lighting
5. Labor
6. Emergencies (communications)

Some ideas presented:

1. Aerify only 1/2 of each green - keeps play on good turf.
2. Use biggest possible number of gangs in mower - 7 - 9 - 11 - 13 - as conditions permit - to keep ahead of players.
3. Use wetting agents to reduce dew on foliage. Must be repeated. Can serve for limited days. Time and cost to be considered.
4. Set up alternate procedures so superintendent will have time free of disturbance.

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AN EFFECTIVE TECHNIQUE FOR RECOGNITION

Howard Gaskill, Supt., Hiwan Country Club
Evergreen, Colorado

There have been innumerable articles written and many speeches given concerning recognition and the golf course superintendent. The subject of recognition generally involves discussion of "professionalism", public relations, and/or public image.

The Rocky Mountain chapter of the GCSAA has recently embarked upon a program of Certification that is relevant. The following is from the explanatory brochure that describes the program:

"The purpose of this program is to encourage members to upgrade themselves as well as their profession. This is to set apart those persons who are truly professional golf course superintendents. Anyone designated as a Certified Golf Superintendent will have the hallmarks of a professional.

He will possess an organized body of special knowledge which cannot be acquired except by long and difficult study.

He will be competent to practice. He will have the experience, the education, and the benefit of professional association.

He will carry his assets primarily in his head, and can practice anywhere that his services are in demand.

As a professional man he will use his talents for the public good, and will share his successful methods with others. He will be known for his good works and actions and expect to be compensated accordingly.

As a professional organization we are putting our stamp of approval on this man and saying to the public - here is a man you can be sure of when it comes to managing a golf course.

By becoming a Certified Golf Superintendent our members will be brought to the public's attention, and it is only by the attention of the public that this certification program will have any beneficial meaning."

While a superintendent's duties may vary from course to course, certain basic qualifications can be singled out as essential:

1. He must have adequate knowledge of types and varieties of turfgrass and the know-how, as well as basic information to produce the desired result.
2. He must know where to obtain specific information relating to all phases of his operation.
3. He must be able to supervise and work intelligently with his employees.
4. He must have integrity, for the club's property is under his supervision
5. He must be able to maintain good records covering everything from budgets to weather reports.
6. He must be able to make decisions in the face of complex problems.
7. He must have tact and diplomacy in dealing with members, guests and club officials.

A candidate for certification must be presently employed as a golf course superintendent and must have accumulated 200 points based on his experience, education and association activity.

Points are awarded according to the following scale:

1. Experience points (70 points minimum requirement):
   A. Assistant superintendent, working under a Class A or certified superintendent. Points can be earned for a maximum of three years and are based on the size of the golf course.

Number of full years	18 holes or less	More than 18 holes
1	5	10
2	10	20
3	15	30

   B. Superintendent. Points are also based on the size of the golf course.

Years	Less than 18 holes	18 holes	More than 18 holes
1	10	20	30
2	20	30	40
3	30	40	50
4	40	50	60
5	50	60	70
6	60	70	80

   etc.

   C. Golf Course Construction. Additional points may be earned by experience in golf course construction. To qualify, construction experience must cover all phases of construction, from rough-grading through seed germination. 15 points for each regulation 9 holes; 10 points for each 9 hole par-3 course.

2. Education points (50 points minimum requirement):
   A. Full school year attendance at college:
      Agriculture major 15/year
      Other major 10/year

B.	Degree(s) following college	5 each
C.	Approved turf winter school	10 "
D.	GCSAA Turfgrass conference	5 "
E.	Regional or state turf conferences	5 "

c. Association activity (15 points minimum requirement)

A.	GCSAA membership	1/year
B.	Chapter meetings (max. of 6/year)	1 each
C.	Chapter office holder	1/year
D.	GCSAA office holder	5/year

I would like to encourage all superintendents present at this Conference to review the point-award system that will be printed in the Proceedings. The Rocky Mountain GCSA has not limited their certification program to members of their chapter. Any superintendent in the GCSAA who feels that he meets the requirements may write to:

Larry Eggleston, Chairman
Certification Committee, RMGCSA
c/o Broadmoor Golf Course
Colorado Spring, Colorado

A $ 15.00 application fee will be charged. The explanatory brochure and application form will be mailed out. When a superintendent is certified he will receive a Certificate of Certification and press releases will be mailed to his local newspaper, the industry journals and magazines. Because of the generous amount of newspaper space this new program has received, I encourage other GCSA chapters to start similar programs and to work for a National Certification program from the GCSAA.

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TEN YEARS OF DECISIONS

James W. Brandt, Supt., Danville Country Club,
Danville, Illinois

It would be grossly unfair if I delved into the decisions that I and the Board of Directors have made at the Danville Country Club over the past few years without giving due credit to my predecessor at the Danville Country Club, Mr. Alan Wyman. I inherited Washington bentgreens that were in excellent condition and entirely free of Poa annua. Fairways had an excellent stand of Common bluegrass. Tees were also bluegrass, but became too small with the greatly increased play.

When I arrived in Danville in March, 1953, Danville had just begun to experience a rapid industrial growth, with a resultant increase in new golfing members. This coincided with a demand for general improvements in teeing areas and effective sand traps on the golf course. The budget for the year had been set at $ 25,000.00. My first inventory included:

1 1937 Ford Tractor in excellent condition
1 1940 Farmall B Tractor with row crop front and equipped with sycle bar
1 Avery Tractor with single front wheel and hand-operated brakes
1 1947 International half ton pickup truck
2 Fairway gang mowing units - tractor drawn 1 5-gang, 1 7-gang
1 set of 5-gang rough mowers
1 150 gallon spray rig with well-rusted tank
Adequate greens mowers
No tee mowing equipment - fairway units were used to mow tees and borders of greens

Watering system. 6 lengths of hose, 6 Buckner sprinklers with roller stands. During summer months of 1953 two men besides myself hand-watered greens starting at 4:30 in the evening and lasting until 11:00 at night. One man had to walk a 90 ft. embankment and manually start a centrifugal pump. The booster pump was then started in the basement of the club house. Water came from two artesian wells. This also served as the club house water supply.

The work shop consisted of a 10 x 30 work area in the club house and basement. The greens mowers were kept in this area and were let down and taken out of the basement on a skid board up and down the 12 steps. It is necessary to give you this background in order that you might know the problems confronting us in our decision making in order to bring the course and equipment up to the point that we are now considered to have one of the better-equipped and conditioned courses in the area.

I placed water and irrigation equipment as the number one item for consideration for improvement. Fairway watering could not be considered, but adequate water for greens and tees was number one priority. A new well was drilled. This well supplied 250 gallons per minute. Additional hose and sprinklers were purchased. Now one man could water in less than four hours, watering 10 greens at one setting. This savings in labor the first season in use more than paid for the $ 2,200.00 cost of well, plus donated pump.

There was an abundance of plantain and dandelions in the fairways and roughs. The sprayer had so much rust and corrosion that it was impossible to use the spray boom. The first season the tractor with the sycle bar was used primarily for mowing the spikes off the buckhorn. A new spray unit was bought in the spring of 1954. We discarded the sycle bar for weed control.

In the first five years the budget was increased from $ 25,000 to $ 27,000. Yet with this minimal increase in budgets we were able to buy new spray equipment, a new truck with dump hoist, replace the two tractors with tractors more adaptable for golf course maintenance. We also were able to fertilize fairways for the first time in the history of Danville Country Club. The same year we bought 2 bushels of Zoysia sprigs at a cost of $ 50.00. These were planted in rows in the nursery.

We had excellent fairways in 1957 - that is until crabgrass took over. At a Board of Directors meeting I was asked if something could be done about the crabgrass problem. This was the first time I had been asked to make any sort of improvement on the golf course. In 1957, at the Fall Field Days at Purdue, we saw some excellent crabgrass control using the arsenicals. Encouraged by these results, I tried my first major selling job to the membership. We put out 10 plots in March of 1958. At the heighth of the crabgrass invasion these plots were posted with signs giving the treatment and cost per acre. After seeing the results, the membership demanded that the control measures be put into effect. In March, 1959, 435 lbs. 85% tri-calcium arsenate was applied per acre. Crabgrass and chickweed control have been outstanding since the initiation of the program. We have been able to maintain our toxic level of calcium arsenate by using 100 lbs. per acre on alternate years.

Meanwhile, back in the nursery the Zoysia had made complete coverage of the initial area planted. Two tees were sodded to Zoysia. The player acceptance was overwhelming. Since that time we have converted all tees, with the exception of #15, which is in complete shade. A mixture of bent and Poa has held up very well on this tee. All tees, with the exception of 3 tees, have been doubled in size in the past 10 years. All of the Zoysia used on the tees has been developed from the original 2 bushels.

The sand traps had been a great source of complaints from the better golfers. Each one had a long, grassy slope extending from the edge of the trap bottom to the edge of the green. It was decided to bring in fill at the edge of one green and make an incline of 4 feet with a good sharp lip facing the golfer. This brought a demand that all traps around greens be treated in this manner. The terrain around 12 of the greens made it possible to make good effective traps. This was accomplished over a 4 year period.

In the spring of 1964 I was faced with another major decision. Upon returning from this Conference in 1964, I was called into the Board of Directors meeting. I was asked if I would assume the duties of manager, as well as being the golf course superintendent. This was a most difficult decision to make as I had been tended an offer to become golf course superintendent at a very outstanding midwestern club.

I must admit that I very much like Danville as a town. Although my salary had been generous, the budget left much to be desired. Here was truly a great challenge. The Club had operated at a deficit for some five years at the rate of some $ 5,000 per year. My most compelling thought was that if I could just get the Club on a sound financial basis, then I could get a much-needed watering system for the fairways. As most of you know, I did stay.

Net income per year -

1964	$ 3,694	loss
1965	15,762	profit
1966	29,412	
1967	17,012	
1968	11,681	

These profits were realized without any increase in membership dues or assessments. The former excise tax was used for capital improvements rather than operating income. At the end of each year the net profit was transferred into the capital improvement.

With the Club again on a sound financial basis, the Board of Directors in 1966 decided that we should consider the irrigation of the fairways. Again we were faced with an inadequate water supply. My recommendation was to dam up a large ravine and use this as a storage basin. The Board of Directors decided to hire an engineering firm specializing in water supply studies. The engineering firm made a feasibility study, finding that our aquafier was adequate to withstand continuous pumping. They were then asked to design and supervise the construction of a reservoir. They advertised for bids, the savings in the bid price over a member quoted price more than paid for the total engineering fee of some $ 2,800.

The Board also decided to hire a firm to design and procure bids for the irrigation system. Mr. Austin Miller was the designer of the original system. The bidding firms were asked to bid on both completely automatic systems, and a system with automatic greens and tees, and manual fairway watering. Kirchdorfer Irrigation Company was awarded the contract for a completely automatic system. They submitted an alternate bid on a two-row system as opposed to a single row system. The price was only $ 2,000 more for the double row system.

I had made a preliminary survey of superintendents who had used automatic and manual systems, and superintendents who only had used manual systems. Every one of the 6 superintendents having automatic systems said they would never go back to a manual system and gave supporting reasons. These letters, as well as my very strong convictions, convinced the Board to go all the way with the automatic system. Three of the four men that I contacted,who did not have automatic systems and said they would not want to go with the automatic systems, are now converting their courses to automatic systems.

At the Board meeting that the watering system was to be voted upon, I brought along these few slides for their viewing. The vote was unanimous to budget $ 120,000 for a lake and the automatic irrigation system. The actual total cost of the system was $ 102,000 of which the lake cost $ 13,000, and engineering services $ 3,800.

Now we have ample mowing equipment, including a 7-gang push-type mower, tee mowers, bunker mowers, apron mowers - all riding equipment. We have a completely automatic irrigation system, a new heated 40 x 50 ft. work area, superintendent's office; in fact, now our real need is some good workmen to operate all of the fine equipment.

In 1964 when I took over the dual-role at the Club, the grounds budget was $ 39,000. In 1969 the grounds budget will be $ 55,000.

Decisions - yes, we all must make many decisions. Yet, every decision should be one that can be substantiated by the need whether it be improved playing conditions, results of inflation, or other need. Sell your decisions to yourself, then your chairman, then the Board, and finally the membership. Lay the ground work carefully and every club member will think that it was his decision. You will then have made the membership happy as well as accomplishing your desired goal.

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DEW IS NOT DEW

Tom Mascaro, West Point Products Corporation
West Point, Pennsylvania

Dew on turfgrass areas is not dew. Most of the commonly called "dew" is in reality exudated water, or guttated fluid exuded from the open stomata, or from the clipped ends of grass blades. Very little research has been done on the origin, composition or effects of exudated water; yet, there is much evidence that it has a profound effect upon turfgrasses.

Many theories have been presented, but few have been documented by resource research. It is my hope that this discussion will stimulate research people and others to delve into this fascinating and important subject, and that the turf man who studies the following presentation will better understand some of its mysteries and hope to cope with its effects through cultural practices.

The effects of exudated water apparently first received recognition when the USGA, over twenty years ago, conducted a survey relating to the incidence of disease. The golf courses that practiced early morning watering had less disease than those that did not. No one understood why, but this practice worked and through the years has been adopted by many superintendents. The practice of early morning watering must, in some way, be related to exudated water, but its function is not too well understood.

Great progress has been made in the development of fungicides. They are tremendous help to carry us through critical periods; yet, they may fail UNDER CERTAIN CONDITIONS. These words indicate a mysterious set of circumstances of which no one is quite certain of the causes. Another great mystery to me is why more basic research is not being done on WHY these problems occur in the first place. Aspirin is great, but it seems to me that it is mighty important to know WHY we have a headache. Therefore, in this discussion I will discuss more the WHY rather than the cure.

During my many years in this great turfgrass industry, I have seen and photographed many problems. I have been particularly fascinated with the mysteries of the effects of turfgrass loss. The evidence accumulated seems to indicate that of many factors exudated water apparently has a pronounced effect as to WHY turf diseases occur. Exudated water is referred to as exudate water - guttated water, water of guttation or guttation fluid, water of condensation, "fairy rain," but most of us call it "dew."

WHAT CAUSES THE DEW TO FALL?

Have you ever wondered why there is dew some nights and not others? Why nights but not days: Why on some parts of the lawn, but never on others, or what dew is? Poets have called dew "nature's water jewels." Children see it as "fairy rain." The meterologist says, "The air got too cold to hold all the moisture - the excess fell to earth."

Three requisites are essential for dew to form - moist air, a cold surface, and a clear sky. If clouds gather, dew ceases to fall. If tree foliage overhangs the lawn effect is like a cloud and dew does not collect. But, when the day has been brightly sunny and the night turns very cool, conditions are right for a copious fall of dew. Next morning you will discover that the very smallestgrass blade has not been neglected. It will be dew-laden and an object of beauty.

Frequently a leaf will have a single large dewdrop deposited at the very tip of the blade, while upon the extreme sharp edge of both sides of the blade there will be a collection of small, bead-like drops in orderly precise fasion. When the large dewdrop perched upon the tip of the grass blade starts to fall, it descends rather slowly at first, following the extreme edge of the blade as it slides down and joins up with the other dewdrops it encounters strung along the edge of the leaf. Eventually the combined drop becomes heavy and falls to the soil. Dew can provide a valuable addition of moisture for your lawn.

Much of this article is misleading, yet it says what most people think about dew. The so-called "dew" we see on turfgrasses is largely exudated water. It does not fall - it rises. Most of it is water exuded or "pumped" out of the plant. Light and temperature affect this process. During the night, with lower temperatures and lower evaporation rates, the exuded water accumulates. Apparently through the process of osmosis,root pressures build up to force water out of the hydathodes. During daylight hours,with higher temperatures and more evaporation, the reverse takes place. A few investigations have shown that the plant system is under tension and water can be taken in by the leaf. If the evaporation rate is low during the day, however, exuded water will remain and sometimes continue to form.

Perhaps the reason so-called "dew" does not form under trees is that the soil is drier and water is not present to be exudated. We know that there is a definite relationship to the amount of exudate and the available soil water. Close observation will show that the orderly, precise arrangement of the droplets is due to the location of the hydathodes, and that the single large droplet at the tip of the blade is much lower than normal if the blade has been cut. These are facts and have been documented by a few research scientists.

Here is what these men had to say about turfgrass disease and exudated water -

J. K. Wilson, 1923. "Exudate contains both organic and inorganic materials."

The organic materials suggest exudate water may have a similar composition to that of hydrogen ion concentration is almost the same as the sap. As plants become older the exudate becomes more acid.

A substance (sugar enzymes perozidase, reductase, or a combination of them) suggests that nitrates which are taken up by the plant are in part reduced to nitrates as they pass up through the plant tissues, and that this reduction may continue for some time after the water has been exuded. The organic material that is present in exudate water seems to be easily utilized by bacteria.

Turfgrasses exudate water at different rates, depending on the species. This is easily seen on turfgrass areas of mixed grasses. The exudated water is much heavier on some than on others. The bentgrasses, Bermudagrasses and Poa annua are prolific pumpers; bluegrasses are medium pumpers, and the fescues and Zoysia grasses are the driest, or pump the least.

G. M. Hoffer, 1949. Hoffer's theory: When turf is well-fertilized with a quickly available nitrogen, the guttated water contains a high concentration of nitrates. The nitrate salts cause a chemical burn on the grass leaf. The destroyed cells are then decomposed by bacteria to available organic matter.

The fungal spores germinate and are sustained by the organic matter. If a great deal of thatch exists, some of the guttated water is absorbed and held. When optimum temperature and moisture exists, fungus starts in the thatch and quickly spreads to the grass blades at the surface. If the soil is compacted this will restrict the infiltration of guttation fluid and a dangerous concentration of nitrates are held at the soil surface. This concentration of nitrate salts will cause a chemical burn of the plant stems and pave the way for fungus growth. If a turfgrass area is well-fertilized with a quickly available nitrogen and the exudated water is collected and poured in one spot, a severe chemical burn will result.

Engle, 1955. "Very acid soil conditions favor most of the turf diseases." Tender succulent grass, which has received an excess of water and nitrogen, is susceptible to most diseases. While high humidity contributes to the softness of grass, it also may aid growth of the fungi. Air movement has a great influence on humidity as well as temperature at the turf level."

Large brownpatch	77 - 86°
Pythium	93°
Copperspot	81 - 86°
Dollarspot	68 - 86°
Pink patch	65 - 73°

Early morning watering rather than evening has been found to keep turf more free of disease. Lime to maintain pH above 6.0.

R. M. Endo, 1967. Guttated water is the fluid exuded from the stomata and tips. When drops of guttation fluid are placed on the leaves of Seaside bentgrass and threads of dollarspot fungus are added to the droplets, the threads grew sparingly to well and caused a variable amount of infection. When water was used the fungal threads grew very sparingly and failed to cause any infection.

When bentgrass seedlings were sprayed with spores of Helminthosporium sorokinanum suspended in guttated water, the plants developed very severe symptoms on 99% of them in 2 - 4 days. Nearly all the seedlings were dead after 6 days. Plant inoculated with spore - tap water suspensions developed water soaking, yellowing and necrosis on 10% of the plants in 6 - 7 days - all plants survived after 14 days. Guttation water increased infection and disease. It induced acceleration and increase in spore germination.

One can readily see, from the research work done by these scientists, that exudated water and disease occurrence are inter-related.

Many golf course superintendents have contributed much to the practical aspects of this problem. To mention a few, Carl Bretzlaff, Superintendent at Meridian Hills Country Club, Indianapolis, would use a drying apparatus on his greens when

disease weather was upon him. The rig consisted of several layers of burlap fastened to an axle mounted on wheels and hand-pushed over the "dew" laden greens. He always kept his greens dry, and with the use of fungicides seldom had trouble.

Joe Valentine, superintendent of the famous Merion Golf Club in Ardmore, Pa., relied on the use of hydrated lime "to change the pH and dry the greens" - as he put it. He would use 5 to 10 lbs. per 1,000 sq.ft. at 3 to 4 week intervals during "brownpatch and dollarspot weather."

Jimmy Comito, Superintendent at Huntington Valley, Pennsylvania, relied on severe dragging of the greens during period of heavy "dew" and disease weather. "Dragging the greens breaks up all that mold", he would say, "as soon as the mold starts up again, drag it some more - keep the greens dry too."

Marshall Farnham, Philadelphia Country Club, firmly believed in early morning watering during the many years that I knew him. I cannot recall his experiencing any difficulty holding grass on his greens. Trained in plant breeding and having graduated from Cornell University, he was well-versed in the science of turfgrass culture. I always felt that he related exudated water with the incidence of disease, and although neither of us had a pat answer, we agreed that dilution of exudated water with early morning watering was a good practice.

Oscar Bowman at Old Warson County Club, St. Louis, Missouri, when he was superintendent at Algonquin would say, "Topdressing does more to prevent and control disease than anything else." A firm believer in topdressing, he has always relied on this important cultural practice,and its value is reflected in his superb greens.

Other superintendents, too numerous to mention, had a number of things in common with these men -

1. They all had a "green thumb" - that is the natural ability to get plants to grow.
2. They all practiced good cultural methods, making sure that everything was in balance
3. Especially during critical disease periods, they used methods that more or less kept the turf dry. Without knowing about exudated water, they sensed that there was a definite relationship between "dew" and disease.

Another factor which should be brought out is the strong possibility that turfgrasses are also injured by accumulated salts carried in the exudated water. Marloth in Egypt in 1887 found salts on the leaves of tamarix as the result of exudated water residue. Lepeschkin in 1906 found glucose and basic oxalic acid. Klein in 1913 found that on some plants nitrate salts were deposited on the leaves as residue from exudated water. Marloth reported after collecting from the leaves and stems, the dry salts consisted of:

51.9%	$CaCo_5$	- calcium carbonate
12%	$MgSO_4H_2O$	- magnesium sulphate
4.7%	$MgCl_2$	- magnesium clorate
3.2%	$MgHPO_4$	- magnesium orthophosphate
5.5%	$NaCl$	- sodium chloride
17.2%	$NaNO_3$	- sodium nitrate
3.8%	Na_2CO_3	- sodium carbonate

We know that plant injury will occur when a high concentration of salts is present in the soil solution. Seeds are also affected. It has also been shown that injury will result by all soluble salts whether they contain plant nutrients or not. Some of the fertilizing materials used have a high salt index!

Material	Salt index
Nitrate of soda (standard)	100.0
Calcium nitrate	72.8
Ammonium sulphate	53.7
Ammonium nitrate	49.3
Muriate of potash	31.9
Urea	26.7
Pottassium nitrate	20.1
Sulphate of potash	14.1
Superphosphate, 20%	6.4

Concentration of various salts can cause injury in one of three ways, or in combination:

1. As the exudate forms and the water evaporates, the salts accumulate on the leaf. When these salts reach optimum concentration, they cause a leaf burn.

2. If the exudate falls and is absorbed by the thatch and held there, plant stems can be injured or burned when the salt concentration reaches a toxic level.

3. If the exudate is washed into the soil rootzone and high concentration of salts is formed in the soil solution, then root burn and injury can occur.

Theory

Turfgrasses can be injured or killed from the effects of exudated water under certain conditions. Exudated water is the result of the natural biological function of grass plants. It is the result of normal transpiration and is a continuous function of normal healthy plants. If normal exudation is stopped or retarded in any way, the grass plants may suffer. Exudate water is formed on the leaf at the open stomata along the sides of the blade and at the tip. If the grass blade is cut and open cells are exposed, exudation will be profuse in this injured area.

Exudated water evaporates as it forms during periods of low humidity. It accumulates during periods of high humidity. Humidity levels are always much higher in the micro-zone where grass grows. (The micro-zone can be considered to exist from ground level to the level of the grass mowing height). Exudated water has the same pH as the plant sap and soil water.

If the pure exudated water droplets contain a high concentration of nitrates, burning of the life tissue may result. Exudated water when diluted with irrigation water becomes harmless provided the diulted exudate is washed into the soil water. Exudated water contains the proper nutrients to support bacterial activity and turfgrass diseases.

Among the popular turfgrasses, their exudating rate can be shown as follows:

Bentgrasses	- high	Bluegrasses	- medium
Bermudagrasses	- high	Fescuegrasses	- low
Poa annua	- medium high	Zoysiagrasses	- low

The bentgrasses and the Bermudagrasses are highly susceptible; bluegrasses are moderately susceptible. The fescuegrasses and Zoysiagrasses are the least susceptible and, of course, are the driest of the grasses.

Wetting agents that reduce the formation of "dew" in reality only reduce the surface tension of the droplets. They adhere less to the grass blade. This may have

some beneficial effect.

Some of the foregoing statements are fact, some theory. Needless to say, there is enough evidence on the relationship of exudated water and turfgrass problems that this whole subject should be thoroughly and scientifically investigated. Until we can get the answers to some of these aspects of exudated water, we must continue to grow turf as best we can. The following is a suggested approach by H. B. Musser:

1. Provide provision for adequate surface and subsurface water drainage.
2. Provide good air circulation over greens
3. Correct surface compaction with suitable aerating tools.
4. Modification of heavy soils by a program of aerating and topdressing to build a porous layer.
5. Adjustment of soil reaction to pH 6.0 or higher.
6. USe of the more slowly available nitrogenous fertilizers in quantities that will produce normal growth without over-stimulating.
7. Provision for a constant supply of available phosphate, potash and trace elements.
8. Adjustment of watering practices to provide as long intervals between applications as practicable. Continuously saturated turf must be avoided.
9. Elimination of matted or spongy turf.

What to do During Periods of Stress

1. Practice early morning watering. (This dilutes the exudated water and dried green before mowing).
2. Use sufficient water to wash exudate into the soil. (Possibility of salt accumulation is minimized).
3. Use high pressure rinse and direct stream directly into turf. (The fungi mycelium can be mechanically destroyed at least temporarily by the force of the water.)
4. If a disease attack seems uncontrollable, drag-mat the green in two or three directions, then mow. (This will mechanically destroy the mycellium of the fungi at or near the surface of the turf).
5. If severe thatch is present and fungicide will not control the spread of the disease, try light vertical mowing. (Verti-cutting will mechanically destroy the fungi mycelium).
6. Topdress lightly. (Topdressing does something to turf for which no substitute can be found. It will mildly stimulate the turf, dry it somewhat to help retard fungal growth).
7. Lime. (If disease is rampant, dust with 5 - 10 lbs. of hydrated lime per 1,000 sq.ft. at 3-4 week intervals. Although this amount of hydrated lime is small, care should be exercised when applying it. Grass must be dry or a burn will result. Apply after exudated water has evaporated. The hydrated lime should not be watered in, but left to remain on the turf until the next watering).

Exudation is a normal function of the grass plant and as such insures normal, healthy growth.

IN CLOSING, I hope I have stirred your imagination. We need documented evidence about the cause and effects of so-called "dew." Research is not the exclusive domain of the scientist - it is also a part of the practical man's job to be inquisitive, to study and to experiment with cultural practices, to help supply some of the answers.

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NEW CONCEPTS IN IRRIGATION

C. K. Watson, Toro Manufacturing Corporation
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Basically we look for seven features about an automatic system:

1. We look for controlled watering, - a precise use of water, applying just the right amount of water, which can be clock timed for a specific soil condition. Sprinkling can be regulated to an area as small as the coverage of a single sprinkler head.

2. Now, next we look for the best possible and maximum use of time available for watering. By the selection of schedules, when water pressure is at its best, wind at its minimum, and interference with people at a minimum. This generally means watering in the late evening, night and early morning hours.

3. We look for evenness of watering, such as a steady sprinkling created by positive rotation of a gear drive. There exists on the market today, two-speed sprinkling heads that allow even watering on single row systems because the head slows down in the areas where the sprinklers do not overlap and speeds up in the overlapping section.

4. We look for frost control which can be accomplished by running sprinklers during early morning hours. A sprinkler system must also be geared toward maintenance syringing on hot days when grass must be cooled once or several times, and when any special application of fertilizers or chemicals requires a little water.

5. Also, a sprinkling system must conserve water - when water is turned on, and turned off at pre-set times without forgetfulness.

6. And lastly, we all know that a deeper root system makes for stronger turf. Therefore, it is likely that with an automated water system turf will be least subject to moisture stress. That is, there will always be water available in the upper 50% of the need range, thus the wilting point for turf is avoided.

What are the new concepts of turf irrigation? Today a two-speed feature not only gives even precipitation, but it also puts water on in less time than do single speed conventional models. An even amount of water can be put on a surface area in 40 minutes with a two-speed unit versus what would normally take an hour for a single-speed unit.

Some manufacturers today have introduced a sealed gear drive - completely protected again the harmful effects of water. These units are manufactured to have a minimum running time equivalent to ten or twelve years of usage. Many manufacturers are thinking with the superintendent as far as easier maintenance is concerned. In many heads, this is accomplished because there is complete accessibility to all components from the surface. This eliminates any excavation. In other words, we eliminate what I commonly refer to as a "thirdy dollar hole."

Some manufacturers have gone to specially selected materials, such as Delran and Cycolac. They were chosen because they are durable, and have high impact resistance, and have developed long wear characteristics that resist the corrosive effects of water. Manufacturers have also designed and created, in the last few years,what is known as a valve-in-head concept. This means that the valve itself is built within the sprinkler head.

Other manufacturers have designed positive winterization for freezing climates. In other words, they have designed heads that are self-draining to avoid freeze damage to the sprinkler head itself. In addition, there are available winterization plugs to winterize the piping system which will protect against back seepage into the piping system itself, and will prevent water from seeping into the pipe line during winter thaws. Then, too, certain manufacturers have developed a gentle control system, slow closing and opening speeds on its valves, resulting in the control of surge pressures on the piping system. It can add considerably to the life of the system.

Basically we look for increased flexibility and decreased cost. In the past, all irrigation has been based upon the principle of applying as much water as possible per irrigation cycle. With the old manually-operated system, this includes the furrow and the flood and the quick coupler. Labor is required for each application of water, which dictated that watering cycles be kept at a minimum - in order to keep labor costs down.

With the advent of automatic watering systems, it is feasible to consider more frequent and even repeat watering cycles. The initial automatic watering systems were the block type where one large valve controlled a great number of heads. Now, the drainage problem associated with this type of system was severe and it was advisable to operate this type of system as we had in the past with as few cycles as possible. Later, a few years ago, designers began to incorporate the valve-in-head concept which, for the first time, eliminated all restrictions of the number of watering cycles that could be utilized; thus, the vari-time system is possible.

Here is a review of the general combinations of automatic control systems, either previously attempted or presently being practiced in some manner:

1. A few controllers with up to 30 stations and operating up to 20 heads per station on a block type system.
2. A higher number of controllers but fewer stations and grouped into zones.
3. Central control with all clocks located in a single control room.
4. All manner of multiple head controls, including block systems, and with as few as 2 or 3 heads per valve.
5. Single head control or a valve per head per station

To achieve good irrigation requires matching together the best concepts of flexibility into an overall system concept. Such a system also takes into consideration the fact -- is it economically feasible? Let's review the basic problems that beset our industry.

1. Water gathers in low areas and in soils that have low porosity
2. Side hill watering results in runoff and erosion
3. Soil conditions vary within short distances of one another
4. Changes in watering programs take time
5. Central control is usually quite expensive
6. Central control lacks visibility for maintenance watering. Two-way radios are not the complete or even a very good answer.
7. Certain types of control systems have complicated programs and, therefore, are ineffective for the layman's use.
8. Certain types of controllers are highly flexible and are very expensive, and are very complicated. And, all of this flexibility is lost if a number of heads are run at one time.

With these basic problems in mind, we attempted to set up the ideal solution, keeping in mind that the principle of reasonable cost was important. Here was our objective:

1. The ideal system should be capable of making changes or by-passing the watering program for the total area in only a few moments.
2. The system should be capable of adjusting to different turf watering problems.
3. Adjustments could be made in areas as small as the coverage of a single sprinkler head and be flexible to adapt to any type of soi.
4. Have the capability of semi-automatic and manual override for maintenance watering in full view of the area being watered.

Then, superintendents indicated four things that the ideal water system should provide as far as they were concerned. We came up with four answers -

1. Even precipitation
2. Flexibility
3. Long product life
4. Practical product maintenance

We came up with a central control system with a two week programming. Next, we placed satellite controllers connected to the one central control which allowed for the flexibility of zone control, plus separate variable timing for each sprinkler head in the field. These are regulated by the central controller which regulated starting times and repeat cycles. Now, the central controllers were located in a superintendent's office or pump house, and they signalled the entire golf course for automatic, semi-automatic, or by-pass sprinkling as required by weather. This central control allows for instant changing of watering times and the number of cycles for effective soil infiltration, and it has the basic benefit of improving the health and vigor of the grass. In this sytem, electric signals are used from the central to the satellite where long distances are involved.

Now, from the field satellites to the individual head, either a hydraulic or electrical signal is used and both of these are only very short runs. The manufacturers feel that this system combines the best of central and zone control, using the best features of both the hydraulic and the electrical control and fusing them into the best possible watering system for the money. By this system it is possible to match soil conditions with watering time available and to adjust each head for individual running time.

In summary, there are many watering systems - installed in the last few years- that are giving their customers an efficient watering job at the lowest possible cost -- while still retaining a high degree of flexibility and effectiveness. And that the vari-time has measured up quite well to the four principles - even precipitation, flexibility, long product life and practical product maintenance.

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AUTOMATIC IRRIGATION

Walter J. Wilkie, March Irrigation Company
Muskegon, Michigan

Last October,at the suggestion of John Dunlap,I wrote Dr. Daniel advising him of the tragedy that was occurring within our sprinkler industry. I told him, in part, that most people blindly look upon any form of an automatic underground sprinkler system as a universal panacea to all of their watering needs. However, we all know that they aren't. Many of you here today, although appreciative of your system,

are somewhat disillusioned at the demands of the work load that you have fallen heir to as you try and implement the so-called managerial control that is supposed to be a part of every automatic system. Needless to say your plight is to be pitied, and if there is any justification for same it, perhaps, lies in the infancy of our industry which means that you're crawling has enabled us to do a better job of walking today, as we try and implement a system of built-in quality control. Why? - because you've defined the problem and have taught us how to build a system with an intended usage pattern, rather than the way time dictates we compromise with its intended use.

For instance, the installation of any given golf course will require anywhere from 18 to 36 controllers, depending upon the size and the geography of the course. These are normally located in three or four controller areas, and it's the management and operation of these controllers that has dictated your success or failure with the system.

For instance, I've heard many of you complain that you've in essence become "scooter jockeys" for to make a simple time change requires that you get on your scooter, drive out to each one of these controller locations, open the control panel, and open each of the controller boxes to reset the sprinkling time on each of the 18 or 36 controllers. This requires, at a bare minimum, at least an hour of your time. Thus if you had an hour program scheduled but really felt that 45 minutes would be a more realistic estimate of your grasses' water requirements, you may do nothing, or because of the criticalness you were the slave of your system and took the time required to readjust same.

As a result of these shortcomings that have seemingly plagued our industry, we feel as if a list of rules should be adopted for the design and installation requirements of all systems so as to refine their operating efficiency. These are as follows:

1. That only greens be on controllers designated to control greens.
2. That only tees be on controllers designated to control tees.
3. That only approaches be on controllers designated to control approaches.
4. That only fairways be on controllers designated to control fairways.
5. That all controllers be capable of operating simultaneously if water permits.
6. That all stations on the clocks be balanced in the field to put no more or less water than the average equivalent desired precipitation by adjusting the nozzle sizes of the equipment.
7. That all controller stations will program to operate for no less than three and no more than five minutes of time during each system cycle.

If we design our systems within these guidelines we can go one step further and add a center controller to control the satellite controllers.

On the lower right hand corner of a panel are four switches, the first of which is the power switch which serves as the master control switch to the master control panel as well as to each of the individual controllers. Next to that is the pump start switch which is purely a manual override for any system which uses the clocks for the "on-off" operation of the pumps. The third switch is a re-set switch which we call the manual advance circuit, which when depressed will automatically bring all of the clocks, regardless of what position they're in, back to the "off" position and stop there.

The last switch, of course, is the rain circuit which, when wired to the rain switch, will automatically stop the sprinkling cycle after a pre-determined amount of precipitation has fallen. Originally we had this so designed that when the rain switch stopped the sprinkling cycle it would automatically move the controllers back to the zero position. However, on many occasions when, say the switch had been set to stop the cycle at the end of 1/10th of an inch, and because that was all the rain

that you had during a given night, many of you wanted to continue the sprinkling cycle the following morning from the point at which it had stopped, and so we now just kill the sprinkling cycle at that point. You then in the morning can elect to manually override the rain switch, or bring the clocks back to the zero position.

With the power in the "on" position we have independent control over all of our green controllers, tee controllers, approach controllers, and fairway controllers and for each of which we have a three-position switch which will put it in the "on-off" or auto position. With the switch in the "on" position it will automatically start a sprinkling cycle at that moment and continue to repeat it until the switch is either moved to the "off" or auto position, after which it will complete its cycle and stop in the normal "off" position. Then, directly above each of these switches is a time-clock which is graduated in 15 minute increments. We can, with this time-clock provided our switch is in the automatic position, control both the time the sprinkling cycle begins and the amount of time that each zone will operate.

For instance, suppose we were to decide that we wanted to water tonight, and that we wanted to water the greens for 15 minutes, the tees for 20 minutes, the approaches for 15 minutes and the fairways for 30 minutes, and that we wanted to start the sprinkling cycle at 10:45 P.M. Well, if you will recall, we said that we, under our system, dial approximately 5 minutes of time on each zone. So, to water the greens for 15 minutes we'd have to repeat three cycles; to water the tees for 20 minutes we'd have to repeat four cycles; to water the approaches for 15 minutes we'd have to repeat three cycles, and to water the fairways for 30 minutes we'd have to repeat six cycles. If we had pre-determined that we wanted to start watering at 10:45, on our time-clock we pull out the first pin at 10:45 and on the greens we would ask it to repeat again at 11:45 and 12:45, respectively.

With this feature we have found that because of the ease with which the superintendent can change the amount of time that he waters each day, he waters more as the grass needs it than as he has programmed it to do because it is now easy to change the time and to compensate for the changing atmospheric stresses placed upon his turf.

The syringe control can remove the dew from the greens, tees, approaches and/or fairways in the early morning hours and would be able to remove frost as it might occur in the early spring or late fall. This syringe cycle is subdivided into "on" "off" auto control for each of the three groups and waters for either a pre-determined or adjustable increment of time on each zone, and the lights under this grouping show which of the controller zones is on during operation.

I'm sure that you can see what I mean when I say that your crawling is enabling us to do a better job of walking today. As a "for instance" - I can remember in the fall of 1966 when we began to negotiate the contract for the Oakwood Club, John Dunlap, their Superintendent, asked me what type of auxiliary controller control we were planning for his installation and I told him that we had a master switch that would stop the sprinkling cycle in the event of inclement weather. He queried the above and said, "It's not enough" and began to tell me all the things that the system was going to have to do, which is basically the essence of everything that I've told you today. We then, with his help, installed the wires and he started us upon our first attempt at a method of Quality Control through Automation, and it's John who will take the last half of this program and explain to you from the superintendent's point of view why these things are so necessary and how they work in practice.

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QUALITY CONTROL BY AUTOMATICS

John Dunlap, Supt., Oakwood Club,
Cleveland, Ohio

A great deal has been written and said about automatic irrigation systems in the past ten years - some of it good and some bad. Many of the first automatic systems were badly engineered and also poorly installed; consequently raising the voices of dissent. In recent years equipment advances and new technologies have greatly increased the reputations of automatics.

The new "super" automatic systems that are now being installed in the Northern Ohio area are very large investments, ranging in costs up to $ 200,000. Any project of this magnitude takes careful planning and engineering, so for the next few minutes let's take a look at what is involved in getting one of these systems into the ground.

Planning and design for a system must start at least a year ahead of the time you hope to install it. Contact qualified irrigation personnel to help lay out a basic plan for your course. After the basic plan is made the superintendent should then go over it and make all necessary changes so that the system is now custom-designed to water his particular course as effectively as possible.

The next step is to contact as many equipment manufacturers as possible and get some of their equipment for your own testing purposes. It is quite surprising to see how much performance differences there are between various makes of equipment. You should decide which kind of electric valve will do the best job, whether you prefer electric or hydraulic operation, and what type of pipe you think will best fit your needs. But choose carefully because there are no bargains, and beware of people offering "deals." Above all else, do not design the system to a preset dollar figure. Design to meet your specifications of performance and then put this plan out for bids to good irrigation installers. Beware of plumbing contractors bidding on such installations - they simply donot have the experience necessary to install something this complex.

When the bids are received from the installers, turn the bids and contracts over to your club lawyers and make sure everything is down in black and white. In the final analysis of the bids the lowest bid does not necessarily represent the best dollar value, so here again choose carefully. Even though the system will probably be installed by an outside contractor and his crew, it is the course superintendent's responsibility to see that the system is installed properly. So, let's look at a few things that are important for good installation.

We mentioned before that planning should start at least a year ahead of time. One reason is so that the contract can be signed several months ahead of actual installation date, and the installer will have plenty of time to order the bill of goods and have them delivered to the job site. Delays caused by lack of piping and sprinkler materials is very costly. When the paper version of the system design is transferred to the course, the superintendent should be responsible for the placing of all sprinkler heads and where necessary be willing to make field changes if they will improve upon the basic design.

The pumping facility of a super-automatic is very important. In the past, many systems were installed with much too small a G.P.M. capacity and this impaired the proper programming of the system. The G.P.M. of today's systems should be adequate to run all controllers simultaneously without loss of pressure. This is of particular value when a syringe cycle is included in the system since a syringe

cycle must be completed in as little time as possible to be of value. A good syringe cycle should be able to wash off the entire golf course in no more than 30 minutes, and in order to do this the pumping capacity for most systems should be at least 1200 G.P.M., and better yet around 1500 G.P.M.

Another feature to consider would be some type of pressure regulating valve so that main line pressure would remain constant at all times no matter if 1 head or 20 heads were in operation. All pump controls should be fully automatic and be kept as simple as possible. This is one area where designers tend to over-design. Flow switches and pressure switches still give the best pump control available and are almost completely trouble-free.

Since the operation of a master control was covered in the previous talk, we won't dwell on it here except to say that this is the heart of an automatic system. Without a master control panel the superintendent becomes a virtual slave to the system. Every time a change in the weather occurs he must visit all the controllers and reschedule his watering program. With a master control he can change, stop, or start all watering cycles from his office. This convenience will pay for itself many times over because the superintendent will easily change his watering program to match day-to-day weather changes instead of "letting it go" as previously programmed.

After the system is installed and in operation you can expect to spend at least a year balancing and adjusting the system to perfection. Time-clocks must be adjusted to compensate for various soil conditions, nozzle sizes on some sprinklers will have to be changed, and pressure might have to be adjusted at individual heads to give proper operation.

All of the things we have said in the last few minutes sound like a lot of work, and they are, but when you are finished you will have a most efficient irrigation system and will be able to give you "quality control" of the water that is applied to the course.

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CENTRAL PROGRAMMING OF GOLF COURSE IRRIGATION

Austin J. Miller, Pres., Miller Sprinkling Systems,
Royal Oak, Michigan

What do you want? You can have every switch, knob, fuse, clock and push-button in your superintendent's office, or the pumphouse, or the clubhouse. The other extreme is also possible, and you can have your controllers scattered around the course in 20 or more locations.

The superintendents operating automatic systems are in the best position to give direction in establishing the happy medium. No one solution is right for every course. Most superintendents recommend 4 to 6 satellite controller locations. This keeps the wire or tube runs reasonable and allows the operator to see the sprinkler he is turning on when manually operating the controller.

At the satellite locations there should be separate controllers for greens, tees and fairways, even approach to the greens. These satellite controllers should have more than one automatic valve per station and must be capable of automatic, semi-automatic, or manual operation independent of the central program. By provid-

ing each satellite with a 24-hour starting clock it can function fully automatic in case of a central program failure from fire, lightning or wire break.

Each satellite controller should have a lightning arrestor on the primary electrical supply and a copper ground rod connected to the cabinet. Controller cabinets need to be on a 42" concrete base to prevent frost heave and resulting misalignment in later years. A concrete pad in front to stand on and at least a 12" concrete apron on the other three sides will permit mowing around the controllers and eliminate hand-trimming. By supplying the satellite locations from the closest electrical source, wire size and distance is reduced. This usually means two or three sources of power, thus reducing your reliance on a single source.

Sounds great, doesn't it? That's a complete automatic control system detailed above. What about central control? That's the point. Central control or central programming should be reserved for those functions you want to do from your office. This can be as simple as a Yes - No switch. Yes - I want water tonight, or No - I don't want water tonight. It can be as complete as remoting every function available at the satellite.

It is generally felt that your central control should let you start your irrigation program for greens, tees and fairways independent of each other. Syringing of greens, tees and fairways should also be independent and the syringe time should be variable. You can also have an on-off switch for each controller on the course so that parts of the program can be omitted. Appropriate lights on the panel will indicate switch position or the function in operation.

Of utmost importance is an emergency switch so that you can turn off the program during operation. A sudden shower or call from the clubhouse that a sprinkler was running would make this switch useful. An adjustable rain switch that will shut down the program after two-tenths inches or more of rain might save a 2 A.M. drive to the course during a thundershower. The controllers should automatically re-set to "off" after the above switches go off. Control of these remoted functions can be in a panel box mounted in the maintenance building or superintendent's office.

Most golf course automatic systems will cost over $ 100,00, and when you're spending that amount of someone else's money (your club members) it deserves the services of a Professional Engineer with considerable experience in golf course irrigation. You shouldn't depend on a free plan from a material supplier,or contractor. You and your engineer can include in your central program the functions that most nearly meet your operating requirements and capital budget.

Central programming won't grow better grass, but it is another step in providing more precise water control which will help you, the superintendent, grow better grass.

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INDUSTRIAL LANDSCAPE IRRIGATION

Austin J. Miller

Your biggest headache? That automatic irrigation system around the new manufacturing plant, city hall, or apartment complex you have just finished seeding and planting? Nine times out of ten you'll end up with a quagmire in a few short days.

The owner or manager probably has no irrigation system at his home and has longed for water during a summer drought. The new automatic controller allows him to put his theory of "a little water is good - a lot must be great" into practice. Result - the system is run so frequently that you get a call complaining the grass is turning yellow.

The answer is simple. You keep the key to the automatic controller. If you control the watering, the automatic irrigation system can be the best friend you've ever had. It will let you keep your sod and plantings in the same good condition as when planted. Turn the automatic system over to the owner only after you have given him instructions on its operation. Recently moisture sensors have been developed which sense soil moisture and omit irrigation if above the pre-set level. This unit should be specified on all jobs.

An irrigation engineer should design the system, but he needs the landscape designer's help to do a good job. Normally, the irrigation system cannot do the right job on lawn and plantings at the same time. Lawns are irrigated frequently and light plantings more infrequently and heavy. If plantings need more than the normal rainfall and cannot stand periods of drought, water them on separate zones from the lawn sprinklers.

Your irrigation designer will need to know what areas to border with part circle sprinklers, i.e., parking lots, walls with low windows and entrance walks. The type of grass and height of cut will influence amount of irrigation to be expected. Slope of the area, drainage and areas shaded by buildings are also important.

Length of available watering time at night and size of water supply will affect main line size and number of automatic controller stations. Location of automatic controllers will depend on who is going to operate the system, i.e., for the maintenance man, install in mechanical room; plant protection man, in office or gate house; outside landscape contractor, on plant wall behind shrubs or plant manager, in manager's office.

A backflow prevention device is required to protect the municipal water supply. This normally extends 12" to 18" above the surface and should be camouflaged in shrubs. The owner should help select the automatic controller and backflow preventer locations. Your irrigation engineer knows sprinklers, pipe, automatic controllers and you know grass and shrubs, and it takes a good dialogue between both of you to provide an efficient irrigation system.

Rates of precipitation for the various types of sprinklers used on the project should be listed on the plan. From these you can instruct the operator in length of time to run each zone and the days of the week that the controller should operate. As a guide, rotary pop-up sprinklers will apply about one-quarter inch per hour and stationary pop-up sprinklers, one inch per hour. You can readily see that they should not be mixed on the same zone control. Manufacturer's tables give exact rates of precipitation.

Some responsible person should be placed in charge to monitor the irrigation system and add or omit sprinkling cycles as changes in weather occur. Herein lies the main advantage to automatic control. The more-skilled and permanent man in 15 minutes a week can replace the less-skilled man working 20 to 40 hours per week. Not only is considerable money saved in operating labor, but the water is applied at the right time and in the right amount. This saving in operating labor will sometimes pay for the whole system in five to ten years and the automatic control portion in one year.

Remember, every irrigation system is custom-designed. The landscape designer must participate in the planning and operation of the system until the owner or operator is fully trained in monitoring the system.

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PRODUCTION, MERCHANDISING AND FUTURE PLANS FOR FYLKING KENTUCKY BLUEGRASS

Doyle W. Jacklin, Jacklin Seed Company
Dishman, Washington

New turfgrass varieties - inferior, superior, dense, thin, profitable, unprofitable, capitalistic, socialistic, headaches, bastards, and several other words may be used to describe proprietary turfgrass varieties which are and will be released in the future. Good or bad, proprietary varieties appear to be setting a marketing trend which will see many merchandising changes in the seed and sod industry. Many of these changes are already occurring and our Company for one has been able to observe through first-hand experience the problems and satisfactions which accompany these changes.

Planned production, promotion and marketing of the patented variety Fylking is no doubt similar to the types of programs followed for Scott's Windsor, NK's Prato, and Warren's A series. As one of the new proprietary turfgrass varieties, however, Fylking is somewhat indicative of the new merchandising techniques which will be followed in the future. By discussing some of these techniques with you I hope to reveal several hints and facts which should prove to be both informative and beneficial in the successful marketing of any variety whether it is public or private. Keep in mind, however, that many of the points I make may not always be applicable to all varieties or marketing programs, but they have been successful or unsuccessful for us, and may indicate the same for you.

First, let me throw out a monetary fact for your consideration. Our experience with Fylking indicates that to successfully introduce a new Kentucky bluegrass variety a minimum initial expenditure of at least $60,000 basis today's money market is required. The first three years following introduction, an annual promotional budget of no less than $ 50,000 to $ 60,000 is required, and as production increases the budget must also be increased. That's $ 300,000 promotional expenditures for the introduction and first three years following introduction with no guarantee of public acceptance.

To give you an idea of where Fylking is today, it has been 2½ years since we made the official public introduction. Naturally, $ 300,000 sounds like a lot of money and believe me it is. Of interest to those who may fear a flood of new varieties, such a large expenditure will tend to automatically limit the number of new Kentucky bluegrass varieties to be successfully released and merchandised now and in the future. Factually speaking, many things must be accomplished to successfully introduce a new variety, all of which require money. Let's look at a new introduction using Fylking as an example to get a better idea of the nature of this expense.

Requirements:

1. The breeding or selection of a variety which is unique and reproduces true to type
2. The increase of the variety for seed testing stocks.
3. The distribution of seed samples to a representative group of testers.
4. The compilation and evaluation of test data.
5. Decision as to whether to introduce the variety or not
6. Publication of test data
7. Decision as to the method of variety protection and marketing procedures to be implemented.

In this regard I make special mention of the U.S. Plant PATENT Act which is the only real means available today for variety protection. Although other systems have been proposed, none have been implemented. Involved in the plant patent application is a detailed description of the variety, a two-to-four year period during which the Patent Office reviews the patent application and naturally patent attorney and application fees. Finally a number is assigned.

Registration of a brand allows an owner exclusive use of that brand in the sales of his particular variety. An example of this is our use of the 0127 registration which identified the North American production of Fylking Kentucky bluegrass. Such a registration again requires application through the U.S. Patent Office, a reviewing period of about 12 months,and naturally attorney fees.

The variety name is distinct, Fylking - it cannot be patented nor branded. In summary, a minimum of over five, and possibly ten, years of investment are necessary even before evaluation, and at the end of this time the variety may offer no advantages over other varieties to warrant its release. To state it bluntly, you must have a superior variety; secondly, you must test it adequately throughout its growing area.

There is one exception to this, however, and that's the variety which is selected because it is distinguishable from others but offers no important improvement and is not properly tested before release. Without trying to revive bitter memories by mentioning Newport, I am inclined to use this variety as a typical example of inadequate testing and unproven superiority prior to release. A situation could well arise today, or in the future, whereby a company or grower desires a new variety for his own and is willing to commit for any variety, whether superior or not, and promote it for all it's worth just so he has an exclusive. Although this would not be a good procedure to follow or condone, it will no doubt happen and then the entire industry will suffer to some degree.

On the other hand, a few other new Kentucky bluegrass varieties are on the horizon ready to be released and have been tested for many years. Due to one or more unique and desirable characteristics, they will be released for public acceptance, and in this group I would include such varieties as Pennstar, Sodco, Warren's A Series, and other of similar stature.

Assuming the variety has been released, what's the next phase of introductory promotion? Since initial quantities of seed will naturally be limited, a certain segment of select customers should receive the majority of seed stocks rather than trying to make it available to all customers in meaningless amounts. For example, with Fylking our initial approach was to sod growers and golf courses only, by-passing the rather lucrative retail seed sales through chain stores, landscapers, hardware stores, etc. There was a method in our madness, however, since we felt that Fylking had a prime place in sod production based on early test results. If the sod growers proved this fact, which they did, then we intended to use this information for all it was worth in the promotion of its superior attributes to the consumer

whether it be in a seed or sod form.

It had been planned that as Fylking seed became available it would be released in straights or mixtures at the retail level. We had hoped for such a retail introduction this spring, but due to a shortage of seed for the second consecutive year Fylking will be available only in limited quantities throughout certain eastern areas. Although this is disappointing, it may prove advantageous since it allows us another eight months to gear up for a full-scale promotion program this fall.

Although initial seed releases were restricted to sod growers and golf courses, there were still a number of promotional items and projects which had to be completed for a successful introduction of Fylking.

1. Fylking had to be introduced to sod growers and golf courses in an informative manner. This was accomplished through mailings of the facts and summations report to sod growers and golf superintendents, either directly or through our own distributors. Promotion of Fylking's superior attributes was accomplished through advertising in trade magazines, journals and newspapers. Trade magazine articles such as appeared in the Weeds Trees and Turf magazine, or the Flower and Garden magazine, were reproduced and redistributed to additional potential customers.

2. Promotional pieces had to be made available to sod growers and golf courses, not only for their own information but in particular for use by sod growers in distribution to their potential customers.

As a grower and processor we are convinced that we have a share of the responsibility in seeing that our customers are able to sell our variety to their customers. We are following through and will continue to do so by providing all the promotion we can through literature and other material made available to distributors and distributors' customers, including jobbers, sod growers or dealers at no charge. These items include:

a. An attractive full-color brochure containing descriptive information about Fylking for use as a point of purchase counter piece, envelope stuffer or handout.
b. A small sized three-color informational brochure which makes an excellent standard size envelope stuffer.

c. A full-color, fade-proof outdoor streamer, capable of withstanding 45 miles an hour plus headwinds, and I can verify that figure since I had to personally test its capabilities myself.
d. Full-color indoor banner especially designed to provide an area for private name imprinting in the upper left-hand corner.

e. Reprints of magazine ads for use as envelope stuffers or in the hardback form provide an excellent standing counter easel or hanging card. With a "Recommendation seal" over-printed on the ad reproduction, this point of purchase piece provides a prestige to the product. This particular ad has the Sunset Magazine seal of approval on it, and in the West the Sunset Seal of approval carries just as much weight to the consumer as the Good Housekeeping seal does throughout the United States. We are using the seal extensively in the West, primarily in California.

f. Full-color postcards, again for use as a counter piece, complimentary favors, or as a self-promoting letter which dealers, nurseries, or sod growers can use in contacting customers through the mail, or perhaps even to be used as a nice reminder that their bills are overdue.

g. Pocket notebooks used as a meeting or conference complimentary favor.

h. Our newest item, which is now being printed, is the full-color seeding, sodding and maintenance brochure for consumer use. It is an excellent piece, and I wish I had it here to show you. Dealing with seeding and sodding procedures, this brochure should answer most questions the homeowner will have if he is planning to sod or seed his lawn, in addition to providing tips for the maintenance of that lawn in a superior condition.

i. A future brochure will be our second technical bulletin which will deal with the technical test results, seeding and sodding procedures, and maintenance requirements described in considerable technical detail. It is not intended for the consumer but will be available to him on request. This brochure will provide the scientific and agronomic information required by golf course superintendents and sod growers for the successful production of superior turf.

With all these promotional pieces you might ask - "What's left for distributors, sod growers, nurseries and dealers to do promotion-wise?" Well, there's lots -- the previous items will fill about 5% of the successful promotional requirements, but the rest comes from direct local promotion throughout the usage area. Consumer magazine, newspaper, regular TV and other forms of advertising which you and I are subjected to every day fulfill the remaining 95%. We are further convinced that a portion of this promotion should be done by our Company as a service to our distributors and their customers.

Our participation will be in several forms, the first of which includes mailing of professionally written turf articles to over 600 newspapers and garden editors throughout the United States. These mailings occur in the spring and fall for a total of 8 - 10 mailings per year. We have had excellent results from this type of promotion with either a portion or our entire article appearing in most of the major United States newspaper garden columns. Many magazines have published or will be publishing these articles as feature stores and some of them include such names as Better Homes and Gardens, Sunset, Flower and Garden, Floral magazine, Home and Garden, Landscape Industry, Weeds Trees and Turf, and many others. Additionally we will participate in direct consumer advertising through ad placement in Sunday newspaper supplements and selected national garden magazines. The major portion of advertising, however, will originate from distributors, dealers, nurserymen and sod growers who handle Fylking seed or sod.

Now that I have mentioned the name sod growers, let's discuss the sod growers' role in the promotion and avertising of any turfgrass variety. Although I am not a sod grower and do not have any direct sales contact with sod growers, I have met many of you at conferences such as this, or during brief visits to your farms. During these visits I often hear the words, "Why should I advertise or promote when I am selling all the sod I can grow without any advertising?" It's a logical question and on first glance it defies an answer. On second glance, however, it is rather easy to dispute this statement, and I give the following reasons:

1. It's going to catch up with you. At some point, maybe this year, or even ten years from now, the supply will eventually exceed demand. From that time on it's going to be either wholesale price cutting, or survival of the grower who has established a favorable production reputation through promotion and merchandising.

2. Foresight in testing and growing new varieties more suited to the public's needs and tastes will benefit most growers who are eyeing the future, not just the present. Promotion of new varieties in the early development stage not only acquaints the public with the new variety, but develops a relationship whereby the public associates this grower with newly released and superior products.

3. There is always the possibility of one or a small group of sod growers having an availability monopoly on a new variety and this can always be advantageous to that group until the other growers catch up. A similar occurrence can be the marketing of a proprietary variety by sod growers to the exclusion of consumer seed marketing. Again, this can be very worthwhile but does require superior promotion and merchandising.

4. Promotion of specific blends or mixtures developed by a grower or the unusual qualities of a particular variety can only mean better sales. It also indicates that a grower must be wise to have a wide selection of not one or two different varieties, but three or even up to six varieties, and/or combinations of varieties which can be promoted as being adapted to the various climatic, soil and physical conditions throughout his major sales area.

5. Although the majority of sod may be marketed through a nursery or similar retail outlet, promotion of a variety by a sod grower not only benefits that sod growers customer, but insures a consistent demand for that sod by the retail outlet in the future.

I could go on but time is running short, and I hope I had made my point. Advertising and superior merchandising techniques are not only important and profitable but very necessary to this rapidly changing industry of ours. My review of our Fylking promotional effort illustrates the importance of promoting any new variety whether it be of seed or sod. The rippling effects produced by advertising are felt by everyone, and I encourage all of you to actively participate in advertising, no matter what the variety, the method or the means.

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WINDSOR - - THE PONY GRASS THAT WENT TO TOWN

Paul Florence, O. M. Scott & Sons Company
Marysville, Ohio

Windsor, an improved variety of Kentucky bluegrass, was a single clone selection made from a pony pasture in Central Ohio in 1949. In Scott's Bluegrass Development Program data consistently rated Windsor superior in these categories:

1. Disease resistance, including the common bluegrass diseases such as leafspot, and dollarspot.
2. Drought tolerance - consistently remained greener and fresher in appearance during periods of extended drought.

3. Color exhibited the fresh, vibrant green color considered so necessary in a premium lawn grass variety.

4. Turf density, due to its disease resistance, drought tolerance and a superior root and rhizome system, Windsor was consistently rated superior in turf density.
5. Texture - attractive in texture, yet extensive clipping weight trials indicated reduced foliar production.
6. Close mowing - Windsor was maintained and performed well at clipping heights as low as 3/4 of an inch.

7. Chemical tolerance - exhibited extreme tolerance to the chemical compounds rapidly being formulated for lawn management. This included the phenoxy herbicides, the mercurial fungicides and the chlorinated hydrocarbon pesticides.

In 1960, Scotts inaugurated a first in the lawn seed industry. Seed producers in the Pacific Northwest were offered contracts to produce seed meeting rigid quality specifications. These products were and still are paid a premium for seed meeting the contractual specifications.

Limited quantities of seed became available and test marketing at retail was initiated in 1962 under Scott's brand - "Gold Label Classic," a bluegrass blend. As the seed producers increased their acreage and yields, Windsor was marketed in a broader geographic area and in several additional Scott brands, including pure variety.

The market place determines the success of any new product whether it be cars, chemicals or seeds. Last year, Scotts spent several million dollars promoting lawn products to the consumer in the United States and in Europe. Windsor was an integral part of that program, and as a result we sold over 3 million pounds of Windsor bluegrass seed in 1968. Windsor bluegrass was made available to the professional sod producer for the first time in 1964.

The plant patent on Windsor places responsibility on Scotts to insure that when any homeowner purchases Windsor sod, he does - in fact - receive sod grown from a Windsor planting, and meeting rigid quality specifications.

Scotts have developed a sod grower licensing program to meet this responsibility and designed to support the professional sod grower with technological assistance in production and marketing. The licensed Windsor sod grower is provided marketing assistance through his co-op advertising fund, designed to broaden the Windsor market, and stimulate the sod market in general.

Selling aids include signs, banners and promotional literature. We also assist him in building his market through seminars held at Marysville and in behalf of his customer whether they be landscaper or retailers. The marketing of Windsor sod is thus stimulated by local, regional and national promotional efforts, and in joint promotional programs with our thousands of Scott retailers from coast to coast.

Our Research Division has thousands of bluegrass varieties under evaluation and tomorrow we may have a replacement for Windsor! Today, however, it is still:

1. The first bluegrass variety to be patented.
2. The first bluegrass variety to be produced under seed contract paying a premium price for quality
3. The first bluegrass variety produced for sod under a successful Patent Licensing Program
4. The first variety sold with a guarantee to the purchaser, homeowner or professional, satisfaction, or your money back - no quibbling - no excuses!

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SODCO BLUEGRASS

W. H. Daniel, Dept. of Agronomy
Purdue University

Sodco bluegrass is a new multi-line variety released by Purdue in 1967. It is a combination of four individual lines selected for similar turf and seed qualities. It is dark green, slower growing, requires less mowing, tolerates shade, tolerates close mowing, is stem rust resistant. (The Anheuser dwarf is only one of the four lines. Anheuser will not be released as a variety nor recognized as such).

Sodco develops slowly, slower than Merion, so you may be disappointed in it as a young seedling both in its slow germination and its early stand. A light mulch, selection of sites where erosion is minimal, light over-plantings of lespedeza, rape or oats, which might reduce erosion - any of these may help - they are your decisions.

Sodco will respond to ample fertilization, equal or ample to Merion. It will develop sod very slowly, slower than most varieties; thus its true value is not its fast, easy performance for individual sod growers. Its excellent turf survival quality in shade, in disease-plagued areas, and its less mowing and less thatch characteristics should be most valuable to your users of sod.

The seed growing contracts are with Agricultural Alumni Seed Improvement Association, 2336 Northwestern Avenue, West Lafayette, Indiana, 47906, who have the responsibility for its production and distribution. Breeder's seed sent West in 1967 produced foundation seed in 1968, which was planted in fall,1968 and spring, 1969, for first certified seed beginning in 1970.

Some 15 sod growers in the U. S. received first demonstration seed in fall, 1968 for testing as sod. Some 40 experimentors have seed for test planting.

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PRODUCTIONS AND PLANS FOR WARREN'S A-20 BLUEGRASS

Ben Warren, Warren's Turf Nursery
Palos Park, Illinois

A-20 bluegrass is a variant found in an old stand of common Kentucky bluegrass. It has been under very close observation for 10 years in our Palos Park plots and in our plots at Goshen, New York; Anderson, Indiana and Crystal Lake, Illinois, for about 5 years. It has been observed in plots at several experiment stations and botanical gardens. The consensus from these evaluations establishes the following:

It is dark green and above average in density with medium width leaves that are upright and strong. Its most oustanding characteristic is its wide range of disease resistances. A- 20 has good to excellent resistances to leafspot, stripe smut, mildew and stem rust, plus above average resistance to Fusarium roseum. This grass will tolerate mowing heights down to 1/2", and at heights of 2 inches, the leaves are stiff and erect enough that satisfactory mowing is possible.

A-20 must be propagated vegetatively because of lack of trueness from seed. Several methods for vegetative planting have been tried in our fields, and to date

we are using one of the machines developed for Bermuda planting in the south with good results. The smaller size of this machine will plant about 3 acres per day. A larger machine being put to work this spring has the capacity of 10 to 12 acres per day. These machines place 3 square inch plugs on 9 inch centers.

Because of the superior performance of this grass, we are planning to convert the major part of our acreage to this strain.

(Editor's note - A-10, a patented bluegrass, is being produced in the St. Louis area. Vegetative increase A-34 is being sold for shade areas - up to 65% shade. Vegetative increase - A-34 is trademarked as is A-20.)

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BLUEGRASS RESPONSE TO CLOSE CUTTING

J. A. Long, O. M. Scott & Sons Co.,
Marysville, Ohio

Close cutting in turf use applications other than putting greens is becoming a routine practice and represents a trend for increased sophistication in managing turf areas. Heights of cut of 3/4" and 1/2" are now generally desired on tees, greens, collars and to a lesser extent on fairways. Improved playability and utility of turf under these mowing levels is the predominate driving force for mowing in this direction. As recently as five years ago many of those in turf research, extension and industry were hesitant in recommending or even suggesting that such species as Kentucky bluegrass could be maintained for extended periods of time at mowing heights of one inch or less. Some are still reluctant.

In our turfgrass breeding program at Marysville, Ohio, Eugene Mayer's group has been maintaining excellent quality bluegrass turf at 1/2 inch height-of-cut since 1963. A number of bluegrass varieties available today, in addition to a number of experimental bluegrasses, have been maintained with very satisfactory results. Mowing frequency of approximately 7 days has been used each year.

The irrigation program has been adjusted to provide at least 3/4 inch of water per week during periods when rainfall is not adequate. The test areas received 5.5 - 1.75 - 1.75 lbs./1,000 sq.ft. annually applied at a rate and frequency of approximately 1 lb. of nitrogen every 8 weeks. Clippings were removed with each mowing. Mowing was done with a trimmer-type reel mower.

Now, let us explore for a moment the interest in maintaining bluegrass at 1/2 inch height of cut at least in the program at Marysville. In plant breeding programs it is essential to use selection pressure to obtain optimum genetic expression.

Physiological Factors of Close Mowing

One of the basic considerations in holding satisfactory turf of close-cut bluegrass involves the maintenance of a proper reserve carbohydrate balance within the plant. If carboyhydrate reserves are depleted in the plant, its capacity to regrow is severely limited.

Genetic variability in bluegrass has an important bearing on its performance under low cut. Newport, for example, in the warmer regions maintains a significantly lower reserve carbohydrate level than Merion bluegrass under comparable mowing maintenance. This characteristic resulted in a decline in shoot density of Newport under the warmer temperatures. Light intensity and temperature variation (day-night) are inter-related to genetic variation and will influence bluegrass maintenance under low mowing heights. Cougar does better where low humidity predominates.

Mowing - How Important?

Frequent clipping of grasses is the one maintenance practice that stimulates the development of what we classify as turf. Grasses when clipped on a regular schedule form a turf as a result of the development of many tillers or shoots. These structures arise from the crown of bunch-type grasses; from lateral underground rhizomes, or from above-ground stolons, or both.

For maintaining bluegrasses at low heights of cut (1/2") it is important to set mowing frequency. If such a situation occurs where the time span is lengthened and considerable top growth occurs, a gradual return to the 1/2 inch mowing height will be necessary to avoid scalping and weakening of the bluegrass.

During periods when conditions favor very rapid growth, the mowing frequency should be reduced to a three or four day schedule. Sufficient leaf area must remain to provide a level of photosynthesis that will maintain the plant in an active and vigorous growth state. This is essential since carbohydrate reserves will be influenced significantly by the plant's capacity to maintain high photosynthetic efficiency.

Irrigation - Essential

Close cutting of bluegrasses result in reducing rooting depth, thus the area that the plant may draw moisture from will be less than would be found for higher cutting heights. Experience has guided us to use frequent irrigations under such conditions.

Secondly, with a trend in total leaf area reduction, the transpiration capacity of the plant is lessened which materially affects the plant's capability to maintain a proper temperature relationship. A certain level of transpiration is essential in the maintenance of the vital metabolic processes of the foliar parts of the plant in relation to temperature. Much closer tolerances thus are required in moisture availability to the plant.

In the Central Ohio area under moderately heavy soils 3/4" to 1" of irrigation water per week has been satisfactory for the maintenance of bluegrass at 1/2 inch height of cut.

Slow Release Nitrogen Desirable

In the maintenance of bluegrass at 1/2 inch height of cut over a four year period, a urea-formaldehyde nitrogen source was used. The fertilizer was applied on a bi-monthly frequency at a rate to supply 1.0 - 0.3 - 0.3#per 1000 sq.ft. The use of the slow-release nitrogen was considered important in satisfactorily maintaining the bluegrass from the standpoint of lessening surge growth. Data from nitrogen fertilizer tests has shown that a two-fold increase in growth can occur with soluble inorganic nitrogen sources applied at comparable rates. Scalping or excessive defoliation that occurs results in a severe shock to the plant reducing its capacity to produce regrowth and avoid stresses of high temperature, low moisture,

or disease attack. If soluble inorganic nitrogen sources are used, reduced rates applied more frequently would perhaps be satisfactory.

Additional Maintenance Requirements

Most bluegrass varieties available today can be maintained at the 1/2 inch height of cut provided that we meet conditions previously reviewed, plus be prepared to employ protective fungicides and insecticides so that buildup of damage is avoided.

Where bluegrass varieties are used that are susceptible to leafspot or stripe smut, and where climatic conditions favor development of these diseases, fungicide use would be essential. Products containing PCNB applied at a rate of at least one pound of PCNB per 1,000 sq.ft. two times each year would provide satisfactory protection from the diseases listed above under average conditions. Under severe conditions additional treatments may be required.

Benelate, an experimental fungicide now being tested widely, appears to be quite effective in controlling stripe smut. However, if leafspot is a problem, other fungicides active on leafspot would be required as Benelate is limited for this disease.

In regions where Fusarium roseum is a problem it may not be possible to check this disease with currently available fungicides. Commercial bluegrass varieties currently in use lack sufficient levels of F. roseum resistance to be assured of maintaining high quality turf where this disease is prevalent and severe.

Sod webworm always poses some threat to bluegrass turf in the northern regions of the U.S. A number of effective insecticides are available today to take care of this problem.

Maintaining bluegrass at low heights of cut requires rather precise mowing. Well adjusted and sharp reel-type mowers are best suited for this application. Where low-cut turf is to be maintained, uniform grading should be carried out to avoid uneven cutting with the close height tolerances.

Annual renovation of thinning turf, plus aerification on compacted areas will provide a more optimum condition for maintaining low-cut turf.

On turf areas where heavy traffic is anticipated, the use of present-day preemergence herbicides will lessen weed problems particularly where turf is scarred and opened up. Topdressing from aerification, plus extra topdressing, can further improve survival.

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CONTINUING BLUEGRASS RESEARCH 1968-1969

Terry Riordan, Graduate in Turf
Purdue University

The year 1968 was a building year, a year of transition from certain objectives to new objectives. It was felt that individual bluegrass plants had been sufficiently studied, and that it was time to select the outstanding plants

(specified selections), and to study these selections as varieties. Summer of 1968 was used to select the better plants, harvest and prepare seed, and to germinate enough seed for the varietal study. Data was also taken to complete the analysis of the 1967 space planting.

Past Background

The current project is a continuation of the work started in 1965 in cooperation with Civil Engineering, Horticulture and Botany, and is funded by the State Highway Commission. Our effort, along with the other departments, was to improve the highway roadside aesthetically, while at the same time making it easier and less expensive to maintain.

During the period of this project 10,000 individual space plants have been screened in the field and greenhouse on the characteristics of leaf height, amount of rhizome spread, rust resistance, leaf color, and seedhead height, quantity and maturity. Also, an overall rating for desirability for selection was made.

New Procedure

Seed of 87 selected plants was planted in rows at the Agronomy Farm in September, 1968. The selections were measured for percentage germination, plant height, and number of leaves, tillers and rhizomes. Sixty selections gave sufficient seed for study, and 40 seedlings from each were transferred to 4-inch pots for winter growth in the greenhouse. Vegetative parent material was used to plant two other pots, and all pots (2,520 individuals) will be transplanted back to the Agronomy Farm during April, 1969.

Individual space plants (single pot) of the same selection will be planted closely together, thus allowing plants to be compared within a selection, but also allowing selections to be compared to each other. Parent plants will be planted with each selection in order to give an estimate as to whether the selection is producing seed sexually, or by the development of an individual from an egg without fertilization (apomixis). This apomixis study will be backed up by cytological chromosome study which will give another estimate of this phenomena. It is felt that if seed is produced through apomixis the selection can be increased and marketed through seed, but even if seed is sexually produced the plant selection could still be used due to the increased technology of the sod industry.

Vegetative increase of several outstanding selections has already been undertaken at the Agronomy Farm in order to increase both the amount of pure vegetative material and also the yield of seed. These increases, which were started last fall (September) will allow material to be available for our first roadside planting.

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LET'S TALK TURF IMPROVEMENT

C. G. Wilson, Head Agronomist
Milwaukee Sewerage Commission
Milwaukee, Wisconsin

The program must be sold, especially if the user's enjoyment will be disrupted in any way. It is not enough to sell oursevles, or for that matter even the Green Committee, if they fail to communicate our improvement program to the membership at large.

Use every means possible to communicate. Demonstration plots, club newsletter, releases through club billing department, and personal contact are important. One notice is seldom sufficient. Three to six mailings spread a month or so apart should be considered. Part of your budget for turf improvement could well include a "media" fund for public relations.

Don't be afraid to challenge your own pre-conceived ideas or the ideas of others. One reason I like Purdue and Dr. Daniel is that neither one are afraid to try a new or radical approach to a problem. The secret, of course, is to try on a small scale first before implementing fully. The late O. J. Noer always felt the first test results should be repeated before embarking full-scale. (Go back and read the previous sentence once more).

Talk to as many people as possible who can offer ideas on your turf improvement project. Turf experts, manufacturers, distributors and your fellow superintendents will all be of help. Contrary to the belief of some, advice does not add to confusion. The truly perplexing problem is the one you try to solve without the help of others.

Finally, implement the project. The value of all that talk will come to naught until this is done.

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CONTROLLING POA ANNUA

W. H. Daniel, Dept. of Agronomy,
Purdue University

Arsenic toxicity can selectively remove Poa annua in turf, thus Poa annua - free turf - is a reality already proven in research and on entire golf courses. Recently a speaker used kodachrome pictures from over 30 golf courses to illustrate observed progress in this. By 1969, over 300 courses currently have some control program underway.

A four step program is basic:

1. Add no more soluble phosphorus. Why juggle two items? Why build phosphorus higher?
2. Start accumulating toxic arsenic. Repeat lighter application, get uniform distribution. Allow time for new grasses to grow and fill in.
3. Start improving stand of desired turf - by Aero-blade, seeder, or any way to get seed into the soil; repeatedly overseed as space is available and weather permits.
4. Short days, cloudy days, wet soil and time favor selective Poa annua weakening to be evident in these periods. Chickweed, Poa annua, crabgrass and goosegrass are less tolerant to arsenic than bentgrass or bluegrass. Arsenic interferes with the transfer of carbohydrates within the susceptible species.

A Weed

Several states have declared Poa annua a weed. For example, in 1968 Florida required that the number of Poa annua seed per pound of grass seed be listed on the label. Further, seed is prohibited from sale if above 5000 seed/lb. And, it is hoped this limit can be reduced after one year of review.

Basically there are five points relevant to the control of Poa annua. These are -

TECHNOLOGY - principles
TOOLS to accomplish the work
TECHNIQUES of man and equipment use
TIMING for the plant and user benefit
TIME for biological processes

Let's describe Poa annua. It is Poa (of the meadow in Greek). This includes hundreds of species scattered almost world-wide of which pratensis, compressa and annua are some representatives. The early botanist seeing Poa annua germinate and produce seed in the same season, which was in contrast to perennial types, called it annua, i.e., it seeds in some 6 to 8 weeks after germination under some conditions. Now, it is just like tomatoes, coleus, etc. - it will vegetatively increase until some adversity kills the plant parts. You have seen summer desiccation, severe disease smothering under ice as such damaging failure points. Also, you have seen a beautiful sheen of new Poa annua come up.

I recall seeing such on August 5 at Cleveland Country Club one year. So, a normal Poa annua plant under watered fairway conditions in Cleveland would be fall germination, winter survival, spring lushness, summertime weakening, some disease, some wilting, and when things really get tough complete loss either in the winter under ice or in the summer, but then new germination occurs. We can break this cycle, we can reduce the competitiveness of Poa annua - the technology is available. Examples of success have been observed, reports of progress have been disseminated.

Club members have seen the bar revised, the kitchen modernized, the locker room changed, the grill increased. They expect these things to be major renovation of high cost with a considerable period when tradesmen may create complete unuse - the bar is closed - the grill is out. Why should it be different when we start to change the grass on the golf course? They expect continued, perfect playability out there! It takes time to revise the grill, to tear out the old, to put in the new, to refinish the walls, and it takes time out there on the golf course.

Again, someone in the club made a decision following a policy that led to improvement, and someone must make that type of decision for the club if they are going to have Poa annua removal, and it is a major decision. It requires financing, public relations promotion within the membership, within the community, for we have all heard statements like - "Say, what's happened to ---- Country Club? Their fairways are all BURNED UP, and the word gets around when really it is to be expected.

Some of the bottlenecks in observing Poa annua control start out rather insignificant. First, things look pretty good; now the club is well-groomed, the course is always ready to play, the superintendent is on the ball, and the turf survived last year, so why change it?

Second, the other country club tried it and they sure had some bare areas. That is not for us. In other words, one decision, one observation and the program is taboo. Our members won't stand that.

Third, the Greens Chairman catches too much "hell" already. He is fair game for every golfer to lambast as if it is club policy to beat down the official. Again, public relations are important, but somebody needs to make decisions for the club during their term of office for the benefit of the club; yet we recognize the problem.

Fourth, there is the problem of superintendent and crew, and equipment setup to do the job efficiently well and effectively. I have seen many errors in applica-

tions, which were unnecessary mistakes. It does take quality personnel and adapted equipment, but these are not new to good golf courses and good turf growers.

Technology

Selective repression of existing Poa annua, selective prevention of new establishment is the key. It is a small job to control Poa annua! The BIG job is to grow desired grass! We know that arsenic accumulated in the rootzone can override phosphorus uptake and selectively stunt existing Poa annua as well as seedlings. We also know that Betasan, Balan, Bandane, among others, can prevent seedlings of Poa annua becoming established. Each chemical has its good and bad points - that is technology. Each chemical will do certain things and permit the turf manager to do certain things. For example, Balan will prevent both Poa annua and new bent or bluegrass from seed; so will Betasan and Bandane.

Nevertheless, the turf manager should select a chemical which will be used in a repeated program that provides him with continued control. Again, technology is understanding the inner-relationships of repression of weeds, forcing a growth of desired, and the principles he must follow to benefit from the selective program. For example, forcing growth with fertilizer, protecting existing with fungicides, overseeding when thinness is evident - all of these are just technology.

Tools

Tools include the equipment and the manpower. The new Rogers Aero-blade seeder combination was recommended to five out of six golf courses considering Poa annua renovation just because it does a uniform job of placing wanted seed in the preferred position for germination and survival.

There are combinations of tools that may be available for spreading the materials, for applying the seed and reducing the thatch, for applying the water. Upgrading to automatic irrigation, purchasing of needed equipment are just preliminary steps providing tools for improvement.

Techniques

Techniques vary widely depending on tools, depending on terrain. Basically the techniques are related to habits. I have seen golf courses start at the edge of the fairways, overlap in the middle with arsenicals just like they were mowing. They crowded together between the sand trap, spread apart in the wide spots, and then two years later you can see where the man did or did not go twice. I have seen where sprayers slowed down and killed everything, where equipment going downhill went fast and up-hill slow so that extreme differences in results were achieved. Even calibration, simple as it is, can be overlooked.

Since this is repeat accumulations, records are important, for if we miss out on how much has been applied, then uncertainty prevails on what should be applied; then question arises as to results achieved. For example, we strongly recommend no soluble phosphorus be used when arsenic is being accumulated as Poa annua is being reduced. With this in mind it takes understanding of technology, it takes different techniques of purchasing, and if one does change his program so he uses some soluble phosphorus, then uses arsenic, who knows where he is? In contrast, if only arsenic is used, then one seeing results can interpret the end results and know where he is.

Timing

Timing is always important whether it be fighting the bull in the arena, or working to get the most from nature's normal responses. When shall the program start? Early fall is preferred. When shall it achieve toxicity? One year later. When shall I put on seed? When there are openings. When shall I put on arsenic? When stress of climate is medium. How soon may I repeat overseeding? Every two weeks. How often may I apply arsenic? After next rain or irrigation. How much shall I apply? All of these are related, thus it is very wise to have samples, models. It is wise to take trips and see other areas previously treated. And, as mentioned earlier, it is strongly suggested that timing be concentrated into one fairway, three fairways, or nine fairways. Don't start on 18 fairways. Set some timing fast and some timing slow. Treating one-half of fairways is simplest and safest for initial program for the "best" half can be used. All clubs that I know of starting a program have later enlarged the control program. (At Brae Burn Country Club, Art Anderson used lead arsenate in 1938, '40, '44, '47, '51, '55, '59 and '64 to maintain his program).

Time

You understand a bluegrass seed. It will germinate in six to eighteen days; puts up one leaf, starts a crown, puts up a second and third leaf. As it starts its fourth leaf it also starts a tiller at the crown, then a second tiller, now has some 8 - 9 leaves, and it is at least two months old - still a seedling. Then, it puts out underground rhizomes, a horizontal stem which, as it emerges, causes spread characteristic of bluegrass. Now it is a teenager. A bluegrass planted August 1 with irrigation could have rhizomes in November, but a seedling dropped carelessly in October may be useless and dried by desiccation in the winter so there is nothing next spring. Meanwhile, Poa annua, which grows more normally and vigorously, completely over-masks it.

For example, at Meridian Hills Country Club in Indianapolis overseedings made in two successive falls produced a very sparse bluegrass cover of less than 5%. When arsenics kept out the Poa annua and crabgrass, the less than 5% advanced to over 95% in one season.

The purpose of overseeding is to initiate sparse-starting plants which, by spread, can fill in. Bentgrass grows similarly making stolons. Bentgrass plants two to three months old are still very small. Actually where arsenics are being used at least 90% of the turf increase is from spread of existing plants. For high budget courses plugging of thin areas is a real possibility in critical spots.

Toxicity with arsenic can be summarized by these steps -

1. Stop applying soluble phosphorus
2. Improve poor drainage areas with vertical trenching
3. Gradually build arsenic toxicity by repeat divided applications
4. Repeatedly introduce the desired by overseeding and plugging.
5. Resod the worst first. For example, fronts of tees and aprons
6. Cloudy days, short days, wet soils and time favor selective Poa annua weakening

In summary, when your club determine policy and budget for the program, then the turf manager carry out the policy. Poa annua control should require two years. There will be problems worth achieving, nonetheless. So, I am through with Poa annua - the failure grass. It is not modern standards. 2,4-D took care of broadleaves, Silvex took out clover, Dicamba has removed knotweed - now it is Poa annua's turn at bat.

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SUGGESTED RATES 48% TRI-CALCIUM ARSENATE GRANULAR PER 1,000 SQ.FT.

If P_2O_5 Phosphorus Test Is	And Poa annua is					Total to reach Poa, crabgrass, goosegrass, and soil insect toxicity	If Soil Type is *
	70 - 90%	50 - 70%	30 - 50%	15 - 30%	Under 15%		
Low	4# fall 4# spring 4# fall 4# spring 2-4# fall	6# fall 6# spring 4# fall 4# spring	8# fall 8# spring 4# fall	10# fall 8# spring 2# fall	12# fall 6# spring 2# fall	16 - 20#	Light Sandy Loams
Medium	6# fall 6# spring 6# fall 2#-6# spring	8# fall 8# spring 4# + 4# fall 2#-4# spring	8# fall 8# spring 4#+4# fall 2# spring	10# fall 8# spring 4-6# fall	12# fall 8# spring 2-4# fall	20# - 24#	Loams
High	6# fall 6# spring 6# fall 6# spring 2-6# fall	8# fall 8# spring 4#+4# fall 2-4# spring	8# fall 8# spring 4#+4# fall 2-6# spring	10# fall 8# spring 6# fall 2-6# spring	12# fall 8# spring 6# fall 2-4# spring	24# - 30#	Buffered Clay and Silt Loams
	Reseed Sod and plug area also	often into worst	Reseed & plug as needed	Reseed if Needed	Reseed if Needed		

*Soils with low buffer capacity, low organic matter, less phosphorus and poor drainage require less arsenical to reach toxicity. After restriction (Poa annua is yellow, thin, weak), then use annually 2 to 3 pounds per 1,000 sq.ft. to maintain toxicity. [illegible] to improved varieties with vertical grooving as often as conditions permit.

HERBICIDES FOR TURF

Wilbur F. Evans, Amchem Products, Inc.
Ambler Pennsylvania

Establishing and maintaining dense competitive turf is an excellent method for controlling many lawn weeds. A number of herbicides are available to help the grower establish new turfgrass areas, or rebuild sod which has been invaded by weeds.

Turfgrass weeds belong to two principal groups - broadleaved and grassy. Weeds may also be categorized as annuals, biennials or perennials. Proper identification of weed species to be controlled is essential.

BROADLEAF WEED CONTROL. Herbicides are of the phenoxy group - 2,4-D, 2,4,5-T, 2,4,5-TP (silvex), MCPA and MCPP (mecoprop). Recently dicamba (Banvel-D) was developed.

2,4-D will control dandelions, plantains (broadleaf and buckhorn) and many other broadleaf weeds in turfgrass.

2,4,5-T is quite effective on white clover, violets and pennywort, etc., and is often used in mixture with 2,4-D to extend the range of weeds that can be controlled by a single treatment.

Silvex, MCPP and dicamba are effective in c ontrolling clover and chickweeds (common and mouse-ear), wood sorrel and yarrow.

Two very difficult weeds to control have been red or sheep sorrel and knotweed. Dicamba at 1/4 to 1/2 lb. per acre has proven quite effective on both species and on yarrow.

Chemicals can be used separately to control a specific weed problem. Also, several combinations have been made to broaden the spectrum of weeds controlled. The most popular of these have been 2,4-D, plus silvex, and 2,4-D, plus dicamba. The rate of actual chemical applied per acre in the combinations has generally been 1 lb. of 2,4-D, plus 1/2 lb. Silvex, and or 0.1 and 0.25 lb. of dicamba. These mixtures are available in liquid or dry (vermiculite) form. This year a three-way combination, including 2,4-D, silvex and dicamba, will be available.

Maximum effect is obtained from foliage applications when soil moisture is good and the weeds are growing actively. Both spring and fall treatments are recommended. However, fall treatments have the advantage of allowing time for the desirable turfgrasses to spread; whereas eradicating weeds in spring may leave open areas suitable for crabgrass germination. Also, danger of injury to desirable plant species is less in the fall.

Certain precautions should be observed:

1. Bentgrasses are generally susceptible to phenoxy materials. Split applications using one-half normal rates are advised. Read the label. Late fall applications on bentgrasses are generally more injurious than spring applications and should be avoided if possible. (Or spray heavy if bent is to be eliminated).

2. Avoid spray drift onto desirable plants or shrubs. Spray when there is little or no wind and at low pressures and medium droplets.

3. Do not apply herbicides within the drip line of trees or shrubs. The materials may be root-absorbed and injury can result, especially with dicamba.

Used according to the label these materials can do an effective job safely.

FERTILIZER-HERBICIDE combinations are available and are very useful. The above precautions apply to these formulations as well.

ANNUAL GRASS CONTROL - Crabgrass (hairy and smooth), goosegrass (silver crabgrass), foxtails and barnyardgrass constitute the most common annual grass weeds in turfgrasses. Other annuals, sandburs, wiregrass, even new nimblewill, may be prevented by timely applications. Goosegrass, although quite similar to the crabgrasses in appearance, is a different specie, germinates later, and is generally more difficult to control.

All the above grasses are annual, germinating in the spring and dying in the fall. Control is effected by applying the herbicide in the spring before the weed seeds germinate. In the Midwest this period is from mid-March to mid-May, depending on location.

Materials in common use for annual grass control are: Azak, Bandane, Balan, Betasan, Dacthal and Tupersan. Rates of active material per area for grass control varies according to the chemical. Some turfgrasses, such as bentgrasses, Bermudagrass and other species are sensitive to some of the above chemicals. The labels should be checked for any restriction of use by grass species. With the exception of Tupersan desirable turfgrasses cannot be seeded until fall in areas where the above chemicals have been used for spring treatment.

POST-EMERGENCE control of crabgrasses can be effected by repeated applications of DSMA or MSMA. These materials have proven effective for nutsedge and sandbur control as well.

PERENNIAL GRASS CONTROL - Control of perennial grasses, such as quackgrass, tall fescue and orchardgrass can be accomplished most effectively by treatment with a non-selective herbicide, followed by removing the treated vegetation, deep cultivation and reseeding of the area. Spot treatments may be adequate if the infestation is not extensive. Amitrole and Dalapon are two compounds which kill both grass and broadleaf weeds, including underground portions. Paraquat is also non-selective, but regrowth from rhizomes may require treatment. Repeated vertical hand-slicing into clumps can weaken tall fescue. Also, very hot water soaking crown area can kill a clump.

WEED CONTROL IN SEEDLING TURF. Spring seeding of large turfgrass areas is a more feasible practice when competition can be minimized.

A new material, bromoxynil (Brominal) is now cleared for broadleaf weed control in seedling turfgrass. Applied as an early post-emergence treatment when broadleaf weeds are in the 2- to 4-leaf stage and the seedling grass has emerged, it controls many broadleaf weeds without injury to the seedling turfgrass. Repeat applications can be made safely.

Tupersan will control germination of crabgrass and other annual grass weeds while allowing desirable turfgrass species, such as bluegrass, to germinate and grow. Application of half the normal rate (5 to 6 lbs. per acre) at seeding time, followed by another half rate one month later, is the recommended practice for grass weed control.

In conclusion, herbicides to control any unwanted weed are for the produc-

tion of good turfgrass. However, good management practices - such as proper cutting height, watering and fertilizing - are important factors in keeping a good turf once the herbicides have done their job.

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IS YOUR GRASS SAFE?

Wayne Morgan, Kellogg Supply Company,
Wilmington, California

When a nationally known sports figure is injured on an athletic field, this type of information usually receives a prominent place in the news coverage. It is unfortunate that equal importance is not placed upon the more than estimated 5000 injuries occurring annually at our colleges and unversities. If injuries obtained at our nation's high schools could also be tabulated, the total number would be quite revealing.

While considerable attention has been directed towards improving protective gear, training facilities and methods and the physical condition of the players, insufficient consideration has been given to the condition of the athletic field, which is one of the major contributing causes of player injury. One report indicated that over 50% of the serious knee and ankle injuries were possibly turf related, with serious knee injuries more prevalent than serious ankle injuries.

Much importance is placed on knee and ankle injuries. It is stated that this type of injury occurs because the body turns but the feet don't. Broken legs received from being tackled while the shoe cleats are anchored into the soil (sometimes referred to as "hanging up") is also another cause of serious injury. "Shin splints," leg strains received from running on hard turf or surface areas are a common problem. Other persons consulted about the safety of grass feel that injuries received from twisting, falling on hard soil, or slipping on wet grasses are problems of equal magnitude.

What can be done to reduce the possibility of injury? A report from Cal-Turf Inc., Camarillo, California, an article from the Athletic Journal (July, 1965) and information from Monsanto, manufacturers of Astro-turf, offer significant promise in the direction of making grasses safer.

A study on how to make athletic fields safe was conducted by Cal-Turf. They tested soil preparation, type of turf and cutting height. These effects on turf quality and speed and usability of the turf were recorded. Their results indicated that from 25% to 50% sawdust mixed with sand was the best soil for energy absorption. Loam soils had the poorest energy absorption. Soil kept moderately moist had greater energy absorption than when either dry or too wet.

The improved Bermudagrass "Tifway" had high impact absorbance for tacked or falling players when compared to bluegrass or alta fescue. Also, in each case the fescue variety showed better impact-absorbing characteristics than did bluegrass. However, the difference between the fescue and bluegrass was far less than the Tifway and these two varieties.

Results from mowing height differences indicate an increase in impact absorption for all three grass species with an increase in mowing height. Their report

stated that Tifway should be held between 1-1/2 to 2 inches in height for football fields. Speed of play was apparently not reduced or affected by these higher cuts.

Under the conditions of the given soil preparation and mowing height, with adequate fertilization for continuous good growth, the Tifway surface has enough sheer strength to resist excessive wear and tear by cleats, offers safer traction when players cleats

1. Entered the grass mat
2. But not the soil itself
3. Nor the root area
4. And allowed the cleats to release and turn

Mr. Harry Wilcox, former County Agent in Pennsylvania, wrote the article on "Safer Athletic Fields." Checking on injuries at a high school field, accurate records were kept both before and after a safety program was instituted at both the practice area and playing field. Before starting their program, the soil had been drastically compacted by heavy equipment during construction. This, and being used for play, had resulted in a weak, thin turf with very shallow roots. Water penetration into the soil was greatly restricted and puddling of water occurred.

Their program for "a planned schedule of turfgrass management to grow grass on a continuing year-round basis" consisted of:

1. Repeated aerification to loosen the soil and break up severe compaction.
2. Repeated seeding the proper grasses that are adaptable to the area and use.
3. Repeated ample fertilization to force growth.
4. Watering to keep grass growing.
5. High mowing off-season; medium-high during use.

They found their program could be carried out simply by reallocating already budgeted funds. Their results show benefits.

During football practice recorded injuries were:

On old field		After the correction program began	
In August	9	In October	2
In September	12	In November	2
	21		4 - 17 less

During games of season - two teams - all season -

In 9 away games on other stadiums	20
In 10 home games on improved field	9
	11 less

Monsanto sent out 542 questionnaires to the nation's colleges and universities and received back 185. The questionnaire inquired about knee and ankle injuries and whether or not it was felt these were turf related. Those responding listed 1771 serious leg injuries. Over 50% of the serious knee and ankle injuries were reported either to be, or probably to be, turf related. The serious leg injury rate for games was .362 per game, while practice rates are only .066 per session. The largest number of serious knee and ankle injuries knee and ankle injuries reported was 84, and the lowest number reported was 0.

Comparing these reports they use results for 1967 from 3 Astro-turf football fields. There were 69 football games and 79 practice sessions. There were 5 serious knee and ankle injuries reported.

Other valuable information pertaining to turfgrass safety was obtained from interviews with the following people:

Mr. Cecil Hollingsworth, Past Director of Athletics for over 25 years at U.C.L.A.
Mr. Frank Schact, Supervisor of Grounds at U.C.L.A.
Mr. Ronald Townsend, Superintendent of Parks and Rose Bowl, Pasadena, California.

1. Soils should be firm with resiliency - not too hard nor too soft. Cleats should not penetrate more than 1/2 depth into soil.
2. There should be both surface and internal drainage - obvious to achieve above.
3. Minimize slippage when overly wet by using mud cleats. Improved drainage, adding calcined aggregates to dry out would be better.
4. Don't have the crest of the field too high or injuries may occur from sudden changes. 12 - 18" center above sidelines is ample.
5. Playing on turf recently sodded without sufficient time for roots to develop results in turned ankles and other injuries. Allow 4 weeks minimum.
6. The turf should be dense enough to provide cushioning for falling players, yet open enough to allow freedom of movement of feet. Use topdressing to aid in this and more frequent mowing.
7. When compared to common Bermudagrass the improved Bermudas seem to make it harder for the quarterbacks to spin on handoffs, so use shorter cleat.
8. For Rugby, which is a fast, continuous game, these improved Bermudas were reported to be slower.
9. Bermudagrasses height of cut should be regulated by the activity used for:

Football	1" to 1-1/4"
Socker	3/4"
Baseball infield	1/2" (want fast for picking up grounders)
Baseball outfield	3/4" to 1"

   The turf should not be too long so that the player's feet will have to be picked up or tangled in the grass. Coaches state what is desirable is the ability for "sliding motion". Topdressing and Greens-aire can help regulate this.
10. Hazards too close to the playing field, such as signs, wires, posts, or open drains have been known to cause player injury.

As can be determined, something can be done to aid in making our grass safer. The answer seems to be in the development of a dense, healthy turf with firm but resilient soil. For the welfare of our prime youth, it behooves all of us to continually strive toward this goal.

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TURF MANAGEMENT FOR PURDUE UNIVERSITY FOOTBALL STADIUM and PRACTICE FIELDS

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Purdue University

As history, in 1964 the stadium field was lowered approximately 8' and a new tile drainage system installed. Then, the field in general was rebuilt with soil and sodded. Because the silt and clay in sandy soil restricted water movement, it was necessary to vertically trench above the tile lines - into pea gravel above

tiles. Then between each tile another trench was placed. This made 151 spacings. Then for final insurance every 5 yard line and sideline were trenched - so drainage is now vertical and fast. Any spot later found wet will be trenched also. We used 2 - 3" narrow trench with pea gravel backfill, then sand cap to overflow.

Some problems of maintenance were needed - fertility, intense aerifying and added topdressing. So, the very first thing we applied 200 lbs. of nitrogen and 200 lbs. 60% potash on the entire field in the last two weeks of March. Then, we sowed 1 lb. of bluegrass seed per 1,000 sq.ft. down through the center. Using a chain link drag, we went over the field and then applied 1/2" of water. Next, we started putting in the slit trenches for drainage.

You must remember that the locality and type of soil you have will affect your maintenance program; hence, the following should only be a guide to anyone who has a problem. A good program necessitates walking over your field daily to permit needed observations.

Date to Do Work

1. March 1 - 30. Fertilize, seed, drag. Overseed in late winter as needed. The last two weeks in March, apply 200 lbs. of nitrogen (mineral base) and 200 lbs. of 60% potash on the entire field (2 acres). Water as needed.

2. April 1 - 20. Roll, mow.
Using a medium weight roller, roll the field before first spring rain. Roll only when soil is moderately moist. Start mowing operation as soon as the grass is long enough to cut. Use only a reel power mower set for 2" height of cut. Cut often - at least once each week; more often if grass grows rapidly. Never let it get beyond 2" long.

3. May 1 - 15. Aerify, fertilize, spray for fungus and weeds.
During the first two weeks of May, aerify the field using an aerifier with 1/2" spoons, 6" apart. After aerifying apply 600 lbs. of 38% nitrogen (urea formaldehyde base nitrogen) and 200 lbs.of 60% potash to the entire field and water in. Keep close watch for fungus infection. If any signs are found commence spraying entire area about every 2 weeks with a fungicide. Use the low side of the manufacturer's recommendation. It occurs most often when you have temperatures above 80°F. at night with exceedingly wet grass and little air movement. Also, watch for weeds and foreign grasses.

4. June 15 - July 1. Fertilize, sod bare areas.
Reseed or spot-sod bare areas and damaged strips; then apply small amount of fertilizer, and wash into the soil.

Continue mowing operation. If clippings are too long and heavy, use turf sweeper to remove. Set sweeper so that it just barely touches the grass blades. Don't sweep any more than necessary. This is to prevent disturbing the crowns of the bluegrass plants. Apply only enough water to keep grass from dying from wilt. The reason for this is the grass roots grow where moisture is most favorable (deep).

5. August 1 - 7. Aerify, soil test, fertilize, seed, drag, water.
In the first week of August use Greens-aire with a 1/2" spoon to bring up much soil. Topdress with porous topdressing to bury crown and reduce divots. Take a soil test and determine analysis and rate of application of fertilizer needed. This will bring the grass back to a good green color for the football season.

6. September 10 - 24. Fertilize, seed, plug.
The second or third week of September apply fertilizer to force fall growth. Mow often; roll lightly after every use.

Before each home game apply 5 - 10 lbs. of bluegrass seed. Immediately after each football game replace all divots by hand and press in with foot. Then water with 1/4" of water. The following Monday roll lightly, repair the damaged playing field with 4" diameter plugs from the sod nursery. These plugs should be 3" deep. You may think this is a losing battle, but it is essential.

7. November 25 - December 15. Aerify, topdress, seed, fertilize, drag, water, drain water system, lock gates for winter.
Before last home game overseed worn spots. The last of November, or the Monday after the last home game prepare the field as follows for the winter:

a. Aerify both ways or double at an angle, using 1/2" spoons. Then topdress field 1/2" deep with the following mixture: 1/4 sand, 1/4 peat moss, 1/4 crushed cobs and 1/4 calcined clay. This buries crown of loosened grasses, reduces desiccation.

b. Take soil test and apply recommended fertilizer, possibly 12-4-8 analysis (50% organic base nitrogen) at 20 lbs. per 1,000 sq.ft.

c. Use a turf mat and drag the field over twice.

d. Replace all divots using extra sod from sod field to repair any additional divot holes. Press down all divots firmly with your feet. Then lightly roll the entire field.

e. Apply 1/4" of water with sprinkler system. This depends on weather conditions.

f. Drain sprinkler system and lock the gates for the winter.

8. March 1. Start over.

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TURF HEATING IN ACTION

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Raymond Freeborg, Graduate Research Assistant, Dept. of Agronomy
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Electric heating is one proposed way to extend the natural seasonal limitations affecting turfgrasses. Plants have a better chance to survive, grow and rejuvenate themselves if the growing season is extended by buffering the heat loss from the earth in the fall, and by hastening the warming of the rootzone in the spring.

The fundamental requirements for design and installation of electric soil-heating cable systems have been determined. The exact design of a system will depend on the extent of, and use for, each turf areas, the climatic location, the availability and cost of power, and the grass variety used. Further, turf heating

as a management tool can be used to keep soil from freezing, keep turf greener, promote new root and blade extension, and melt snow.

A few commercial systems have been installed in Scotland, England and Sweden. In the United States, investigations of the use of electric heating for turf have been a cooperative venture of the Farm Electrification Branch, ARS, and the Departments of Agronomy and Agricultural Engineering, Purdue University.

Falcon Stadium

Falcon Stadium, U. S. Air Force Academy, was the first college athletic field in the U. S. to employ turf heating. The expressed purpose for the installation was to insure a frost-free football playing surface, thereby increasing precision of play and helping to reduce some of the serious injuries which have resulted from frozen football fields.

Fifty-five cables, each 1560 feet long and producing 7800 watts are installed 7 inches deep, spaced 1 foot apart lengthwise in the field. These polyvinyl-chloride insulated cables can give off 5 watts of heat per foot of length. Each cable has a braided copper grounding jacket and is protected by a 40-ampere, single-pole, 277-volt breaker. The total connected load is 429 kw with the system operating from a three-phase, four-wire, 277/480-volt substation.

Center sections of football fields, as a result of more traffic, frequently have less turf for insulation than the edges. This, combined with differential use, shadows, etc., makes sectioning of heating systems desirable - between the hash marks, then to either side to 5 yards beyond the sideline markers.

Each zone is equipped with a control panel consisting of a relay, on-off automatic selector switch and a light which indicates the zone is being treated. The control circuits include an air thermostat set so that heat will be called for when the air temperature drops below 40°F. This is in series with a liquid filled remote bulb placed just under the sod in each zone, which limits the application of heat when the $1\frac{1}{2}$-inch soil temperatures are 50°F or less.

The cables were buried under a bare surface in June, 1966, using a modified subsoiling tool preceded by a rolling coulter. No particular problems were encountered and the installation was completed by fall. The three "separations" during installation were found to be at the junction of the cold lead to the heating element. The compressive butt connectors must be firmly clamped, and pulling on the cold leads should be avoided. The system was not used in the fall of 1966 since no late season football games were scheduled. If a system is to cause earlier than normal root and blade growth in spring, heating should begin 3 weeks to 1 month before normal growth begins.

The heating system was next used from September 1 through November 30, 1967. Only the middle zone was powered the entire time. On November 14 the heated turf of this zone appeared to be greener and was judged to be more dense than the unheated outside zones. The outside zones were then turned on for the last 2 weeks of November. No freezing occurred either in the heated stadium field or in nearby unheated practice areas.

Busch Memorial Stadium

Busch Memorial Stadium, St. Louis, was the first multi-sport professional stadium to have an electrically heated playing field. Heating began October 28, 1966, from 49 cables, 1796 to 2741 feet in length. The cables were knifed into the

turf in late August and September. These heating elements run lengthwise, are spaced 1 foot apart and were specified to be 6 inches deep. Difficulty in getting them to this depth caused problems later. The polyvinyl-chloride insulated cables provide 4.6 watts of heat per foot length, and per square foot of area, when operating at 277/480 volts AC. Grouped, not individual, cables are fused. The total length of cable is approximately 115,000 feet, giving a combined load of 529 kw.

The heating grid is in four separate zones. The baseball and football fields are such that one goal post is at homeplate and the other deep in center field. Two of the zones start at the center line of the baseball diamond-football field and extend to just beyond the sidelines of the football field. The other two zones extend outward from the football field to the edges of the massive movable stands as they are placed for football games. By this sectioning, areas can be selectively heated according to usage.

The automatic control system consists of a time-clock and an air thermostat in series with soil sensor resistance elements. The air thermostat responds to general weather conditions, and the soil thermostats are used to limit heat application according to the reserve in the soil.

A mixture of Zoysia and bluegrass was used for the initial sod. Heat was to stimulate the Zoysia into early spring growth and later fall activity, while the bluegrass was to remain active throughout the winter. But, no known grass will stand near constant practice and play. The sod placed on this field in early spring was destroyed from wear by mid-December.

The turf heating system was used to keep the ground thawed to permit wintertime rebuilding and reconstruction. A grader windrowed the residue during late December. In doing this, some cables were found less than 2 inches deep; in fact, some 30 breaks that occurred during the sod removal procedure were repaired. After some recontouring and refinishing, the heat was turned off. Then during February, 1967, Meyer zoysia sod was hauled in and laid on frozen ground. Next, the heat was turned on and the field was covered with clear plastic. Thusly managed, early knitting and growth were forced so that the stadium was quite ready for baseball on April 11, 1967. This would have been impossible except for turf heating. As the Zoysia needed additional heat,the air thermostat setting was raised to 70°F. and the soil sensors to 65° for the fall heating season 1967.

During 1967 the field was scheduled for 78 baseball games,plus home team practice and warmup sessions. In between baseball games, 16 soccer games were played. Professional football added 12 games to the load, plus band performances, special events and other uses. Can any turf survive? It was worn out again.

The field was again renovated between January 15 and April 15, 1968. The infield was raised, trenches were dug over each tile and filled with pea gravel topped with a calcined aggregate to improve drainage, 4500 square yards of badly worn areas were resodded with Tifway bermuda; other areas were aerated and overseeded and the field was ready for the opening 1968 baseball game. The field was again renovated and resodded with Bermuda in January and February, 1969.

Lambeau Field

Further north, the Green Bay installation began in July, 1967; actual heating started October 13. The primary objective was to prevent the field from freezing, at least until after December 31. Further, a place was needed on which to hold practices once the regular practice fields were frozen. Other results were hoped for: reduction of costs of seeding and sodding, faster rejuvenation of turf after damage, reduced injuries, faster drying and some snow melting.

Preceding installation of cable, diagonal slits across the gridiron were made and filled with a calcined aggregate to increase drainage. About 73,000 ft. of cable, in 48 sections 1520 ft. long, were buried through existing sod, lengthwise of the field. The cable layer was pulled by winches. It was made of a blade, cable guide and rolling coulter mounted on a frame. No breaks or damage occurred during installation, or since. The cables, buried 6 inches deep and spaced 1 foot apart, are stranded copper, insulated with Vulkene over which is a braided copper ground, also covered with Vulkene. These are rated at 10 watts per foot for a total connected load of 730+ kw. Each individual cable is fused and allowance was made for expansion and contraction. The 190- by 380-foot heated area extends about 6 feet beyond the playing field. Power is supplied to the field's underground distribution system through a 12.47-kv to 277/480-volt, three-phase, 1,000-kw pad-mounted transformer.

The heating grid is divided into three individually controlled zones with the control system similar to that used in Busch Stadium. The air thermostat is set to allow heating below 45° to 50°F. The soil resistance bulbs were initially balanced to limit heating to when the 3-inch soil temperatures were below 45°. This placement, while deep enough to prevent damage to the sensing elements, was too deep and too close to the cables. Some crusting occurred. To eliminate this, the bridges were reset in early December to allow heating when 3-inch soil temperatures were below 50°, and reset to about 55° just before the historic NFL championship game December 31.

The system is said to have cost $ 80,000. Some authorities say $ 100,000. The best energy consumption estimate was one million kw hours per season. If the average rate is from 1¢ to 2¢ for each kw hour, then the Packers' electric heating bill could be $ 15,000.

By November 20, 1967, the practice fields had frozen and all practice was on their heated stadium field. For the last regular league game on December 17, the heated field was in good to excellent playing condition. At 7 a.m. Wednesday, December 27, the air temperature was -11°F. At 11 a.m. it was one above as practice began. Yet, the playing surface was firm and unfrozen.

A field cover is used on cold nights and to keep rain and snow off the playing surface. Snow falls on the cover and is removed. The condensed moisture at the turf surface under covers is a big unsolved problem.

Officially, 50,861 spectators were present at the December 31 NFL championship game. The air temperature was -13° and getting colder, and a 15 mph wind was blowing. The field covering was removed between 9 and 10 a.m. The game began on a damp, but thawed surface that began to crust in the fourth quarter. All but one player wore cleats the entire game, which indicates that traction was still available.

In Conclusion

Proper, careful installation of a well-designed system is mandatory. Shallowly buried cables can cause many headaches. Trouble-shooting to find breaks is very difficult and time-consuming. Groundskeepers must be careful or they will dig or drive spikes through cables, necessitating expensive repairs.

The key to a successful commercial turf heating installation lies with management personnel. These people must develop an understanding for potential difficulties along with an understanding of the good to be gained through use of a system. The Busch Stadium field could not have been prepared for baseball without a guaranteed frost-free field in mid-winter 1967, 1968 and 1969. And, three 1967

professional football games would have been skating matches except for supplementary electric heating at Green Bay.

Certain things must be recognized concerning turf heating. Poor drainage will not be improved, bluegrass will not produce a hay crop, bluegrass can be stressed by high temperatures, Zoysia will not become a darker-than-normal green, snow may not melt as fast as it falls, additional fertilizing is necessary, and, in general responses will be slow, as heat transfer and changes in life processes are slow.

The use of coverings is critical and will be a lasting problem. Covers slow heat loss; keep rain and snow off; help melt snow in the grass blade-zone; slow evaporation from the surface; collect radiant energy which can cause damage from excessive buildup of heat, and necessitate a large labor force. In general, use covers as little as possible - for condensation causes slick, wet surfaces. Special insulated covers, which reduce interface, could be very helpful.

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UNDERSTANDING TURF DISEASES

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It is important for the Turf Manager to understand the cultural and environmental conditions that lead to disease development, the significance of symptoms in order to diagnose a particular problem, and the proper control measure for each disease problem. A few principles regarding the causal agents of plant diseases and the symptoms of some of the common turfgrass diseases are -

First, plant diseases are a normal part of the biological check and balance system found in undisturbed nature. Thus, plant diseases often become increasingly important in Turf Management as the intensity of turf culture is increased. Some diseases are associated with the rapid death of an entire plant. Others kill certain plant parts. Still others cause only a slight stunting.

In a broad senses, a plant is diseased when it fails to develop normally. However, this definition is deficient because normal growth and development are relative terms. A plant makes its maximum growth and development when grown under optimum environmental and cultural conditions.

Causes of Plant Diseases

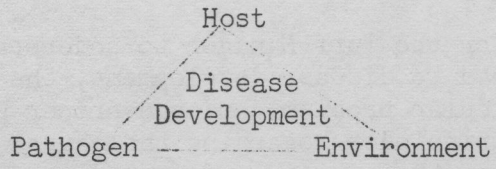
Non-infectious diseases are caused mainly by improper growing conditions. Non-infectious disease agents cannot be transmitted from affected to healthy plants. Some causes of non-infectious diseases are:

1. Excessively high or low temperatures
2. Improper soil-water relationships
3. Injurious impurities in air, soil or water
4. Mineral deficiencies, excesses or imbalance
5. Improper oxygen relationships
6. Extreme alkalinity or acidity of growing medium
7. Improper balance of light
8. Plants grown out of ecological range
9. Mechanical damage
10. Lightning damage
11. Genetic factors

Infectious diseases are caused by parasitic agents, i.e., bacteria, fungi, nematodes, mycoplasma-like organisms, viruses and flowering plants such as dodder. The causal agent can be transmitted from diseased to healthy plants. The majority of infectious turf diseases are caused by fungi. There are over 100 infectious diseases that may affect grass plants.

Plant Disease Development

Development of an infectious plant disease results from the interaction of three factors: the host, the pathogen and the environment. The host plant must be susceptible. Inoculum of the pathogen must be disseminated to the susceptible host in sufficient quantity. The proper environmental conditions affecting both the host and pathogen must occur before and during the time the pathogen is in contact with the host. The absence of any one of these factors will prevent disease development. The following drawing illustrates this phenomenon.



Any disease control measure must protect the susceptible host, make the host more resistant, eradicate or reduce the pathogen, or change the environment to make the host more resistant or the pathogen less virulent. Plant parts affected cannot be "cured" but developing new parts can be protected.

Environment and Disease Development

Environment influences the ability of a pathogen to perpetuate from one season to the next, the development of inoculum, the dissemination of inoculum, the infection process, and the development of disease after infection. Each pathogen has its set of ideal environmental conditions. Environment may influence disease development by predisposing or "conditioning" a host plant. Each plant species, like each pathogen, has its own set of ideal environmental conditions.

Soil-borne pathogens are more or less permanent soil inhabitants, and infection primarily occurs through portions of the plant that are at or below the soil surface. Air-borne pathogens complete a large portion of their life cycle above ground, and in relation to the aerial parts of the host. Some important environmental factors are:

1. Temperature of air and soil
2. Humidity of air
3. Frequency of rainfall
4. Amount of rainfall
5. Soil moisture
6. Soil pH
7. Soil type
8. Soil fertility
9. Micro-flora and micro-fauna of soil

Effect of Cultural Practices On The Development of an Infectious Disease

Proper cultural practices may help to protect the host, eradicate the pathogen or reduce the severity of a disease.

1. Nutrition. Proper nutrition will help any grass to maintain its highest natural resistance to a pathogen. Nitrogen is the most important single element for growth, but excessive use of it may increase the susceptibility of grass to pathogenic organisms. This is especially true when nitrogen is high in relation to potash and phosphorus. Research indicates that many variables exist between different elements and disease resistance. However, one trend remains clear - generally, plants have their highest degree of resistance when nutrients are maintained in balance.

2. Cutting. Grass mowed at the proper height has more resistance to disease than grass mowed too closely or allowed to grow too high. Scalped grass does not have enough leaf surface to produce sufficient carbohydrates for the production of new leaves, roots or stolons. Excessively tall grass reduces air movement and provides an excellent incubation chamber for pathogens. The removal of half or more of the grass blade at one mowing may weaken plants.

3. Watering. Excessive watering causes poor soil aeration,and roots suffocate from a lack of oxygen. Poor surface or subsoil drainage causes similar problems, and increases the damage caused by over-watering. If grass blades, including thatch, could be kept dry while maintaining sufficient water in the rootzone, foliar diseases would be non-existant. Soil kept near the saturation point prevents normal root growth and favors growth of pathogenic organisms like pythium. Proper water control is the single, biggest environmental and cultural factor in disease control in turf.

4. Thatch. Pathogenic organisms thrive on the dying, dead and decaying organic matter found in the thatch layer. Thatch absorbs excess moisture and acts as an incubation chamber. With the removal of the thatch, the pathogens must compete with non-pathogenic bacteria, fungi and other organisms in the soil. Many non-pathogenic organisms produce substances that are toxic to pathogens. The antagonistic effects of these organisms reduces the inoculum potential of the pathogenic organisms.

5. Injury. Careless use of pesticides and fertilizers, the improper use of machinery, excessive traffic, or the removal of half or more of the grass blade at one mowing may injure and weaken plants. Injured or weakened plants have less resistance to pathogens than healthy plants.

6. Promote rapid drying of leaf blades. Fungi, with the exception of the powdery mildews, require free moisture on grass blades for 3 to 12 hours for infection to occur. Rapid drying of dew and guttated water is important for disease control, especially on golf greens. Guttation fluids contain the amino acid glu-

tamine, which increases the virulence of certain fungi. Poling or brushing greens may facillitate drying. Removal of trees, shrubs or brush from near greens may aid in air circulation and drying. Problem greens are often improved by increased air circulation.

7. Maintain proper soil conditions. A well-drained, fertile soil with proper fertilization, water and pH promotes healthy,vigorous plant growth. Healthy vigorous growing plants are more resistant to most pathogenic organisms than weakened plants.

Chemical Control of Infectious Diseases

Correct diagnosis of a disease is extremely important from the standpoint of using the proper control measure. With most fungicides the disease organism is killed or prevented from infecting the plant and producing disease. The use of turf fungicides on a preventive schedule, must be applied before the disease strikes.

Follow the manufacturer's directions on the package label for rates, interval between applications, compatibility with other chemicals, grasses on which the chemical may be used, etc.

High pressures are not necessary. It is much more important that the fungicide be applied evenly. It usually is best to use a multi-nozzle boom and apply the chemical equally in two directions. The time interval between spray applications should vary with temperature, expected disease, grass condition, chemicals used, and amount of rainfall or watering.

The spray interval may be short as only two or three days in hot, wet weather, or three weeks if the weather is cool and dry. Some fungicides give some protection for a week or 10 days even when 4 to 6 inches of water has fallen as rain, or been applied by sprinkler. Another chemical may last only two or three days under similar conditions. The problem is complex and one that you have to "feel out" for yourself, based on your knowledge of the chemical and its past performance, the turf involved, the past fungicide schedule, and a knowledge of the factors that cause a particular disease to flare up. Only by keeping records can you determine why a certain fungicide failed or did a good job. Fungicides cannot make up for poor Turf Management.

Every turf manager should specifically have a collection of bulletins, leaflets and articles on turf diseases, both from Experiment Stations and industry. Then annually - or as reference - check this to keep informed.

One leaflet NC-12, Turf Diseases in the Midwest, is available.

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WHAT'S NEW WITH BENTGRASS DISEASES

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Some of the exciting new developments concerning bentgrass diseases and their control include:

1. The stimulation of the growth of pathogenic fungi by the amino acid glutamine, sugars and other nutrients secreted by the cut ends of bentgrass leaf blades. Healy and Britton at Illinois found that Helminthosporium sorokinianum, the cause of melting-out of bentgrass putting greens during hot weather, was stimulated by guttation fluids on the leaves to produce more germ tubes which branched and formed multiple appressoria. The result: a tremendous increase in fungal penetrations and the production of large lesions which quickly girdled and killed the leaves. The increased severity of H. sorokinianum on bentgrass during the summer is believed due in part to an increased glutamine content in the guttation fluids. The glutamine stems from a more rapid release of nitrogen (from organic sources of application of soluble nitrogen).

   Since glutamine occurs in guttation fluids only when too much soluble nitrogen is present, the obvious control is to change fertilization practices to provide only enough nitrogen for good growth of grass. Early morning removal of the guttation droplets - preferably by syringing with water -- should be a standard practice.

   The fungi causing brownpatch, Sclerotinia dollarspot and pythium diseases, as well as Curvularia, are also known to be stimulated by guttation fluids.

2. Two smuts are becoming prevalent on bentgrasses in the Midwest: stripe smut caused by Ustilago striiformis, and flag smut caused by Urocystis agropyri. Under the close mowing of a putting green or tee, both smuts produce identical symptoms. Only by a microscopic examination of the black smut spores in the ruptured leaves can you tell the two smuts apart. The teliospores of the stripe smut fungus are single cells. Those of flag smut are "spore balls" consisting of one or two fertile cells surrounded by several empty cells.

   It is not uncommon to find both smuts attacking the same turf area -- even the same bentgrass plant. This might explain some of the erratic control results of the past. Smut-infected plants are readily killed by drought and high temperatures in the Midwest. The smut fungi survive in the crown of infected plants and as spores in the soil, thatch, or on seed. New infections in bentgrass arise from smut spores in the soil infecting the lateral buds on crowns and rhizome nodes of mature plants, thus giving rise to new smutted tillers and rhizomes.

   Smut on bentgrass is a much more serious and widespread disease than most people realize. The large number of infected plants in putting greens is apparently the result of the penetration of lateral buds and the spread of the smut fungi from perennially-infected crowns. Frequent watering of greens and tees contributes to a buildup of smut since perennially-infected plants do not die in hot, dry weather as, for example, in unwatered fairways or lawn-type turf.

   Races of the smut fungi are known to exist so grass varieties resistant in one locality may be susceptible in another. Promising control of smuts has been obtained with systemic fungicides.

3. The first effective systemic fungicide for turf diseases is now available. This is Benlate or DuPont 1991.

Benlate is scheduled to be released later this year for use on turf and ornamentals. It will be marketed as a wettable powder containing 50% 1-(butylcarbamoyl)-2-benzimidazole carbamic acid, methyl ester. Benlate is a long-lasting, broad-spectrum seed, soil and foliar fungicide that possesses excellent residual, curative and systemic properties. It also keeps mite eggs from hatching. Benlate gives excellent, long-lasting control of Sclerotinia dollarspot, Rhizoctonia brownpatch, stripe rust, smuts; Fusarium patch or pink snowmold and powdery mildew. Benlate, when applied several times to smut-infected bentgrass plots at Urbana, Illinois, at 3 and 6 oz. per 1,000 sq.ft. in 50 gal. of water, has kept smut from reappearing. It will be another year or more before we can tell whether Benlate eradicated the smut fungi, or merely suppressed them. In adjacent plots sprayed only with water, smut is abundant. Britton also found in greenhouse tests that Benlate kept bluegrass plants free of powdery mildew for at least $3\frac{1}{2}$ months when mixed with the soil at planting time, or sprayed over the seed at the rate of 3 ozs. per 1,000 sq.ft.

In the future we can vision using Benlate, possibly in combination with chloroneb (Demosan), Daconil 2787, Dyrene, Terrazole or Koban, or other fungicide, to give control of all important bentgrass diseases. Instead of spraying on a weekly or 10-day protective schedule, perhaps fungicide(s) will be mixed with the topdressing or a slowly available fertilizer and be applied in the spring and fall following aerification. Here is the area where we will be working at Illinois in the years ahead.

4. Pythium control. Pythium was damaging throughout much of the Midwest in 1968. Where water could not be removed no fungicides would check it. The best we can suggest is -

a. do everything possible to remove quickly all excess surface and subsurface water, i.e., rebuild problem greens for 3- or 4-way drainage, put in slit trenches, add dry topdressing, prune or thin trees and shrubs to improve air drainage, etc., and

b. apply a fungicide effective against Pythium. The best results have been obtained from using Dexon, Terrazole (or Koban) and Demosan either applied alone or mixed with Dyrene, Daconil 2787, Tersan OM, Panogen Turf Spray, or other mercury-containing fungicide.

Dexon (Chemagro) available for turf as a 35% wettable powder and as granules, should be applied at dusk or at night since exposure to light results in loss of fungicidal activity. When properly applied, Dexon may persist in soil for many months.

Terrazole (Olin Mathieson) is a new soil fungicide being marketed as a 35% wettable powder containing 5-ethoxy-3-trichloromethyl-1,2,4,-thiadiazole. It gave the best control of Pythium in Oklahoma tests. At present there is no label for turf. Mallinckrodt's new product, Koban (MF-344) has the same active ingredient as does Terrazole, and is registered for turf. We will hear much more about Koban in the future.

Demosan (DuPont 1823) contains 1,4-dichloro-2,5-dimethoxybenzene. It is available as a 65% wettable powder, a 10% dust and 10% granules. It has also checked stripe smut in mature turf of Merion Kentucky bluegrass for several months and gives excellent control of Typhula blight or gray snow mold.

Superintendents should experiment (in an out-of-the-way nursery) using fungicide dusts or granules applied to wet grass to control Pythium. This would remove some of the surface moisture needed by the fungus to spread and infect.

c. a high level of available calcium, based on a soil test, is another possibility of controlling Pythium. Couch and co-workers, in growth chamber tests, found calcium to be the key element in keeping Pythium under control.

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MANPOWER ON THE MOVE

Tom Sams, Supt., Audubon Country Club,
Louisville, Kentucky

With today's labor situation as it is, the proper utilization of manpower has become a critical problem with the majority of Turf Managers. In order to effectively use what manpower we have, we must make the transition to mobility wherever possible. Let's face it - trying to compete in today's labor market with private enterprise is almost impossible, so we have to resort to a more modern equipment inventory to offset this problem. We also must display a certain amount of ingenuity wherever and whenever possible. In short, being a Turf Superintendent in today's times requires a lot more than the knowledge of growing and maintaining fine turf. Having ingenuity permits us to improvise on our everyday problems whenever we have to; it also permits us to constantly improve on routine management. One question that keeps popping up is, "How can we get better results from our employees?" "Is what you are doing on your golf course with your manpower going to benefit me?"

When Louis Miller, Superintendent of Louisville Country Club, was asked this question he commented - the answer to effective manpower utilization is not the Superintendent trying to gear his operations to that of another superintendent, but to adopt effective methods of efficiency that can fit his own situations. He cites an example on his own course where he has a completely automatic watering system on his fairways, but he has to resort to watering his greens by hand because of their age.

As antique as his greens watering program is, Louis has gone quite modern in many other aspects of Turf Management. For example, he, along with Charles Oller, Superintendent of Standard Country Club in Louisville, have installed two-way radios in their private vehicles as well as key vehicles that are used on the course. Charles figures that the savings in time traveling around his course supervising his personnel is about one-fourth.

Another example of manpower on the move is at Wildwood Country Club in Louisville where George Littrell, Superintendent, has converted to spiking his greens with a three-gang unit pulled behind a truckster. It wasn't too many years ago that the thought of putting a truckster-type vehicle on a green made most superintendents shudder. With today's more sophisticated machinery, this is very commonplace - Superintendents are spiking, cutting and spraying greens with riding equipment.

There are times when the budget won't stretch to purchase a certain piece of equipment, or maybe what you need isn't available. This is when we must display our ingenuity, this is the time to improvise for without this faculty that most Turf Managers are blessed with can you imagine how much more difficult our jobs would be!

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MANPOWER ON THE MOVE

Robert V. Mitchell, Supt., Sunset Country Club
St.Louis, Missouri

Since the beginning of time, industry has been constantly mechanizing their operation. The maintenance of golf courses has followed this same trend for essentially the same reasons - to make budgets stretch farther and buy better conditions. But, we have an additional motive - the inability we're facing today of obtaining a labor force.

One would probably be safe in saying that there is no job being done on golf courses today the same way it was done 20, 10 or even 5 years ago. The use of maintenance vehicles is commonplace today, and only ten years ago very few were used. You'll find this is true with all courses regardless of size of budgets. We've all seen and used ideas of our own to make better use of the labor and equipment that we have. I think it well to point out here, however, that seldom do we see and never do we agree that changing a method of doing a job for speed alone is better, unless the change produces a more satisfactory turf. I'd like to share with you a few idea that I've seen used to solve a need on golf courses:

Use of a low "sled" -- wooden platform on rounded skit boards - - pulled by a tractor to carry tools and equipment from place to place. Hooked short it doesn't tear up turf.

Construction of small, low, two-wheeled carts to carry greens mowers from green to green to be pulled by "hand-me-down" electric golf carts when club purchased new carts. Bag cavities on carts are useful to carry miscellaneous tools to do many jobs on the course.

Needing something for conveyance, one superintendent removed the cutting units from a National mower, which served his purposes.

Another superintendent used a golf cart that wasn't busy to pull his sod cutter and Greens-aire from job to job. (I caution the use of this idea on hilly courses).

To hasten the raking of his 9,000 sq.ft. greens, one superintendent mounts Del Monte rakes in an old set of fairway mower frames -- removing the reels and knives. Pulling this 3-gang rake outfit with a tractor keeps six green cutters busy trying to catch up. This same fellow topdresses greens with a two-wheeled tractor-drawn Rotary spreader equipped with terra tires. I found that the addition of calcined clay added to the topdressing makes it flow better and more evenly through the spreader.

And, as you know, there are a great many superintendents using 2-way radios to more effectively dispatch their labor force.

This topic, "Manpower on the Move" suggests to me not only methods and/or innovations to better move men, but any item that better does a job, or does a job faster with the same results that releases men to do other things.

1. Effective safe method of hauling telephone poles - chain one end to tractor and other end across a trailer.
2. Tiller rake effectively smooths and compacts new green for planting
3. Widening bridge to 20' enables crossing with 7-gang mowers without breaking them down and thus saves many manhours.

4. Wetting agents will prohibit frost accumulation for a day or two for earlier golf or early work on green.
5. Deep Verti-cut with some blades removed will adequately shred sod into stolons for small areas.
6. Large areas to be stolonized can be accomplished with a manure spreader
7. Hay rake can effectively remove straw from Bermuda tees and nurseries in the spring.
8. Automatic irrigation system reduces manpower for watering and for use elsewhere.
9. Drop-type spreader - tractor drawn quickly topdresses tees.
10. Same spreader can be used on greens and nurseries.
11. Drag matting with tractor saves labor effort
12. Where vehicles can't be used - this Park Special with 4 - 16" street brooms mounted in front does a splendid job of brushing-in topdressing.
13. 3-wheel vehicles speed fairway spraying by at least 1/3 over older types. Boomless sprays even faster.
14. Four 3-wheeled vehicles ready to go cut greens - each contain whipping pole for dew removal, greens mower, ramp board for loading and unloading, and a box to hold clippings.
15. Tractors with 3-point hydraulic systems makes use of carry-all rack to haul materials and equipment inexpensively
16. Effective use of vehicles in all weather shows need for access roads or trails. All golf cart paths should be 8' for equipment use.

These are just some ideas on how you can move manpower and accomplish more with your resources.

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IRRIGATION NOW AND THEN

Thomas J. Kramer, Kirchdorfer Irrigation, Inc.,
Louisville, Kentucky

Changes have occurred in turf irrigation for three closely related reasons: technology, efficiency and economy. These criteria are used by manufacturers in developing new products, by architects and engineers in analyzing system design, and by turf managers in the selection of an irrigation system. The irrigation industry is constantly working for more efficiency and better economy to help grow better turf for less money and effort.

Efficiency is a method of rating the proportion of work produced to that put in. In irrigation we use efficiency ratings to select pump plants, piping systems, and water distribution patterns. Usually, the more efficient an irrigation system is, the lower the operating costs will be.

Under economy, on the other hand, we include the initial capital expenditure, plus the operating costs amortized over the system life expectancy to deduce the cost per year to own and operate an irrigation system. An economical system is one that will do the necessary job for the least amount of money and effort.

The history of turf irrigation has been one of rapid change. In many parts of the country the concept of an irrigation system has changed from one of hand-watering to one of fully automatic in less than two decades. This has occurred

because the public has demanded better turf areas for recreational use. Turf Managers have realized that to grow this quality turf they would be forced to exercise more and more control over their watering practices, and thus fully automatic systems have gained prominence. Superintendents in all parts of the country are realizing that to grow a better stand of turf the control available with automatic irrigation is highly beneficial and at times necessary.

Automatic fairway irrigation systems here in the Midwest are of two basic types; the first being the single row system with pop-up sprinklers spaced down the center of the fairway. The second type, the multi-row, spaces the sprinklers in a triangular or square pattern with two or three rows per fairway. Some of its advantages are:

First, the multi-row system uses smaller sprinkler heads which we space in a triangular pattern at between 60% and 70% of the diameter of the sprinkler, depending on local conditions. This gives us a precipitation rate on the order of 1/3" per hour. The precipitation rate of the larger heads used in the single row system is in the neighborhood of 1/2" per hour. A lower precipitation rate can more closely match the infiltration rate of most soils. We can obtain a more firm surface condition, which reduces excessive structural breakdown, if we give the water an opportunity to move through the soil profile at the same rate that it is being taken in. We also lose less water to surface evaporation because the rate of evaporation is proportional to the degree of wetness at the surface. On slopes where runoff will occur this lower rate also helps.

Secondly, the smaller heads will operate on less pressure than is required with the larger units. We can actually use about 22% less pressure with the multi-row system. This can be converted into power costs, which results in a considerable savings. Another feature of the multi-row system is its tolerance to more wind. This is a result of the triangular pattern used and again we conserve water.

Perhaps the most important feature of the multi-row system is its distribution efficiency - the uniformity of coverage that a sprinkler or group of sprinklers can attain. An effective method of measuring this efficiency was developed by J. E. Christiansen and is called the Uniformity Coefficient. This rating will vary according to nozzle size, pressure and pattern of sprinklers involved. The multi-row system will carry a much higher coefficient than can be attained with the single row system. Uniformity efficiencies of 90% are common for the triangular pattern, whereas ratings of 75% are the rule rather than the exception with the single row design. Aside from these specific advantages, other features are generally incorporated into the multi-row design.

Usually several sprinklers are grouped to one valve. The actual number will vary from four to six, depending upon soil conditions and topographical considerations. This means that we use about one-fourth the number of valves needed for the single row system. This also means we use less wire and fewer controller locations. Generally it requires about 50 automatic valves for fairway use with the multi-row, whereas a single row system will take about 200 valves. This results in less maintenance for the automatic portion of the system, such as valves, wire and controllers.

We may install these valves in the rough, rather than in the fairway. A large valve box is used at each valve and thereby saves the digging necessary with that of the direct buried valves. This also reduces maintenance costs. These are just some of the advantages of the multi-row system. But, what about costs?

The cost of a multi-row system will generally be 5 - 10% higher than an equivalently engineered single row system. The actual figure will vary according to the course layout. But, I feel this difference is justifiable when the efficiency and economy are considered. Better coverage pattern, better utilization of

water, lower pumping costs, lower water costs, and less maintenance will contribute to make the multi-row system help to grow better turf for less money and effort.

But, what can we expect in the future in the way of fairway irrigation? One of the most exciting developments that I know of is the use of soil moisture measuring devices to determine the moisture content and, therefore, the available water supply. This is then converted to control the irrigation cycle.

The problem of frequency of application has become pronounced in the advent of automatic irrigation. Before automatic irrigation it wasn't feasible to produce exacting water rates, and we were lucky in some instances if the night watering man make it through the entire system at all.

The exact amount of water used will vary according to the evapotranspiration rate, species grown, soil structure, and management program. This can be determined manually with tensiometers or resistance blocks, but it generally isn't feasible for large scale turf areas such as golf courses. So, it is left to the Superintendent to either take a calculated risk and apply the exact amount of water, or to over-water, and the latter is what usually occurs.

Automatic soil moisture control has been used for small turf areas for some time now. Experiments on the west coast by (Wayne Morgan and others) have shown considerable savings in water and pump costs, with a resultant of better quality turf. This is because an ideal soil-water-air relationship is established when there is neither too much nor too little water.

We first became interested in this idea several years ago for fairway use, and after looking at various methods we chose the resistance method with one sensing unit for each automatic valve. We found that the multi-row system is ideally suited to the moisture control idea because of its even distribution patterns, and because there are about 50 valves on a fairway system and this means fewer sensing units. This is what makes the idea feasible for large scale use in the Midwest.

After building our own controller we installed the system on Danville Country Club's #9 and #10 fairways, but did not get to use it enough last year to gain any important information. But, I look forward to reporting in the future on its development. This concept will eventually become practical for use on any automatic system, and it will provide control that cannot be matched by the present "guess method." I believe also that besides its efficiency it will in many cases save a considerable amount of money and be very economical.

These are just two items in an industry that is growing by leaps and bounds. But, before you jump on any bandwagon remember that changes and innovations should be both economical and efficient if they are to be justified. It is up to you as architects and turf managers to choose a aystem that will do the best job.

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