PROCEEDINGS

SIXTEENTH ANNUAL

SOUTHEASTERN TURFGRASS CONFERENCE

GEORGIA COASTAL PLAIN EXPERIMENT STATION

and

ABRAHAM BALDWIN AGRICULTURAL COLLEGE
COOPERATING

TIFTON, GEORGIA

APRIL 9 – 11, 1962

P R O C E E D I N G S

Sixteenth Annual

S O U T H E A S T E R N T U R F G R A S S C O N F E R E N C E

Tifton, Georgia

April 9-11, 1962

Sponsored By

UNIVERSITY OF GEORGIA COASTAL PLAIN EXPERIMENT STATION

In Cooperation With

ABRAHAM BALDWIN AGRICULTURAL COLLEGE

UNITED STATES GOLF ASSOCIATION GREEN SECTION

FOREWORD

The Sixteenth Annual Southeastern Turfgrass Conference is over. Its hours of fellowship, of observation, of new equipment, of studies of new grasses and new management problems and techniques have passed. This proceedings publication will provide for you an opportunity to relive parts of the program. Read and study it; it contains much of value to many of you who were in attendance. We hope it will be helpful.

We enjoy the Turfgrass Conferences and welcome the opportunity to continue to cooperate with our many friends who do so much to make both our turf research and the turf conferences a success. You have been generous with your time and resources. We value that, which we accept as an indication of your interest in the program we are conducting. Truly, this turfgrass research program and conference are outstanding examples of the most wholesome kind of cooperation between many people. The results have been gratifying to us.

We look forward to seeing each of you at the Seventeenth Annual Conference.

Frank P. King
Director

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CAUSES OF COMPACTION AND WEAR ON TURFGRASS AREAS

Thomas C. Mascaro
President, West Point Products Corporation
West Point, Pennsylvania

Compaction, in its broadest sense, simply means the reduction of pore spaces within a soil mass. Turfgrass roots do not grow in the soil particles, rather, they grow in the spaces between the soil particles. Space between these soil particles is not only needed for roots but also for air, water, and nutrients.

There are many forces which are constantly at work on turfgrass areas that create compaction. The major forces of compaction on turfgrass areas might be listed in the following order:

Water
Mowing equipment
People
Golf carts
Maintenance equipment

Water is certainly a major source of compaction. The impact of a water droplet, whether natural or artificially applied, will disassociate soils. Admittedly, a turfgrass cover reduces this effect considerably but on thinly covered turfgrass areas the effect can be serious. Water moving through the soil causes compaction by the simple process of melting the soil to finer particles which in turn fill the pore spaces.

Also water, being a good lubricant, allows soil particles to slide together into a solid compacted soil mass—commonly called mud. When the soil dries, the particles remain together. This is compaction.

Mowers, people, golf carts, and maintenance equipment are all forces causing compaction. Not only must we consider the weight of these forces, we must also consider the kneading, or puddling action of these forces.

The sheer weight of tractors, mowers, people, etc., compress the soil, reducing the pore span within the soil mass. However, we must also consider that the greater force of compaction results from the kneading or puddling effect. When a wheel turns, or a person's foot rolls on the turf, soil particles, lubricated with water, move quite easily into compact masses. Water is squeezed out and its place is taken by solid particles.

Turfgrass managers must bear these fundamental facts in mind. Although we realize that these compacting forces cannot be eliminated, many things can be done to minimize these effects.

These principles also apply to turfgrass wear. Grass can be compared to a steel beam. A steel beam can support just so much weight, and then it is going to break. The same is true of turfgrasses. Managing turfgrass areas to distribute wear over large areas will do much to minimize this problem.

The various panels of this conference will cover many ways to minimize compaction and how to overcome it as it occurs. Compaction in my opinion is a problem that must be controlled as it occurs. Compaction must not be allowed to become so severe that major renovation is needed.

The slides I will show will illustrate many of these causes of compaction.

Let us not forget that the turfgrass areas we are charged with maintaining are not our paradise. We must maintain them for the use of the people. Therefore, we must explore every method, consider every plan and constantly develop new approaches in order to give people what they demand.

SOME SOIL PHYSICAL EFFECTS OF TRAFFIC

J. R. Watson, Jr., Director, Agronomy Division
Toro Manufacturing Corp., Minneapolis 20, Minn.

Turfgrass areas of all kinds are being subjected to an increasing amount of traffic each year. True, new facilities--parks, school grounds, athletic fields and golf courses--are continually being constructed, but many of the older recreational sites are being converted into housing and industrial developments. This, along with a rapidly increasing population--over five million within two years after the 1960 census--and the availability of more leisure time than at any period in history is placing heavy demands on all types of recreational facilities and services. Improvement in economic and production efficiencies will, unquestionably, result in even more leisure time in the future.

That the American people will devote a large share of their leisure time either directly, as participants, or indirectly as spectators, to utilization of recreational facilities involving turfgrass is most apparent. To illustrate: consider the number of teams in major league baseball and professional football today as contrasted to five years ago; think for a moment of the number of post-season college football "bowl" games that will be played in 1961-62--most of us can remember when there was only one and all will recall when there were only four; ask the golf course superintendents about the number of golfers today as compared to ten years ago; talk to the park and school representatives about "park league" sports, little league baseball and intramural programs. All of them (and more) activities may be cited as examples of the trend toward increasing traffic on recreational turfgrass. Stepped up physical education programs and intramural activity in our elementary and secondary schools, colleges, and universities insures continuing participants and interested spectators. As an example, many colleges and high schools teach golf in their regular physical education curricula. It would seem, then, that a discussion of traffic and its effect on soil physical properties is an appropriate subject and one that needs to be thoroughly evaluated.

SOIL PHYSICAL PROPERTIES

There are certain basic requirements which soil must provide for satisfactory plant growth. These are: support, water, air (oxygen), temperature, and nutrients. Of these, water and air along with their inter-relationships directly relate to soil physical properties. Hence, the subject "Some Soil Physical Effects of Traffic" may be discussed in light of the effects that traffic has on the air-water relationships of the soil and how this influences turfgrass growth. The chemical and biological properties of soil are equally important in the growth of turfgrass and their influence must always be kept in mind, but basically this discussion will deal with soil physical properties.

The texture, structure, porosity, and organic matter content of a soil governs the infiltration (movement of water into a soil), retention (water-holding capacity), and movement of moisture through (percolation) and out of (drainage) the soil. These physical properties likewise control the air-water relationships, and because of their inter-relation with the chemical and biological properties, exert a major influence on the productivity of the soil.

A brief review of the terms pertinent to a discussion of soil physical properties as affected by traffic may be in order.

Texture

This is a soil term which refers to the size of the individual soil particles. Sand, silt, and clay are the basic textural terms. "Soil class" (terms like sand, clay, clay loam, sandy loam, etc.) indicates the predominant soil separates. Texture is a most important characteristic of soils because it describes, in part, the physical qualities of soils with respect to porosity, coarseness or fineness of the soil, soil aeration, speed of water movement in the soil, moisture storage capacity and, in a general way, the inherent fertility of the soil. Sandy soils are often loose, porous, droughty, and low in fertility, whereas clay soils may be hard when dry or plastic when wet, poorly aerated, but high in moisture retention and possibly high in fertility. Between these two extremes we find the loams and sandy loams which, in general, are more desirable for turf growth.

Structure

This is a soil term which refers to the arrangement or grouping of the individual particles into units. A structural unit may be defined as a group or groups of particles bound together in such a manner that they exhibit different physical properties from a corresponding mass of the individual particles. Such a structural unit is called an aggregate. Terms used to describe various types of structure are granular, crumb, platy, etc. In general, the granular and crumb structure is most desirable from the standpoint of plant growth. Platy structure is generally associated with slowly permeable soils derived from shales. Soils in which structure has been destroyed--partially or completely--are said to be dense and compacted.

The structural aggregation of soil is greatly influenced by the amount of colloidal organic matter present. The end product of decay or organic matter--humus--is an integral part of soil aggregates and is sometimes referred to as the cementing or binding agent in aggregates. Stability of aggregates is directly dependent upon the amount of organic matter and the degree of biological activity obtained. The structural aggregation of soil determines, to a large extent, the porosity, permeability, and water capacity of soils of like texture.

Porosity

This term may be defined as that percentage of the soil volume not occupied by solid particles. In a soil containing no moisture, the pore space will be filled with air. In a moist soil, the pores are filled with both air and water. The relative amounts of water and air present will depend largely upon the size of the pores. Two types of pores are recognized--the small (capillary) and the large (non-capillary). The small pores hold water by capillarity and are responsible for the water-holding capacity of soils. The sum of the volumes of the small pores is called "capillary porosity." The large pores will not hold water tightly by capillarity. They are normally filled with air and are responsible for aeration and drainage. The sum of the volumes of the large pores is called "non-capillary porosity" or large pores.

The total porosity of a soil is not as important as the relative distribution of the pore size. Total porosity is inversely related to the size of the particles and increases with their irregularity of form. Porosity also varies directly with the amount of organic matter present in the soil. Clays, for example, have a higher total porosity than sands. Clays have a large number of small pores which contribute to a high water-holding capacity and slow drainage. Sands, on the other hand, have a small number of small pores which are responsible for a low water-holding capacity and rapid drainage.

If traffic were not a consideration, the ideal soil for plant growth, in general, should have about 50 percent total porosity equally divided between small and large pores; or, in other words, contain 25 percent water space and 25 percent air space. On areas where traffic becomes an overriding consideration, then the total porosity of the soil is of less importance than ability to resist pressure (traffic). This is evidenced by results of studies sponsored by the USGA Green Section and conducted at Texas A & M. These studies have shown a requirement for a minimum total pore space of 33 percent. Significantly, the small and large pore is approximately equally divided--12 to 18 percent for large pore space and 15 to 21 percent for the small. The aim or purpose in using high sand percentages is textured stability of pore space.

It must be recognized that the exact proportions of solids, air, and water space seldom exist in native soils. The specified proportions are merely a goal or standard to strive for. Modification of the physical properties of soils for certain turfgrass areas may be desirable, but for most, modification is not practical and one must work with the existing soil. Size of the area and the amount and kind of traffic (intensity of usage) to which the grass will be subjected are the major factors governing the decision to modify.

TRAFFIC

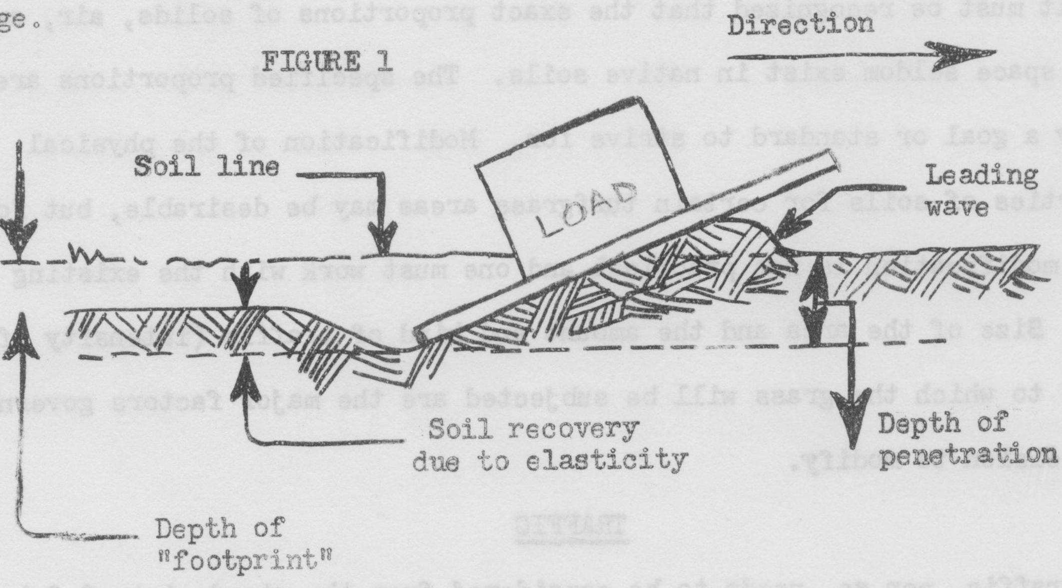
Traffic, per se, needs to be considered from the standpoint of friction and unit pressure and then these related to the effect or influence they have on turfgrass and soil physical properties.

Friction*

Friction is usually thought of as being of two forms--sliding and rolling. Although quite similar in their over-all effects, there are differences that should be pointed out.

Sliding friction, for example, may be defined as the force required to move an object and is determined by multiplying load by the coefficient of friction of the two materials in contact. The actual area in contact is of no consequence in this case. The coefficient of friction for materials such as steel, cast iron, leather, etc., have been calculated and are readily available. As an example, it requires 0.3 x load to slide steel on cast iron, 0.2 x load to slide cast iron on cast iron, and 0.5 x load to slide leather on steel. Exact figures (coefficient of friction) are not available for direct application on turfgrass. Nevertheless, by considering area and studying the effects of friction from the standpoint of the damage it may produce, it is possible to obtain a relationship between area and damage.

FIGURE 1



*The author wishes to express thanks and appreciation to Harley Kroll, Research Engineer, Toro Manufacturing Corporation, for his help and assistance in preparing this section of the paper.

In this illustration, which is obviously distorted, it may be noted that pressure is the major factor affecting soil displacement. Pressure is a function of load divided by area. Pressure is the direct course of the depth to which the footprint penetrates the soil.

In Figure 1, the force required to move the load over the soil is actually greater than just the force determined by the coefficient of friction. This is true because, in addition to the coefficient of friction between the load and the soil, an additional force is required to lift the load out of the depression produced or, in other words, to lift the load up the "hill" created by penetration into the soil.

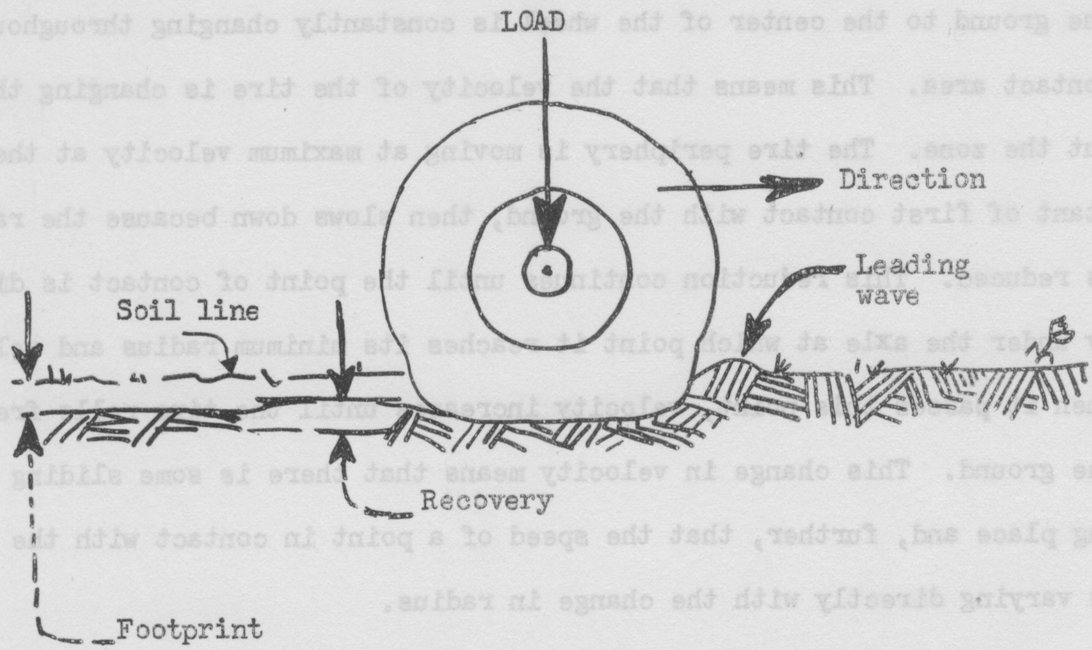
This second force (that above the requirement to overcome coefficient of friction) may be reduced by increasing the area in contact with the soil. This may be illustrated by comparing a trapper walking on snow with or without snowshoes. When walking on snow, one is literally always walking "uphill." The steepness of the hill is a function of the depth to which the "load" penetrates. When equipped with snowshoes the trapper will not sink into snow as deeply as he would without snowshoes. With snowshoes the depth of penetration is less because of the greater contrast area; therefore, the "hill" or incline which he is climbing is less; hence, the force required to overcome sliding friction is reduced. This is one of the reasons why heavily thatched turfgrass areas (St. Augustine lawns) are often said to "tire you out."

Another consideration of sliding friction and its relationship to area involves the "fragility" of the sliding surfaces. For example, by using a long plank (greater area) one is able to stand on thin ice which otherwise would not support his weight. In this case weight is distributed over a much greater surface area. Similarly a load may be slid over turfgrass without crushing or bruising the grass or deforming the soil if the contact area is sufficiently broad. Visualize the difference in damage resulting from a 200-pound man wearing football shoes and the same man wearing regular shoes. *Football shoes are equipped with seven cleats. Each cleat has a diameter of 0.9 centimeter or an area of 0.636 square centimeter. Thus, each shoe has a surface area of 4.452 square centimeters. Converting this to square inches of surface will show that the entire weight of the player and his equipment is supported by only 1 1/3 square inches. This means that the 200-pound player exerts 150 pounds static pressure per square inch. When running he will easily exert two to three times this pressure. In contrast, a regular shoe print would have approximately 32 square inches of surface and the 200-pound man would exert only some 6.25 pounds per square inch. If walking normally and placing his entire hull down first he momentarily exerts approximately 17 psi.

<u>Rolling friction</u>, or the force required to move a load bearing wheel over the ground, is in most respects quite similar to sliding friction. The force required to overcome penetration is the same in both cases (sliding and rolling) and if the materials are the same, the force required to overcome the coefficient of friction is the same in both cases. The differences between sliding and rolling friction comes about because a load supported and being moved by a wheel produces a decrease in radius of the wheel directly under the axle. This is illustrated in Figure 2, which is again exaggerated.

*Information from Dr. Don White, Turf Specialist, University of Minnesota.

FIGURE 2



This shows a rubber tire moving over soil into which it penetrates and leaves a "footprint" or trail. The tire is trying to climb out of the depression; hence, is going "uphill" in the same sense as explained under sliding friction. This explains why it is harder to push a wheel barrow through soft sand than over solid ground or pavement.

Note also that the bottom of the tire is flattened and, therefore, the area in contact with the ground is increased, thus spreading the load over a larger area, thereby reducing penetration. This fact will help one when driving a car through snow or mud. The car will move through places with soft tires that it cannot negotiate if the tires are hard or have a higher inflation pressure which precludes the development of extensive deformation.

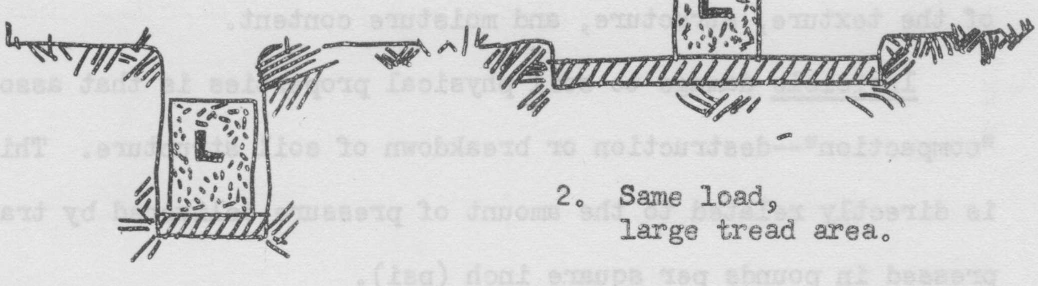
Figure 2 also shows that the distance from the point of contact with the ground to the center of the wheel is constantly changing throughout the contact area. This means that the velocity of the tire is changing throughout the zone. The tire periphery is moving at maximum velocity at the instant of first contact with the ground, then slows down because the radius is reduced. This reduction continues until the point of contact is directly under the axle at which point it reaches its minimum radius and velocity. When it passes this point, velocity increases until the tire rolls free of the ground. This change in velocity means that there is some sliding taking place and, further, that the speed of a point in contact with the soil is varying directly with the change in radius.

As the load passes over the soil it is deformed. This deformation is of two types--permanent and temporary. The permanent type is easily recognized as a footprint or tire mark after the load has been removed. The temporary deformation is not so easily seen because it exists only while the load is actually applied and is a measure of the tensile strength of the soil (the soil's elasticity, or its ability to recover from deformation). This <u>temporary</u> deformation or compression may be just as destructive to plant roots as the permanent deformation because of its tearing action.

Most materials such as steel and rubber have a uniform rate of deformation with load--by this we mean that if a given load will cause steel to bend one inch, twice this load will cause a deflection of two inches. This is not true of soils. When a load is applied to soil it compacts or increases in density. Because of this, a support area that will sink into soil one inch with a given load will sink <u>less than</u> two inches when the load is doubled. The rate per inch is a function of soil texture, structure and moisture content. The depth of penetration is a function of pressure and "compactibility."

Pressure is defined as load divided by area as explained earlier. Compactibility is defined as an increase in density--weight per unit volume. Pressure may be modified as shown in Figure 3. In this case penetration is modified by varying the support area. This is the same as was described in the case of the trapper's snowshoes and football vs. regular walking shoes.

FIGURE 3



2. Same load, large tread area.

1. Large load small tread area.

EFFECTS OF TRAFFIC ON SOIL PHYSICAL PROPERTIES

It is evident from the preceding discussion that the effect of traffic on turfgrass areas falls into two categories: (1) the effect on the grass and (2) the effect on the soil physical properties. In this discussion we are primarily concerned with the latter, but the effects of traffic <u>on</u> the grass as well as the effects <u>of</u> the grass cover cannot be overlooked or omitted from an over-all standpoint.

The effect of traffic on soil physical properties may be further divided into visible and invisible damage.

Visible damage on soil would include marking (depressing), slipping, and sliding. The degree of soil damage is directly related to the resistance offered by the turfgrass care and the soil. Resistance offered by the turfgrass cover is a function of the degree of coverage (stand or density), the amount of thatch or cushion, the inherent wear resistance of the grass, and the general state of moisture within the grass plant. Cells with a low water content (wilted) offer less resistance than cells filled with water--tugor pressure. Resistance offered by the soil as already mentioned is a function of the texture, structure, and moisture content.

Invisible damage to soil physical properties is that associated with "compaction"--destruction or breakdown of soil structure. This, of course, is directly related to the amount of pressure delivered by traffic and expressed in pounds per square inch (psi).

Compaction brings about an increase in density with a corresponding decrease in pore space, particularly the large pore spaces. A severely compacted soil may become so dense that for all practical purposes the air space (large pores) is almost completely destroyed.

Data compiled by Dr. R. B. Alderfer (Head, Soil Department, Rutgers University) illustrates the effect of compaction on soil density and pore space.

Effect of Compaction on Soil Weight per Cubic Foot

Compaction Intensity	Weight of a clay-loam soil per cubic foot
None	68 pounds
Medium	92 pounds
Heavy	112 pounds

This table shows that as the intensity of compaction increases there is a corresponding increase in the weight of an equal volume of soil. In other words, the greater the applied pressure the more dense the soil becomes.

This next table shows the effect of compaction on pore space.

Effect of Compaction on Non-capillary Soil Porosity

Compaction Intensity	Percent Non-capillary Pore Space
None	33.1
Medium	12.2
Heavy	6.1

Non-capillary pore space in this table refers to the large pores (air spaces). These two tables illustrate the effect of compaction on soil density and porosity as aptly as any information available.

Changes in soil density and porosity are reflected directly in the quality of the turf. A severely compacted, as well as a water-logged soil, prevents normal root activity and, in most cases, results in definite injury.

Under such conditions the oxygen supply becomes practically exhausted. Oxygen is, of course, just as essential for the proper functioning of turfgrass roots as it is for the proper functioning of an animal. A compacted soil slows down the movement of air and water and results in its becoming saturated with carbon dioxide, other gases, and certain reduced compounds quite toxic to plant roots. Plant roots cannot perform their function of absorbing water and nutrients under such conditions.

On turfgrass areas most of the soil compaction, fortunately, occurs at or near the surface (primarily in the upper two inches). It is recognized that good turfgrass must be grown in spite of the fact that many factors seem to operate adversely. The use of mechanical cultivating equipment is, perhaps, the first approach to alleviating compaction. The results of cultivation are, unfortunately, not permanent and it is necessary to repeat the operation every so often. At the present time, however, this technique affords the most practical means of correcting and improving poor physical soil condition on large areas. Likewise, on small intensively used areas (golf greens) cultivation provides a means of maintaining proper air-water relationships. In combination with "spiking" such will assure proper water infiltration.

SOIL COMPACTION AND RELATED FACTORS

A Panel Discussion

Mel Warnecke, Atlanta, Georgia
Maynard Brown, Thomasville, Georgia
James R. Watson, Minneapolis, Minn.
Thomas C. Mascaro, West Point, Pa.
Charles G. Wilson, Milwaukee, Wisc.
Fred V. Grau, College Park, Md., Moderator

The following notes were taken by the Moderator during the course of the discussion. No claim is made for completeness nor is credit extended for the remarks. In a panel, everyone participates and everyone shares.

In days long past, golf courses were "smoothed" with 25-ton rollers. This created extreme compaction. In highway work, extreme compaction with heavy equipment is essential to create a desirable base for the roadbed. Operators of heavy equipment used for building golf courses seem to think that this type of compaction is okay.

When soils are compacted, they need to be aerated or cultivated, not so much to let air (and oxygen) into the soil, but to let poisonous gases (CO_2 and methane) escape. Ventilation is the real need in compacted soils.

Compacted soils cannot supply oxygen to the bacteria in sufficient quantities to meet their needs. As a result, there is reduction of compounds and formation of toxic substances. Roots slough off and the plant suffers. Bacteria also lose their ability to aggregate soils.

Compaction has been recorded to depths of several feet in the far West. Continual force applied to the surface is transmitted in waves until deep soil layers are compacted. Even sandy soils can be severely compacted.

Compaction results from men and machines. The impact of a man's heel creates severe compaction. Vibration of machines can cause compaction similar to the <u>settling</u> of wet concrete with vibration.

Soil mixtures can be made scientifically so as to minimize compaction. Materials that contain graded particles permit fines to fill spaces between larger particles, thus reducing pore space and increasing compaction.

In rebuilding East Lake, 14 inches of carefully pre-mixed soil was laid on 6 inches of stone over tile, then compacted over and over. In the discussion, it was brought out that the soil was firmed, not compacted. It was designed so that it could not be compacted beyond certain limits, so that it would allow good root growth.

Terms such as "sharp sand" need further specific definition, so that rigid specifications can be written and duplicated. The local soil must be analyzed physically to permit specifications to be written.

Severely compacted soils can be alleviated without going to the heavy expense of rebuilding. Several machines are on the market that are capable of loosening, cultivating, and aerating the top three inches of soil without destroying the turf and without seriously affecting play. One principle to note carefully is that of avoiding the addition of excess organic matter. Grasses do a good job of building more than enough organic matter if they are well fertilized. If soils are heavy (clay) the best thing to add is coarse sand, well mixed into the top three inches by repeated cultivating.

Overwatering can cause compaction by drowning the organisms that help to create soil aggregates (crumb structure). Soils that alternately are wetted and dried tend to swell and shrink, so that cracks or fissures occur. This aids greatly in aeration, hence in root growth, which further relieves compaction.

Compost is receiving increased attention. A physical mixture of materials isn't soil. It becomes soil after microorganisms have "homogenized" and aggregated the materials and given them life.

Education of golf clubs is very much needed. New clubs, especially, make some horrible blunders because they do not know the background of soil formation and do not seem to know where to get the information. No clear-cut answer to this problem was forthcoming. New club committees are too dependent on one man--the architect.

Compaction due to excess root growth was discussed. It was concluded that the effects may resemble compaction, but the culprit is thatch which does also prevent free movement of air, nutrients, and water. Thatch is a subject in itself and was not discussed further.

Topdressing with coarse sandy material, the use of lime, the use of fertilizers that stimulate microbial action--all aid in relieving compaction and in preventing it to some extent.

The use of mole drains and plows was touched on briefly, also closing the course when conditions favor compaction. Elimination of carts was suggested, but that did not seem to be too practical, since many people derive income from sale, operation, rental, and maintenance of carts. Some courses set aside part of the cart fees for use by the superintendent to fertilize heavier, cultivate more, plant tougher grasses, etc.

Compaction is here to stay, same as golfers, carts, and maintenance. Today we have the equipment, the grasses, the fertilizers, and the know-how to alleviate compaction and go right on playing golf.

IDEAS, GADGETS AND THINGS

Alexander M. Radko, Director
Eastern Region
USGA Green Section

"Necessity is the mother of invention." Never were truer words spoken so far as golf course maintenance and management is concerned. Superintendents strive to make the maximum use of every piece of equipment; they improvise or make changes in order to get top mileage for every dollar expended. In our travels we have the opportunity to see many of these ideas and gadgets at work. Here are a few that may be helpful to you.

1. A slicer for putting green turf. Credit for this gadget we believe belongs to Mr. Manny Francis, Superintendent of Vesper CC, Lowell, Mass., although we recently observed it in use at Pelham CC, Pelham Manor, N. Y., where Mr. Steve Kristoff is superintendent. Many clubs have as standard equipment a power sod cutter which does a fine job of cutting sod to a uniform depth and has made the task of sodding greens, tees, aprons, and other turf areas much easier. This sod cutter employs the principle of an oscillating movement of the cutter blade to do its fine work. This is but one job for one machine and when not in use, like other specialized equipment, it sets in the barn for long periods unused. These men did something about it--they took a worn cutter blade and welded the serrated, triangular sickle bar knives, which are standard for all hay or cutter bar units, vertically $1\frac{1}{4}$ inches apart to the worn cutter blade. Thus they employ all the good principles of the power sod cutter to slice their greens. The improvised gadget doesn't cost much to make, and it is excellent to use on greens to cut through thatch, isolated dry spots, for overseeding, or prior to fertilizing, liming, or top-dressing. According to Steve, they can do nine greens a day at Pelham with the improvised turf slicer.

2. Don't discard that old barber's chair -- do as Mr. Ray Brigham, superintendent at the Rhode Island CC, West Barrington, R. I., did with one. By removing the back and replacing the seat with a flat board surface he converted the old barber's chair into a swivel workbench. By use of the swivel operating handle, which is standard for barber's chairs, Ray can turn the improvised workbench to any desired position from any working angle.

3. Polyethylene to the rescue -- Last winter the freezing weather closed-in on the Northeast sooner than expected and many were unable to complete projects underway. One who was caught in this predicament was Mr. Elmer Michael, Superintendent at Oak Hill CC, Pittsford, N. Y., who had just lifted some fine Merion bluegrass sod from the nursery. The sod was all rolled and stacked neatly when the "deep freeze" set in around Thanksgiving Day. Fearful that he would lose the sod completely he decided to cover it with a polyethylene tarp. The sod was covered through to April when it was laid on the tee, weak but still alive.

Incidentally, and in the same vein, Mr. Ed Casey, Superintendent at Baltusrol Golf Club, Springfield, N. J., has made it a practice with good success to cover stolons, when planted late in fall, with a polyethylene tarp also for winter protection.

4. To spread traffic on fairways -- Many, many tractor miles are driven over fairways during the course of each year. Particularly in mowing fairways is tractor and gang unit traffic heavy. Also as fairway outlines are fixed, mowing in the same manner each time will cause for tracking and added compaction where tractor and mower wheels move in the same lanes each time fairways are mowed. The accumulated effect of equipment traffic on fairways can cause

turf injury, and we see this mainly in the narrow approach areas where the tractors with mowing units generally have to turn and in doing so the turf is bruised, torn, or otherwise injured. Throughout the rest of the fairway, mechanical injury is not so acute a problem, but lesser difficulties could result.

To reduce the chances of injury and to distribute tractor and gang unit weight, Mr. Jack Ormond, Superintendent, Canoe Brook CC, Summit, N. J., employs the following technique.

Mr. Ormond mows fairways three times weekly, on Monday, Wednesday, and Friday. On Monday he uses only five units to make the outline cut-- this is done by disengaging the two outside units and allowing them simply to ride over the rough.

On Wednesday only one unit is disengaged and the outline cut is made with six units. On Friday the outline cut is made with all seven units engaged and in cutting position.

Once the outline cut is made, then all seven units are engaged to mow the remainder of the fairway area. In this way, Mr. Ormond distributes the tractor and mower weight throughout each fairway and lessens hazard of turf injury due to mechanical wear.

5. <u>For accurate measurement of chemicals</u> -- Fungicides and herbicides must be used in exact amounts to give desired results on fine turfgrass areas. The margin of tolerance of grasses to chemicals is often slight; therefore, you must be sure of the amounts being applied. For dry materials, Mr. Sherwood Moore, Superintendent of Winged Foot Golf Club, Mamaroneck, N. Y., uses a regulation post office scale for accuracy in weighing chemicals for use on greens.

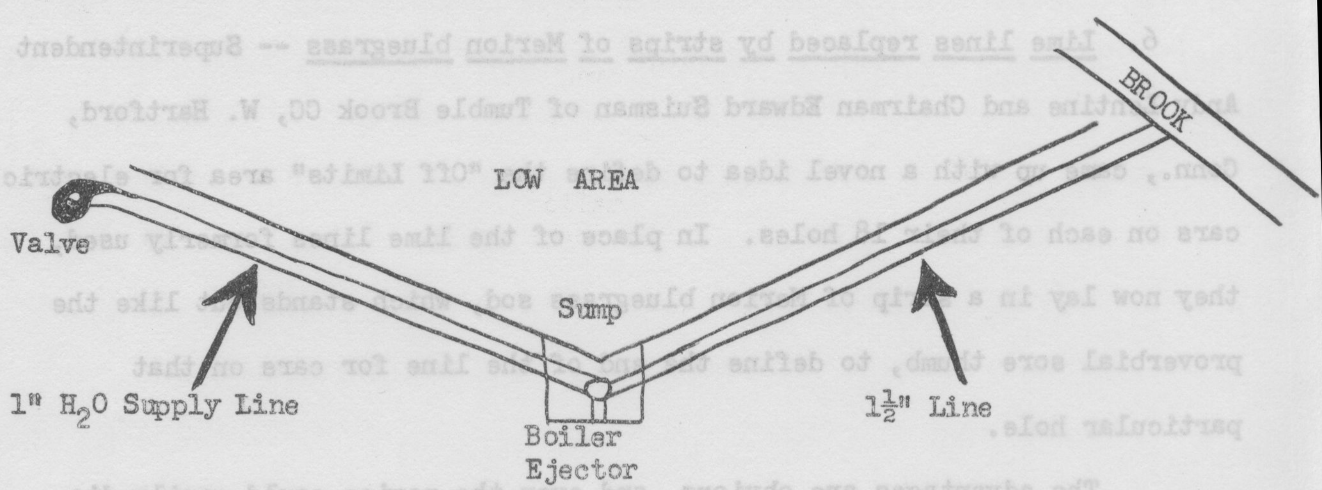
6. Lime lines replaced by strips of Merion bluegrass -- Superintendent Andy Lentine and Chairman Edward Suisman of Tumble Brook CC, W. Hartford, Conn., came up with a novel idea to define the "Off Limits" area for electric cars on each of their 18 holes. In place of the lime lines formerly used, they now lay in a strip of Merion bluegrass sod, which stands out like the proverbial sore thumb, to define the end of the line for cars on that particular hole.

The advantages are obvious, and even the novice could easily distinguish the Merion bluegrass strip in the bentgrass fairway.

7. Suction drainage for low areas in fairways or roughs -- Superintendent Paul Weiss of Lehigh CC, Allentown, Penna., gets credit for this idea of draining hard to drain areas--where terrain and pitch is such that conventional methods of drainage fail.

Mr. Weiss utilizes the siphon and force feed pressure principle to lift water from low areas into brooks several feet higher than the area being drained. In this drainage work a boiler ejector is used with one-inch intake and one and one-half inch outlet. This principle is the same as used for the small cellar suction pumps used by homeowners. The boiler ejector is standard plumbing equipment and is available at any plumbing supply house. It is hooked up to a water line and anytime the area needs draining all you need to do is turn on the water, and the area drains by suction and force feeding into the brook.

(See next page for illustration.)



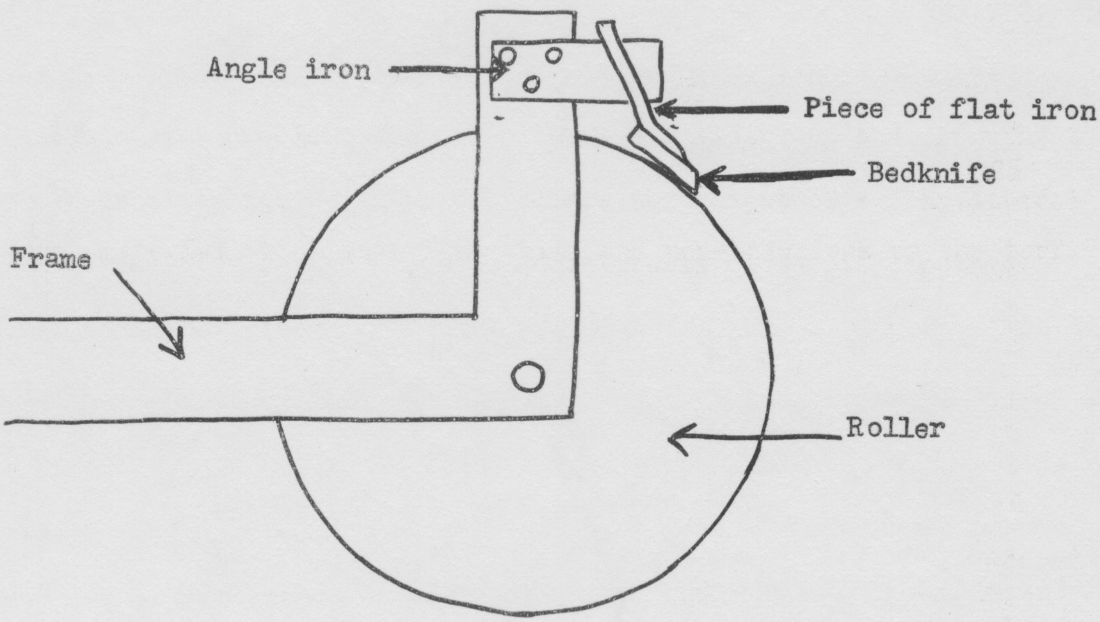
8. Gadget #2 for side-hill sod cutting -- When Mr. Charles Baskin, Superintendent of the Country Club of Waterbury, Waterbury, Conn., looked for a nursery site, he could find only a sloping bit of ground of suitable size. It was no problem for Mr. Baskin to grow the putting green turf; the problem arose when he tried to get sod cut to an even depth from this sloped area. The operator tried to guide the power sod cutting machine, but the pressure exerted could not possibly be kept constant, so an unevenly cut sod was the result. After giving it some thought, he came up with the idea of affixing a rubber-tired wheel to the side. This wheel was bolted onto the housing frame with an angle iron so that the machine now rides level, and sod cut to a uniform depth then was stripped from this side-hill nursery.

9. Define the target zone with flour -- "Hole in One" contests are popular events with golfers on a one-day outing. The usual procedure for this event is to mark off a target area--a lime lined circle within a 5-foot radius of the cup on a par 3 hole. Superintendents have experienced difficulty

in selecting a material which is bright white and non-injurious to the turf. Mr. Bob Mucciaroni, Superintendent at the Dedham Polo and Country Club in Massachusetts, however, has solved the problem at his course--he uses FLOUR to define the circle and he reports that it is far better than anything previously tried.

10. Roller cleaner for fairway units -- Mr. William M. Dest, Superintendent of the Wethersfield CC, Wethersfield, Conn., devised a simple and inexpensive roller cleaner for his fairway units (see sketch below). This device overcomes the annoying problem of grass clippings building up and clinging to the roller. When clippings build up on rollers the height of cut is altered and sometimes causes for an uneven cut. Additionally clods of clippings bunch up and fall off rollers and tend to make fairways untidy--this ingenious gadget helps scatter clippings, and so eases the problem of messy mowing.

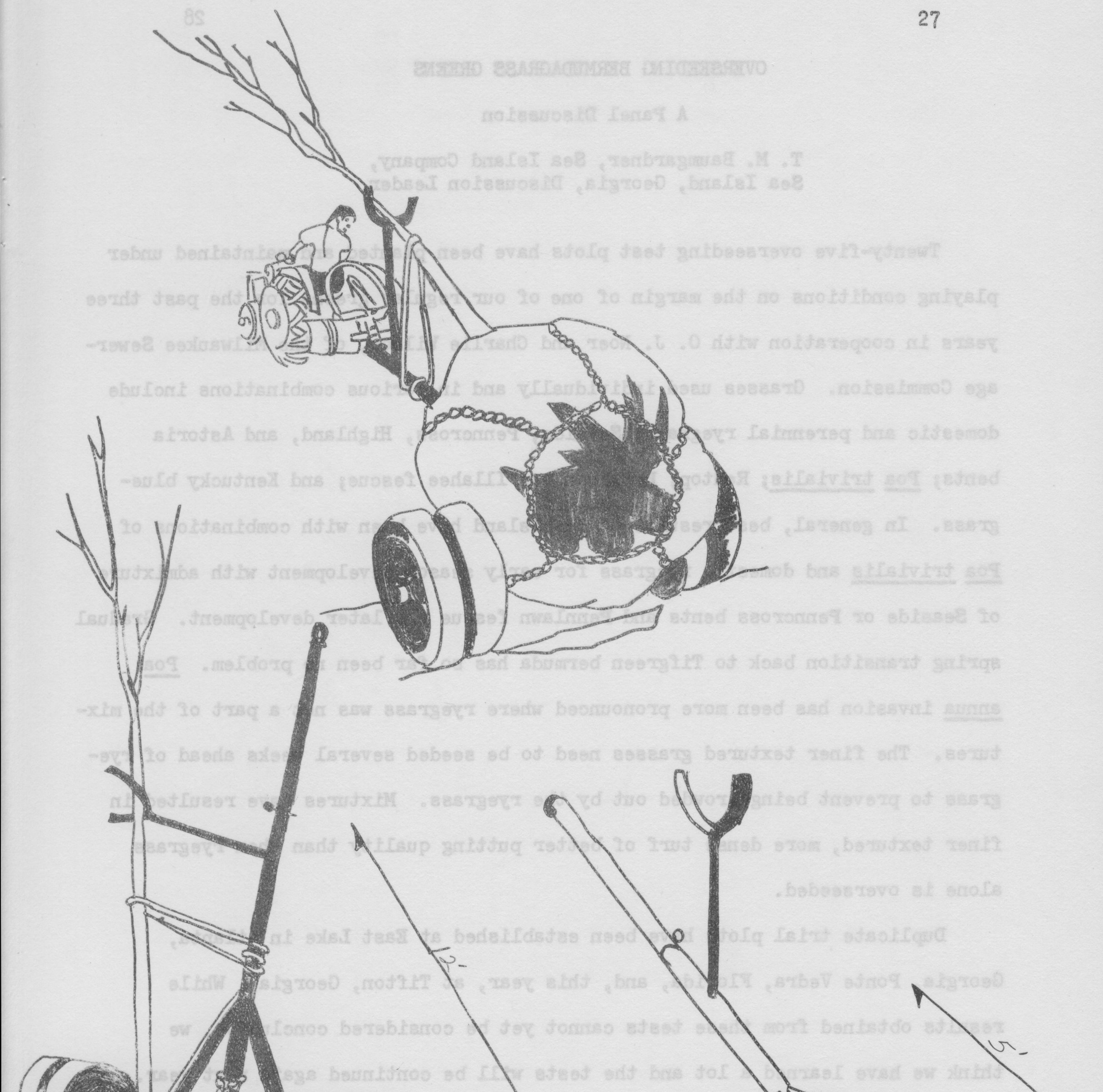
The roller cleaner consists of a discarded bedknife attached to the roller brackets with angle iron and bolts. The old bedknife is held almost against the roller with just a minimum of clearance.



11. <u>An improved tree mover</u> -- Superintendent Jim DeBottis of the CC of Rochester, Rochester, N. Y., improvised an excellent tree mover when called on to do some tree planting to outline fairways on the new sixth hole at his club--moves trees 40-feet high with this device.

The DeBottis Tree Mover has it all over the old stone boat in my opinion--it does a much neater job, easier by far than the old stone boat. In fact, Jim now advocates that they take the stone boat to China!

(See next page for illustrations.)



600 x 20 Dual Wheels
15 lbs. pressure

OVERSEEDING BERMUDAGRASS GREENS

A Panel Discussion

T. M. Baumgardner, Sea Island Company,
Sea Island, Georgia, Discussion Leader

Twenty-five overseeding test plots have been planted and maintained under playing conditions on the margin of one of our regular greens for the past three years in cooperation with O. J. Noer and Charlie Wilson, of the Milwaukee Sewerage Commission. Grasses used individually and in various combinations include domestic and perennial ryegrass; Seaside, Penncross, Highland, and Astoria bents; Poa trivialis; Redtop; Pennlawn and Illahee fescue; and Kentucky bluegrass. In general, best results at Sea Island have been with combinations of Poa trivialis and domestic ryegrass for early season development with admixture of Seaside or Penncross bents and Pennlawn fescue for later development. Gradual spring transition back to Tifgreen bermuda has so far been no problem. Poa annua invasion has been more pronounced where ryegrass was not a part of the mixtures. The finer textured grasses need to be seeded several weeks ahead of ryegrass to prevent being crowded out by the ryegrass. Mixtures have resulted in finer textured, more dense turf of better putting quality than when ryegrass alone is overseeded.

Duplicate trial plots have been established at East Lake in Atlanta, Georgia, Ponte Vedra, Florida, and, this year, at Tifton, Georgia. While results obtained from these tests cannot yet be considered conclusive, we think we have learned a lot and the tests will be continued again next year.

At Sea Island the grasses other than rye did not develop fast enough in the fall to provide satisfactory color and density in December and January when our bermudagrass is normally dormant. We have important tournaments during these months and we must also compete with south Florida resorts so we feel we must still use some domestic ryegrass because of its earlier development.

For the past three seasons our superintendent, Marion McKendree, has overseeded our 27 Tifgreen (No. 328) bermudagrass greens with a combination of Poa trivialis, Seaside bentgrass, and domestic ryegrass. He uses the following renovation and seeding methods:

In early October greens are seeded with 3 pounds each of Seaside bent and Poa trivialis per 1,000 square feet. We believe now, however, that this rate is too light to provide good density and color in the early winter months and we are planning on increasing the seeding rate next year to 6 pounds of Poa trivialis and 4 pounds of Seaside per 1,000 square feet. Seed bed is prepared by previously aerifying greens with 1/4-inch spoons and at time of seeding they are verti-cut fairly severely in at least two directions and thoroughly spiked with the Wolfram 3-gang spiker. The greens are then lightly topdressed, seed sown and lightly matted in. Daily hand-watering is practiced until seed is well up.

Fungicides are applied when weather conditions are favorable for fungus development.

After an interval of three to four weeks, domestic ryegrass is planted at the rate of 50 pounds per 1,000 square feet. Greens are not verti-cut for this ryegrass planting because we think this would tend to thin the stand of Poa trivialis and Seaside bent. The greens at this time are thoroughly spiked with the 3-gang spiker, seeded to ryegrass, and topdressed lightly. Greens are kept in play continuously with mowing height raised to 3/8 inch for a three-week period while the ryegrass is young, then gradually lowered to 1/4 inch.

We have had uniformly excellent greens for the two seasons we have followed this seeding procedure although, admittedly, weather conditions have been favorable and results might not be as good in a season when weather is more conducive to fungus development.

The greater density of the turf has apparently resulted in finer texture of the ryegrass blades than usual for our climate and, of course, the Poa trivialis and bent have contributed to finer texture and better appearance and putting quality. Transition back to bermudagrass in the late spring and early summer at least for these two seasons has been gradual and no trouble. Greens have been aerified with the Greensair 1/4-inch spoons at least once during the winter season and more often in the case of two or three "problem" greens.

I think we still have much to learn in searching for the most reliable combination of grasses for use in various sections of the winter overseeding belt. Each section and perhaps, to a lesser extent, each course has its own peculiar problems. Florida courses, for instance, can no doubt eliminate the use of ryegrass and use only the finer textured grasses. Farther north ryegrass may still have to be added because of its earlier development and because it tends to discourage and better mask out Poa annua in the spring. Our problems in overseeding, of course, will all be a great deal simpler if and when Pythium and the damping off diseases, as well as Poa annua, can be more dependably controlled.

THE SHADE PROBLEM AND WHAT YOU CAN DO ABOUT IT[1]

Glenn W. Burton[2]

Every living cell must have a supply of food and water. Green plants differ from other organisms in that they can manufacture their own food. To do this, however, they must have water, air, nutrients (nitrogen, phosphorus, etc.), favorable temperatures, and light. This process of food manufacture by green plants, called photosynthesis, occurs largely in the leaves.

GRASSES SHADE THEMSELVES

Only a small fraction of the light at noon on a bright day is needed by a single leaf for optimum photosynthesis. It must be remembered, however, that the top leaves shade those below them and several layers of densely placed leaves can absorb all of the light. Thus, plants tend to shade themselves and the light available to the lower leaves for food manufacture is much less than that striking the top leaves.

The continuous process by which plants use food to live is called respiration. During a 24-hour day, no food can be manufactured at night and the rate of manufacture is lower early in the morning and late in the afternoon than at mid-day. Obviously the plant must manufacture and store enough food

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1 Cooperative investigations at Tifton, Georgia, of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the University of Georgia, College of Agriculture Experiment Stations, Coastal Plain Experiment Station. Published with the approval of the Director.

2 Principal Geneticist, Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the University of Georgia, College of Agriculture Experiment Stations, Coastal Plain Experiment Station, Tifton, Ga.

when there is adequate light to keep it alive the remainder of the time. Additional food will be required for growth and to renew tissues that die of old age, disease, etc.

Most of the shaded areas where people try to grow grass are difficult because they lack more than light. Trees compete with grass for water and nutrients. The amount of competition varies with the species and the size and density of the trees involved. This competition can be minimized by the application of water and fertilizer and by using deep rooted trees for shade.

Traffic by man is frequently greater in cool shaded areas than in the open. Grass growing in the shade is more succulent and more susceptible to trampling injury. Reducing traffic to the minimum will greatly facilitate the establishment and maintenance of grass in the shade.

Grass diseases are often more severe in the shade due to the greater humidity usually found in well shaded areas. The increased succulence of grass growing in the shade may also make it more susceptible to disease.

Grasses growing in the shade develop longer stems and leaves because they need more leaf area to produce their food requirements. Research at the Georgia Coastal Plain Experiment Station has proven that all warm-season turfgrasses will do better in the shade when the mowing height is raised to more than two inches.

Shade, if not too dense, may actually favor the growth of turfgrasses. It is not uncommon to see grass suffering from lack of water in open areas before those areas in the shade. This is particularly true if the shade is provided by buildings or deep rooted trees. Obviously, grass growing in the shade requires less water than that growing in full sunlight.

A canopy of trees will protect grass from frost to the extent that lawns under trees will often remain green several weeks longer in the fall than those in the open.

Chinch bugs prefer to feed in the sun and usually damage St. Augustine grass very little in well shaded areas.

SHADE EXPERIMENTS

During the past three years, ten grasses (four bermudas--common, Tiflawn, Tiffine, and Tifgreen; three Zoysias--Meyer, Emerald, and matrella; Pensacola bahiagrass; St. Augustine; and centipede grass) growing at Tifton, Georgia, were clipped at heights of $1\frac{1}{4}$ and $2\frac{1}{4}$ inches in the shade and in the open from April until November each year. Shade that excluded only light was provided by using a woven translucent shade cloth that allowed only one-third of the light to reach the grass below it.

This research showed that shade adversely affected sod density of all grasses studied. Each grass maintained a better sod when cut at a height of $2\frac{1}{4}$ inches than when mowed at a height of $1\frac{1}{4}$ inches. Striking differences in shade tolerance were exhibited by the ten grasses under observation. St. Augustine and Zoysia matrella were the most shade tolerant, and common bermudagrass was the least. Pensacola bahia ranked close to St. Augustine in shade tolerance. Improved bermudas, superior to common bermuda in sod density, color, and resistance to weeds and diseases in the open, continued to show this superiority in the shade. It is believed that new grasses significantly better than old ones in the sun will generally exhibit this superiority when they are compared in the shade.

YEAR-AROUND DISEASE CONTROL ON SOUTHERN GREENS[1]

Homer D. Wells[2]

Golf is a year-around sport and business in the South. The golf course superintendents must maintain attractive and playable greens during every day of the year. Most golf courses in the South maintain bermudagrass greens during the warm season and overseed these greens with annual ryegrass or various winter-grass mixtures for cool-season play. The bermudagrass and winter grasses are subject to diseases that reduce their utility. Much of this damage could be minimized or eliminated if the turf workers were acquainted with the preventive and control measures that should be practiced during the different seasons.

Spring: Diseases are usually not too destructive on bermudagrass during the spring. Dollar spot may occur if the fertility is too low. However, one usually fertilizes heavily during the spring and generally is not troubled by dollar spot. Winter grasses, however, are very susceptible to diseases during the spring; but, since one usually wants to replace the winter grass at this time, the diseases often are helpful in accomplishing this objective. However, in cases where the winter grass must be maintained late to insure a quality turf for tournaments, it may be necessary to apply fungicides regularly (see Table 1).

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1 Cooperative investigations at Tifton, Georgia, of the Crops Research Division, Agricultural Research Service, U. S. Department of Agriculture, and the University of Georgia, College of Agriculture Experiment Stations, Coastal Plain Experiment Station. Published with the approval of the Director.

2 Pathologist, Crops Research Division, Agricultural Research Service, United States Department of Agriculture, Tifton, Georgia.

Summer: The two most common diseases of bermudagrass turf during the summer are dollar spot and brown patch. Dollar spot can usually be minimized, and often eliminated, by maintaining a high level of soil fertility (this must include adequate K_2O and P_2O_5 as well as nitrogen). Brown patch is accentuated by fertilization, and thus one must use fungicide for the control of brown patch. Some superintendents have fair success in minimizing brown patch by watching the greens for signs of the disease and then spraying with fungicides at "curative" rates. However, since the disease usually strikes during extended rainy periods, and rains may persist for several days, the greens may be destroyed by brown patch before a fungicide can be made effective. Several such instances were brought to my attention during the summer of 1961. Therefore, one who is not willing to gamble on losing his bermudagrass should follow a regular spray schedule during the summer months (see Table 1).

Fall: During the fall bermudagrasses appear to be somewhat more susceptible to leaf spots than during other seasons. This may stem in part from the fact that soil fertility may have become depleted. Cool nights also retard the growth and lower the general vigor of the bermudagrass, also increasing susceptibility to disease. Another possible factor is that the leaf spot organisms have been building up all summer and, consequently, the infection potential is greatest during the fall. The ryegrass and other winter-grass mixtures must be established during the fall. A good "rule-of-thumb" (from the disease standpoint) is that if the weather is warn enough to grow bermudagrass it is too "hot" to establish ryegrass or other winter grasses without the likelihood of severe disease outbreaks. However, the superintendent must have an excellent winter cover before the bermudagrass fails. Therefore, he must establish the winter grasses during a season in which they are highly susceptible to brown patch and cottony blight diseases. Thus, these diseases must be prevented, if at all possible, by the use of a strict fungicidal program. The brown patch problem has usually been corrected by the use of several well-known turf fungicides on the market. However, none of these have proved satisfactory for the control of cottony blight. Research conducted during the past year indicates that P-dimethylaminobenzendiazo sodium sulfonate, Dexon[3], (2 oz. of 70% wettable powder per 1,000 square feet of turf) applied at weekly intervals will control cottony blight. The Dexon, however, <u>will not</u> control brown patch and, therefore, a mixture of fungicides will be necessary during this period (see Table 1).

<u>Winter</u>: Diseases are a minor problem on winter grasses during cool weather. However, prolonged warm humid periods suitable for disease development occur during most winters. Cottony blight, brown patch, anthracnose, and *Helminthosporium* leaf spots and turf spots may attack the grass during these periods. Since the winter grasses do not grow back in areas where they have been killed by diseases, it is important that a preventive fungicide spray program be followed. It is more economical to spray according to weather rather than according to the calendar. The superintendent should keep abreast of weather forecasts and plan to make fungicidal applications (Table 1) to afford protection during periods when warm weather is forecast.

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3 Mention of trade name is for specific information only and does not constitute a guaranty of the product or signify approval by the U. S. Department of Agriculture over other comparable products.

Table 1. Recommended fungicides and frequency of application schedule for the prevention and control of diseases of greens in the South. (Apply all fungicides in 5 gallons of water per 1,000 square feet.)

Seasons	Diseases Likely to Occur	Fungicides for Disease Control	Rates per 1,000 sq. ft.	Frequency of Application
Spring	Brown patch and leaf spots on winter grasses	Mercury-containing Thiram-containing	Manufacturer's recommendations	If winter grass is to be maintained, apply every 7 days. For bermudagrass, apply every 21 days.
Summer	Brown patch, leaf spots, and dollar spot	Mercury-containing Thiram-containing	Manufacturer's recommendations	Apply every 7-14 days.
		Cadmium-containing	Manufacturer's recommendations	Apply with other fungicides monthly.
Fall	Brown patch, leaf spot, and dollar spot on bermudagrass	Mercury-containing Thiram-containing	Manufacturer's recommendations	Apply every 21 days.
	Cottony blight and brown patch on ryegrass and other winter grasses	Dexon + Mercury-containing or Thiram-containing	2 oz. 70% WP of Dexon + Manufacturer's recommendations for others	Apply at time of seeding and at 7-day intervals as long as warm humid weather persists. After onset of cool weather, apply when hot humid periods are forecast.
Winter	Brown patch, cottony blight, anthracnose, and <u>Helminthosporium</u> leaf spots.	Mercury-containing or Thiram-containing	Manufacturer's recommendations	Apply at onset of warm humid periods and at 7-14 day intervals during extended warm periods.
		Dexon if cottony blight is present	2 oz. 70% WP	Apply at onset of hot humid periods and at 7-day intervals during extended hot humid periods.

SIXTEENTH ANNUAL SOUTHEASTERN TURFGRASS CONFERENCE

Tifton, Georgia
April 9-11, 1962

TOTAL REPRESENTATION FROM EACH STATE:

Alabama	11
Florida	23
Georgia	70
Illinois	1
Maryland	2
Minnesota	1
Missouri	1
New Jersey	2
North Carolina	12
Pennsylvania	1
South Carolina	3
Virginia	1
Wisconsin	1
TOTAL	129

ATTENDANCE ROSTER

Name	Affiliation	City
ALABAMA		
Berdeaux, C. G.	Box 500, Montevallo Rd., S. W.	Birmingham
Brooks, Fate, Jr.	The Amer. Agric. Chemical Co.	Montgomery 2
Burns, Bud	Selma Country Club	Selma
Kennedy, W. T.	Montgomery Country Club	Montgomery
Metcalf, Herb	200 Blumberg Drive	Dothan
Neese, Jack	Country Club of Columbus	Phenix City
Nixon, M. C.	Nixon Grass Farm	Auburn
Nordan, William W.	Nordan's Grass Farms	Abbeville
Norrie, Bill, Sr.	Mobile Country Club	Mobile
Somerville, A. M.	Hercules Powder Company	Montgomery
Soutar, W. R.	Woodley G & C Club	Montgomery
FLORIDA		
Amick, William W.	Golf Architect	Ft. Walton Beach
Billett, Robert W.	O. E. Linck Company, Inc.	Hialeah
Carr, Charles	N. A. S.	Orange Park
Cowen, Tracy, Jr.	Wilson-Toomer Fertilizer Co.	Jacksonville
Delsaver, Carl E.	Miami Shores Golf Course	Miami Shores 38
Derzypolski, Marion S.	Capital City Country Club	Tallahassee
Foraker, Bob	Whispering Hills Country Club	Titusville
Fosse, C. O.	U. S. Air Force	Eglin AF Aux. #9
Horn, G. C.	University of Florida	Gainesville
Irwin, Jack D.	Irwin Grain Company	Kendall
Jicha, James	Whispering Hills G & C Club	Titusville
Lassiter, Glyn W.	U. S. Air Force	Ft. Walton Beach
Mascaro, Charles	West Point Products	Miami
Meyers, Bill	Riviera Country Club	Ormond Beach
Norrie, Bill, Jr.	Scenic Hills Country Club	Pensacola
Nutter, Gene C.	Golf Course Supt. Assn. of America	Jacksonville Beach
Ousley, J. E.	Ousley Sod Company	Pompano Beach
Palmer, Walter E.	Riviera Country Club	Coral Gables
Robinson, B. P.	Rainy Sprinkler Sales	Gainesville
Sanders, E. V.	U. S. Air Force	Eglin AFB
White, Ralph	O. M. Scott & Son Co.	Pompano Beach
Williams, Henry E., Sr.	Daytona Beach Country Club	Daytona Beach
Wilson, Allen	University of Florida	Gainesville
GEORGIA		
Barnette, Ralph E.	Ft. McPhearson Golf Club	Atlanta
Barnhart, George E.	Cherokee Town & Country Club	Atlanta 5
Baumgardner, T. M.	Sea Island Company	Sea Island

GEORGIA (Continued)

Name	Affiliation	City
Bear, Lewis T. "Tommy"	Jekyll Island Golf Course	Jekyll Island
Beck, Elmer	Ga. Coastal Plain Exp. Sta.	Tifton
Booterbaugh, E. E.	Druid Hills Golf Club	Atlanta 7
Branch, Donald J.	Green Island Club	Columbus
Brasington, Charles E.	Town & Country Club	Blakely
Brown, Maynard	Glen Arven Country Club	Thomasville
Burgess, W. A.	Department of the Army	Ft. Stewart
Burton, Glenn W.	Ga. Coastal Plain Exp. Sta.	Tifton
Carter, R. L.	Ga. Coastal Plain Exp. Sta.	Tifton
Casteel, Charlie	River Side	Macon
Clements, Lee	Ga. Coastal Plain Exp. Sta.	Tifton
Cole, James B.	Columbus Lawncare	Columbus
Collinsworth, Roy, Sr.	Golfland, Inc.	Macon
Cordell, Tom M.	Abraham Baldwin Agric. College	Tifton
Cottle, Donald H.	Dixie Turf Farms	Ty Ty
Crady, M. N.	DuPont Company	Atlanta 5
Culpepper, Sam H.	Georgia Institute of Technology	Atlanta
Dearman, A. V.	California Chemical Company	Atlanta
Dembnicki, Edward	Green Hills Country Club	Athens
Evans, Rufus	Dixie Turf Farms	Ty Ty
Evans, Thurlow, Jr.	Stovall and Company	Atlanta 18
Goldthwaite, Howard	Cowan Supply Company	Atlanta
Good, J. M.	Ga. Coastal Plain Exp. Sta.	Tifton
Goodwin, Wayne	Cowan Supply Company	Atlanta
Green, Roger O.	Golfland, Inc.	Macon
Greenway, C. D., Jr.	Landscape Architect	Alma
Hammond, Curt	Kiwanis Golf Club	Reynolds
Hart, R. H.	Ga. Coastal Plain Exp. Sta.	Tifton
Haskins, Fred	Country Club of Columbus	Columbus
Heath, Donald	Ga. Agricultural Extension Service	Cedartown
Holden, Preston L., III	Vineland Chemical Sales Corp.	Smyrna
Inglis, Hugh A.	Georgia Crop Improvement Assn.	Athens
Jackson, James E.	Southern Turf Nurseries	Tifton
Jensen, E. Ray	Southern Turf Nurseries	Tifton
Johnson, Dewey W.	Evans Implement Company	Atlanta
Kincaid, Ed	Evans Implement Company	Tifton
King, Frank P.	Ga. Coastal Plain Exp. Sta.	Tifton
Kirkley, James W.	39 Jackson Avenue	Ft. Stewart
Lambert, Jimmy	Evans Implement Company	Atlanta
Lambert, Paul W.	Stovall and Company	Atlanta 18
Land, Sam A.	Stovall and Company	Atlanta 18
Langston, M. L.	Cherokee Country Club	Cedartown
Lawrence, Lester	Country Club	Ft. Benning
Madden, Loyd	Sunset Hills Country Club	Carrollton
McDonald, C. R.	Wyandotte Chemicals Corp.	Atlanta 25
McGowan, D. R.	Country Club	Valdosta
McKendree, Marion	Sea Island Golf Club	St. Simons Island

GEORGIA (Continued)

Name	Affiliation	City
Moncrief, James B.	U. S. Golf Association Green Section	Athens
Moore, Hugh, Sr.	Augusta Country Club	Augusta
Morcock, J. Cooper, Jr.	Allied Chem. Corp., Nitrogen Div.	Atlanta 3
Mullen, C. C.	Cherokee Country Club	Cedartown
Nichols, T. H.	Zonolite Company	Atlanta 19
Ourecky, D. K.	Ga. Coastal Plain Exp. Sta.	Tifton
Parker, E. M.	Spencer Chemical Company	Griffin
Shields, E. A.	Standard Club	Atlanta 19
Smith, Gerald E.	University of Georgia	Athens
Smith, Joe W.	Evans Implement Company	Atlanta
Sperry, R. F.	American Legion Golf Course	Albany
Stovall, Paul S.	Stovall and Company	Atlanta 18
Strong, John J.	Patten Seed & Turf	Albany
Thomas, George P.	Lakeside Country Club	Atlanta
Ward, Joe	Idlehour Club	Macon
Warnecke, M. J.	East Lake Country Club	Atlanta
Wells, Homer D.	Ga. Coastal Plain Exp. Sta.	Tifton
Wilson, Perry	Forest Heights Country Club	Statesboro
Winstead, Elmo	Georgia Dept. of Agriculture	Atlanta
Wright, Harry	Peachtree Golf Club	Atlanta 19

ILLINOIS

Duguid, Robert	Roseman Mower Corporation	Evanston

MARYLAND

Grau, Fred V.	Hercules Powder Company	College Park
Kreitlow, K. W.	U. S. Department of Agriculture	Beltsville

MINNESOTA

Watson, J. R.	Toro Manufacturing Corporation	Minneapolis 20

MISSOURI

Moss, Frank A. J.	Mallinckrodt Chemical	St. Louis

NEW JERSEY

Cleary, Leo	W. A. Cleary Corporation	New Brunswick
Radko, A. M.	U. S. Golf Assn. Green Section	Highland Park

Name	Affiliation	City
NORTH CAROLINA		
Boger, Luther E.	Cabarrus Country Club	Concord
Bridgers, W. A., Sr.	Southern Testing & Research Labs	Wilson
Burgin, George	Alamance Country Club	Burlington
Campbell, Don B.	Cherry Point Golf Course	New Bern
Eagles, J. C., Jr.	Happy Valley Golf Course	Wilson
Helm, Marshall S.	The Amer. Agric. Chemical Co.	Greensboro
James, Bryson L.	North Carolina State College	Raleigh
Lineberger, Abel R.	Gaston Country Club	Gastonia
Mann, W. E.	Camp Lejeune Golf Course	Midway Park
Sapp, Ralph B.	Old Town Club	Winston-Salem
Sutton, William C.	604 S. Andrews Avenue	Goldsboro
Weldon, Wilfred E.	Mid Pines Club	Southern Pines
PENNSYLVANIA		
Mascaro, Tom	West Point Products Corporation	West Point
SOUTH CAROLINA		
Inman, Joe L.	Winyah Bay Country Club	Georgetown
Ready, E. L.	The Amer. Agric. Chemical Co.	Johnston
Shirley, Jim	Oconee County Country Club	Seneca
VIRGINIA		
Savage, Hurley	309 Mattox Drive	Newport News
WISCONSIN		
Wilson, Charles	Milwaukee Sewerage Commission	Milwaukee 1