PROCEEDINGS

NINETEENTH ANNUAL

SOUTHEASTERN TURFGRASS CONFERENCE

GEORGIA COASTAL PLAIN EXPERIMENT STATION

and

ABRAHAM BALDWIN AGRICULTURAL COLLEGE

COOPERATING

TIFTON, GEORGIA

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PROCEEDINGS

Nineteenth Annual

Southeastern Turfgrass Conference

Tifton, Georgia

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Sponsored By

UNIVERSITY OF GEORGIA COASTAL PLAIN EXPERIMENT STATION

In Cooperation With

ABRAHAM BALDWIN AGRICULTURAL COLLEGE

UNITED STATES GOLF ASSOCIATION GREEN SECTION

and

SOUTHERN GOLF ASSOCIATION

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FOREWORD

The Nineteenth Annual Turfgrass Conference set a record in both attendance and in the quality of the program. We are delighted that those of you who are interested in turf grasses see fit to visit with us each year for this occasion and to support our program throughout the year.

While we are confident that the ultimate in turf grasses will never be achieved, it is our purpose to continue to work toward that which we all consider perfection. We recognize that our concept of the perfect turf grass will change from time to time. Each of these annual turf grass conferences has not only renewed our enthusiasm for strengthening our turf program, they have helped us to better determine the requirements of turf grasses to meet modern uses. We are grateful for your support; grateful for your visits with us, and are grateful for the opportunity to work with you in this important segment of research which affects the lives of so many people.

Frank P. King, Director
Coastal Plain Experiment Station

ADVANCES ON GOLF COURSES IN FOREIGN COUNTRIES

Dr. O. J. Noer, Agronomist
Robert Trent Jones, Inc., Milwaukee, Wisconsin

Dr. King, Dr. Glenn Burton, and members of the 19th Annual Southeastern Turfgrass Conference, it is indeed a pleasure to be back here and to participate in the program, which is always a fine one.

I was sorry that Dr. Burton could not be at the Annual U.S.G.A. meeting in New York on January 27th to receive the plaque bestowed upon him by the Green Section for his outstanding work in producing better grasses for golf courses in the South. His hybrid grasses have been outstanding in performance and have made the turf vastly better and more pleasing to the golfer. Dr. Burton has done more for golf-course turf in the South, or the Bermudagrass section, than any other living person. We overlook the other phase of the work which he has done in the South and which is probably considered even more important by some. His pasture-grass work has created a new industry for the South in that he has developed grasses which have made a beef-cattle industry possible.

Before my retirement from the Milwaukee Sewerage Commission in 1960, I was privileged to tour all parts of the North American continent from Puerto Rico to Vancouver and from Guadalajara and Mexico City to 200 miles north of Quebec City. It provided an opportunity to observe golf turf in every part of the continent and become familiar with maintenance practices that have been responsible for excellent golf turf. During that time, I have had many interesting experiences. Some were amusing and others were very interesting. During the depression, I happened to be in the mountain area of West Virginia with a Mr. Griffith. He stopped at a little 9-hole golf course, where the man in charge was manager, professional, and greenskeeper. His first remark to "Grif" was that they were having trouble with a disease which he could not recognize. Grif told him I was there and would diagnose the trouble for him. I felt I might as well be the "goat" because I did not anticipate ever returning to that part of West Virginia. As we walked toward the green, I noticed that there were plenty of localized dry spots. When we reached the green, I cut a plug out of the turf which was still green and handed it up to the manager. He took one look, and then said, "In the New Deal days, water is no longer wet." I believe we gave him the solution to his problem and showed him how to restore moisture to the dry soil.

We have had a number of interesting and amusing experiences in New England. I recall being in Maine with Mr. Clapper. He wanted to show me what a good Milorganite salesman he was, so he asked the superintendent what fertilizer he used on the greens. The reply was, "Milorganite." I asked for the rate of application and was told, "50 pounds." When I said per 1000, he said, "Naw, per green!". The greens were of modern size, averaging probably 8,000 to 9,000 square feet. At another time, we were in Concord, Vermont. The golf course was a 9-holer. Power greens-mowers were just beginning to be produced. I asked Mr. Wilson if he ever considered using the power greens-mower. He said, "Naw, engine holds you back." Then when I asked Clapper after we left the course, what prompted the remark, he said, "Mr. Wilson is afraid of a motor of any kind and was able to mow the greens with a hand mower faster than his robust son could do it with a power mower."

Since retirement, I was called to make a visit to Pine Valley Club in Toronto. When I reached there, the owner told me he planned to plow the greens and reseed them. When I asked him what prompted such action, he told me the grass was too coarse. The greens had been seeded to Seaside. I showed him that the only places where the grass was coarse was where the turf cover was thin and assured him that all he need do was to fertilize to produce a dense turf. Then the turf would be of uniform and fine texture. I suggested applying 60 pounds of Milorganite and 10 to 15 pounds of 10-6-4 per 1,000 square feet. The Scotch superintendent was appalled at such a recommendation and remarked that he would have nothing but disease. We told him that the grass was so starved that he could not apply too much fertilizer. When I told this to Howard Watson, the architect who built the course, he said, "The answer is very simple. If fertilizer had been applied, then it would become necessary to mow the greens."

Several examples will suffice to illustrate other interesting experiences encountered on golf courses. At one time, I was in Los Angeles. The chairman of the greens committee at the course I visited said that crabgrass was a tremendous problem with them on the fairways. I told him I would not quarrel if the course were located in Kansas City because we usually refer to crabgrass in that area as "Kansas City bent." I said that I felt there must be something basically wrong with the maintenance practices. As we walked over the course, I noticed patches of weeds which were rather large in extent. I did not recognize the weed, but was told the name was "fennel." This was in May; the weed seemed to be fading out. I was told it provided a good lie during the winter and then disappeared in the late spring and did not reappear until fall. My suggestion was to fertilize generously in order to encourage growth of the bermuda and hold the crabgrass in check with light, frequent applications of sodium arsenite. The chairman told me it had better work, or I should not come back to visit the club. My answer to that was that they should experiment on a couple of one-half-acre plots first. The program worked and today, the fairways at this club are excellent bermuda and none of the pre-emergents of the other weed killers are needed — if and when a little crabgrass begins to show, the superintendent sprays several times with sodium arsenite, which is cheap and effective.

Before Mel Warneke came to East Lake, the roughs were crabgrass almost entirely. It had been suggested that a pre-emergent weed killer be used. That did not seem like the best answer to me. I felt they should be happy with the crabgrass until the time for bermuda to start growth. Then it was deemed wise to fertilize, use lime, encourage the bermuda and again, hold the crabgrass in check. The use of some bermuda seed was suggested because there seemed to be almost no bermuda on the areas in question. When I returned in the fall, there was an excellent cover of bermuda. Much to my surprise, Mel told me it had not been necessary to use any seed. This time, the fertilizer and the sodium arsenite, to hold the crabgrass in check, did the trick. These are but a few of the many interesting experiences.

During the past 11 months, I have been associated with Mr. Robert Trent Jones in the capacity of Agronomist. He is the outstanding architect in America and has many of the finest courses in the country to his credit. In addition, he is fast becoming the finest architect in the world because he has built courses in South America, several in Spain, two in Hawaii, is building another in the Philippines, and will probably do a course in Japan and one in Belgium and Portugal. My association with him has enabled me to see turf in the British Isles, Spain, Hawaii, Japan, the Philippines, and Hong Kong. When we start to show the pictures, it will be a joint venture with Mr. Jones covering the architectural aspects and I will deal with the agronomic problems.

The visit to England and Scotland was most revealing. The greens are cut close, actually turf is skinned. I have an idea that the bedknives are taken off and the lip ground down so as to cut the grass even closer. Despite that fact, the roots were 8 to 10 inches deep and they were all nice, white, healthy roots. The soil in the greens was of uniform texture with absolutely no layering of any kind such as sand, dead grass, humus, etc. The soil in the greens on the courses around London and the seaside courses in Scotland consisted of a loamy, fine sand. We have frowned upon its use, but one cannot argue with success. I estimate the organic content as in the range of 15% to 20% by volume. The fairways are cut very close, also the approaches are about like our greens, being cut in the range of about 5/16 of an inch. The grasses are mostly bent (the colonial and creeping types), along with fescue and some perennial ryegrass. The amount of Poa annua was less in this country, probably because of the more frugal use of water. Soil in the greens at Glen Eagles is a bit more like the kind we find here because the soil in that area is normally of a loamy type. I did not see a divot on any one of the courses, both on the tees and fairways, that had not been filled with soil. On some courses, the soil used contained seed and on others, it looked as though only soil was used. The roughs on all the courses in Britain are rugged. The grass is long, there is plenty of heather and other types of vegetation. If one loses the ball there, he had better forget about it. Fertilization is at lighter rates than are used here. Watering seems to be less also. At St. Andrews, I made this statement to the starter, namely, that I could see fairways never received any water and that not too much was used on the greens because of the localized dry spots. So I asked him how often are the greens watered. He replied, "If it rains, about three weeks later, a little water is applied and the golf-course greens were spoiled by providing water for them."

From Britain, we sent to south Spain to see the course which is called "Sotogrande," built by Mr. Jones. Among other things, he brought Tifgreen and Tifway to this course, along with Penncross bent for the greens. The turf was making excellent progress. The 18-hole course and the shorter 9-hole course are now in play. Another 18-hole course is under construction at Marbella and Mr. Jones is the architect of that course.

A two-day stop was made in Madrid. While there, we saw the two main golf courses, Puerto Huerto and Campo de Campus, where the Canada Cup Matches will be played this year. The greens at both courses are bent, mostly of the creeping-bent type. The tees and fairways are a mixture of fescue and bent, with almost no bermuda despite the fact that the climate is very similar to southern California. The probable reason for survival of the fescue and bent is the fact that minimum amounts of water and fertilizer are used on this course.

In December, Mr. Jones and I went to Hawaii, where we saw the Royal Kaunapali course during the Canada Cup Matches and then went on to Mauna Kea to watch the Nicklaus, Player, and Palmer matches, which were televised in March. The greens at Royal Kaunapali are Seaside, including seeding right down to the base of the slope in order to prevent invasion by bermuda. Nevertheless some has gotten into the greens. At other courses in Hawaii, where bent is on the greens, women are used to hand-weed any bermuda which starts to grow in the bent turf. When Mr. Jones built this course, he procured Tifgreen (328) for the fairways and used Uganda on the tees. The Tifgreen has done very well on the fairways, but the Uganda has been found to be unsatisfactory. So the tees have been changed to 328. They were in excellent condition during the tournament, being mowed close at about 5/16 inch with a 27- or 30-inch power mower equipped with a grass catcher. One could have putted on the turf. The new Lawrence Rockefeller course at Kamuela, on the big island of Hawaii, is a Robert Trent Jones' masterpiece. The volanic rock was crushed to make soil. Tees, greens, and fairways are 328, which, of course, is Tifgreen bermuda. The course is in excellent condition.

Our stay in Japan was limited because of air-transportation difficulties. We visited two of the golf courses, namely, Kasumigaseki and Koganei, both of which have 36 holes. The turf is matrella-type Zoysia on the fairways and and tees. They are produced by sodding. The roughs on the courses are japonica type of Zoysia. There are two greens at each hole, one for summer play planted to the tenuifolia type of Zoysia and the other for winter play, where cool-season grasses are used. We feel sure only one green need be used, provided it is planted to 328 bermuda and then overseeded for play in the wintertime.

During the winter when a frost or freeze is predicted, the greens are covered with 6-ply, heavy-duty black plastic in the evening. It is removed first thing in the morning, so that play can start immediately.

On the day of our departure from Tokyo, we got an early start from the hotel in order to stop to see the 3-decker driving range located in the center of Tokyo. It is said to be packed from early morning until late at night. Artificial light is available so the range can be used at night. Its popularity is another evidence of the tremendous enthusiasm the Japanese have for golf. It is fast becoming the most popular sport in that country.

From Tokyo, we flew to Manila in order to visit Luisita Golf Club at Tarlac, which is located midway between Manila and Baguiro, which is the summer-resort spot in the Philippines. There is a 9-hole course, but Robert Trent Jones is building a new 18-hole course alongside of it, which will be the finest in the Philippine Islands. Tifway bermuda was sent to Tarlac to plant a nursery in order to provide enough planting stock, so tees, fairways and greens will be of this grass. It will be the first large-scale planting in the Islands.

Rainfall in the Philippines is heavy, ranging from 70 to 120 inches a year. There may be as much as 30 inches of rain in a single month. The rainy season starts in May and extends through September.

Iron chlorosis was very prevalent on the greens of the 9-hole golf course, even in December at the time of our visit. Grass was thin because of the chlorosis. Teodoro de la Paz, the superintendent, confirmed our suspicion that chlorosis was much worse during the rainy season. He applied ferrous sulfate to a test plot at our suggestion because it had never been used before. Within 12 hours, a marked difference was apparent. Since then, ferrous sulfate has been used in accordance with instructions. The remarks in a letter received sometime after our visit confirmed the need for the iron, but de la Paz remains unconvinced about grass behavior in the rainy season. He said, "Your memorable stay with us contributed a big jump toward our goal. The ferrous sulfate you recommended made an abrupt change of golden-colored spots to more eye-soothing, pleasing green color. It was only No. 6 that consumed much time in reaction. At present, most of our greens are such that the soil is hardly seen, especially greens 5, 7 and 9, where you said we are much behind comparatively to what you have in the States. I can say you should see them now. Although such is the case, come rainy season again, even a non-golfer would not enjoy seeing our course."

There may be no answer to the turf-density problem during the rainy season, but the challenge is there. These things should help. Surface drainage must be perfect, and in several directions, in order to move surplus run-off rapidly. The sub-grade must contain plenty of tile. The tile should be covered with a blanket of 5 to 6 inches of gravel or stone. The topsoil should be sand mostly, not to exceed 15% to 20% of organic matter by volume. Too much organic matter will result in overly wet soil because of its high water-holding capacity.

Introduction of Tifgreen bermuda by Robert Trent Jones may be an added help because it will produce a better turf than common bermuda. Then judicious fertilization and weekly applications of ferrous sulfate should provide better turf than heretofore. In bad spells, it may be necessary to use a little ferrous sulfate even more often. The secret is to apply it just as soon as the yellow color appears and not wait until after the grass has succumbed and is dead.

The next stop in the Oriental tour was at Kowloon, which is the airport for Hong Kong. We visited the Royal Hong Kong course, which is located about 4 miles from the Red China border. The drive was time-consuming, so there was very little opportunity to examine the turf and course in detail. The fairways seemed to be weeds mostly, of the bullgrass type. Soil in the greens was extremely heavy and very compact. The vegetation cover was weeds mostly, with patches of bermuda and some Zoysia. To have good turf on the greens, it would seem necessary to provide a better soil from a physical standpoint.

The objective of every golf-course superintendent is to provide a turf which is pleasant for the golfers to play. Sometimes this means doing things which complicate maintenance of the grass. Climate and weather play an important part, together with other maintenance factors, and also the type of grass used. Meetings of this kind are invaluable and attendance by the superintendent should be fostered by the golf club because it gives him an opportunity to keep abreast of developments in the turfgrass field.

With these introductory remarks, we will proceed to show the slides and this will be a joint venture, with Mr. Jones covering the architectural aspects and I will dwell upon the agronomic features of the courses we visited.

TYPES OF IRRIGATION SYSTEMS AND THEIR USE

Panel Discussion

Moderator: Mr. James B. Moncrief, Agronomist
USGA Green Section

Panel Members: Mr. T. M. Baumgardner, Member
USGA Green Section Committee

Mr. Harry Wright, Superintendent,
Peachtree Country Club, Atlanta, Georgia

Mr. Jimmy Dudley, Greens Chairman,
Athens Country Club, Athens, Georgia

Talk by Mr. Moncrief:

Archaeology of prehistoric people indicates that irrigation, or the application of water to lands by artificial methods, is a very old practice. One of the oldest written records that refers to this ancient practice is found in Genesis 2:10, which is: "And a river went out of Eden to water the garden. . .". Evidence points to Egypt as its place of origin. Ancient Egyptian paintings and sculptures show that water was bailed up for watering crops at least 4,000 years ago.

Modern irrigation was begun in the United States in 1847 by pioneers of Salt Lake Valley, Utah. Since that time, the practice has spread first into the richer and warmer valleys and then generally throughout the arid part of the West and elsewhere until now, there is an area of above 20,000,000 acres under irrigation in the continental United States. Skinner was about the first to design a sprinkler irrigation system in 1896.

There are seven principal ways of applying water to land, which are as follows:

1. Flooding - running water over a smooth field surface

2. Furrow - applying water in furrows

3. Check method - pooling water successively into checks or rather large pools or squares into which the fields may be divided

4. Basin - similar to the check method except that the basins are smaller. This type is used primarily in orchards.

5. Border method - flood irrigation between controlling borders or ridges

6. Sub-irrigation - application of irrigation water below the surface accomplished by means of open drainage ditches and underground basins

7. Sprinkler irrigation - application of water under pressure in pipes so that it comes through fixed nozzles or whirling sprinkler heads as a spray. This is the type of irrigation used on our golf courses. Most courses of today are thinking in terms of installing irrigation systems of some sort.

Manual System -- can be a system of several designs:

1. One quick-coupling or "snap" valve at each green and tee with use of hose and roller-base sprinklers, is one type of manual system for watering greens and tees only.*

2. A complete manual system normally includes quick-coupling valves on 90' spacing on the fairways and one or more quick-coupling valves, placed at the greens and tees into which the sprinklers and keys are plugged in order to cover the turf area.* Other designs for manual systems perhaps are using

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* Automatic Golf Course Irrigation, Regele, Carlyle D.

travelling sprinklers, etc. but all manual systems require manual labor.

Semi-automatic Systems

This can mean one of many designs. It could mean the greens and tees automatic with the fairways quick-coupling or one portion of the system automatic with the rest of the system manually operated.

Automatic System (Fully)

The superintendent is not eliminated, but is even more important. He has full control of the system and he must determine when to irrigate and how long, and not the designer. It is entirely up to the user to use the system to its utmost efficiency to produce the desired turf.

Regardless of which system you have, there are several factors necessary for the best results:

1. Proper design and installation
2. Good coverage
3. Even distribution
4. Pressure adequate
5. Quality equipment

This panel discussion has tried to point out the flexibility an irrigation system can have from a manual to a completely automatic type. Also, showing that all phases of systems are being used and each golf course has a choice to make.

Talk by Mr. Baumgardner:

Sources of adequate water. An abundant and economical water supply should be one of the main factors in selecting a site for a golf course. The allocation of the use of water is an ever-increasing problem in many areas and where water supply is not now, or will not in the future be adequate to meet all needs, it becomes a complicated social, political and economic problem.

Sources of water for golf-course use can be from the following sources: Wells, streams, ponds, lakes, reservoirs or from municipal distribution systems. Where use of water from streams, lakes or reservoirs is contemplated, the proper federal, state or local officials should be contacted for information regarding permits, riparian rights, apportioning regulations, if any, costs, etc. Sources of water should be thoroughly investigated for contamination or high salt or chemical content, which might be injurious to grasses and where doubt exists, the best advice obtainable should be enlisted before going ahead. Water containing high sulphur or other chemical content may have an adverse effect on certain types of valves, pipes or sprinklers and here, previous experience may be the best teacher.

Kinds of Systems - Advantages and Disadvantages of each.

Irrigation is as old as history, but probably more progress has been made in the last 15 to 20 years than in all the years before. The development of new materials and automated methods have gone a long way in the elimination of guesswork and reduction of labor costs.

Good management through efficient and dependable piping and sprinkling systems can result in giving each area the right amount of water at the right time without waste. Maximum benefit from fertilizer, fungicides, and chemicals should result.

I think we are all more or less familiar with the various types of systems in use on golf courses today. Starting with the oldest, most labor-consuming and largely outmoded types, the Greens and Tees only - Hose and Sprinkler Systems; then the first break-through in labor saving, the Traveler Sprinklers of various types; then the Single-row, Quick-Coupling Valve Systems, first coming into general use in early '20's and still the most prevalent system in use today except on the newer courses or recently remodeled courses. This was the forerunner of today's Semi-automatic and Fully automatic systems. Automation first appeared in over-all golf-course irrigation in the form of conversion of these single-row, quick-coupling valve systems to semi-automatic control. This was made possible by the development of pop-up-type sprinklers capable of covering the full width of the average fairway. The first systems of this type, I believe, were installed in the West around 1955. This type of semi-automatic system was at that time, the least expensive to install and simplest to design, but left much to be desired in the way of uniform distribution. The next steps in design improvements led to today's Multi-row Fully Automatic Systems, which now appear to be the ultimate in efficient over-all golf-course irrigation.

Many factors, however, may still influence the decision as to what particular type of sprinkler system to choose for any particular course. These factors include geographic location, climate, rainfall distribution, drainage conditions, soil characteristics, topography and elevations, type of grasses used, degree of maintenance, perfection desired, and last but not least, economics.

Watering of greens and tees only, still a fact at many courses, is no longer considered adequate even in areas of high rainfall, as today's golfer expects green fairways throughout the season.

Hose and Sprinkler and Traveler Sprinkler methods are largely obsolete and Manual, Quick-Coupling Valve Systems are fast becoming so because of mounting labor costs, unionization and player demands for better, more uniform playing conditions, tee through green.

Semi-Automatic Systems, usually feature automatic time-clock sprinkling of tees and greens with pop-up sprinklers and single-row, standard quick-coupling valves in fairways, which are activated by hydraulically or electrically operated valves. With this type of system, it is necessary to insert impact-type, long-range sprinkler heads in the quick-coupling fairway valves each night when watering is to be accomplished and removing them again in the morning. Existing manual, quick-coupling valve systems can be converted to this system without too great expense. This system also allows for considerable latitude in selective watering and is somewhat simpler and less expensive than fully automatic systems.

The advantages of modern Fully Automatic Systems include the following: Almost complete elimination of watering labor. It is the most accurate and offers variable control of water application, reduces waste and water costs, greatly reduces chances of human error, extends play from dawn to dark, reduces length of work-day of maintenance employees and superintendent.

Automation permits use of greatly reduced pipe sizes throughout the system, which, of course, reduces costs. Smaller range sprinklers with closer spacing are used, providing more uniform coverage without increasing operating costs.

The modern Fully-Automatic System ideally will include the following features:

1. Water cycles started by an automatic 24-hour clock, coupled with a repeating 14-day calendar programmer. Individual timers allow adjustments between various units from as little as 2 minutes to an hour, allowing different amounts of water to be applied to high and low areas. Repeat cycles quickly available so that the watering on a given night to a specific area may be applied in more than one application to minimize ponding and runoff. A new development by at least one manufacturer is a valve built in with the fairway sprinkler head unit, which is said to save as much as $40.00 per fairway head in installation cost. Entire course normally watered at night or early morning hours. Valves are either electrically or hydraulically operated. Separate control valves for each head may be desirable on some courses, where drainage and soil conditions vary and this can now be accomplished without much additional expense.

2. Both greens and tees have separate controls from fairways.

3. Manually controlled, quick-coupling valves at all greens.

4. Sprinklers of a maximum diameter of 110 feet, with triangular spacing of around 75 feet, are considered most desirable, although existing quick-coupling valve systems with 90-ft. fairway spacings can be successfully converted, without re-spacing.

5. In freezing climates, some systems have pneumatic control of the automatic valves or separate antifreeze solutions are used in the case of hydraulically activated systems.

6. Hydraulic systems are said not to work as well as electrically activated systems where there are extreme differences in elevation.

Cost of installation of the various systems discussed will, of course, vary greatly depending on a great many local and regional factors. Comparative costs in the Southeast (which is the only area I am familiar with) would probably be today, about as follows for an average 18-hole course, using the best-quality materials throughout and including pump and well installation:

A completely automatic system using single-row fairway heads would probably figure in the range of $75,000 to $100,000.

The same completely automatic system using multi-row fairway heads for fairways would be about 10 or 15% higher, or in the range of $90,000 to $115,000.

Six years ago, when we built an additional 9 holes at the Sea Island Golf Club, we received competitive bids on three different types of systems, namely (1) manual, quick-coupling valve, single-row system, (2) semi-automatic fairway and greens and automatic-tee sprinkling, and (3) fully automatic multiple-row system. Our bids (exclusive of pump and well) for the 9-hole system were: $28,000 for manual, quick-coupling, $36,000 for semi-automatic single-row, and $65,000 for the fully automatic multiple-row system.

Today, due to improvements in materials, equipment, know-how and installation techniques and due to the use of much smaller pipe sizes in fully automatic systems, the gap between the cost of fully automatic systems and manual or semi-automatic systems, under favorable conditions of terrain and soil, have so greatly narrowed that it seems undesirable to consider anything but a fully automatic system.

I am advised by a reliable Southern irrigation contractor that a fully automatic system, using a newly developed fairway combination, automatic valve and sprinkler head can now be installed for no more than 15% to 20% greater cost than a manual, quick-coupling valve system. This small difference in cost could, of course, be retrieved in a short period of time in reduced labor costs.

Specifications and Bids. When a new course is being planned or when improvements to an existing-course irrigation system is contemplated, club officials are inevitably confronted with the problem of whom to turn to for the best advice in regard to their irrigation problems.

If the club subscribes to the U.S.G.A. Green Section Service, a natural source of good advice would be the U.S.G.A. Regional Agronomist, who would be in position to, at least, recommend the necessary steps and procedures, and could point out the advantages and disadvantages of the various types of systems as related to the particular course.

The first step, of course, should be the securing of a good, complete over-all plan and adequate specifications to suit the requirements of the particular club and course, prepared by a recognized and experienced expert in the field of golf-course irrigation.

Millions of dollars have been spent on research by manufacturers during the past decade to develop better sprinklers, controller equipment, automatic valves, pipe and installation techniques to improve and lessen the cost of over-all golf-course irrigation systems. It is obviously no longer possible for a local plumber or someone without wide previous experience to design a modern system.

The names of capable experienced designers, as well as contractors in the same category, can usually be obtained from golf-course architects or by contacting other clubs who have recently had successful systems installed. Valuable information may also often be obtained from various manufacturers' representatives and from reliable dealers.

Wherever possible, the next step, after suitable over-all plans and specifications are in hand, should be to invite competitive bids from reliable, experienced contractors. Where automatic and semi-automatic systems are involved, only contractors experienced in this type of installation should be entrusted with the work, as there are too many unfortunate pitfalls and "tricks of the trade" involved to risk installation by the uninitiated.

An adequate plan should include the locations, sizes, and specifications for all pipe, valves, sprinklers, pumps, hydraulic tubing or electrical activating systems, controllers, switches and electrical hook-ups, etc. Detailed specifications for installation procedures should also be included encompassing such things as pipe and tubing-laying procedures, depth of pipe, replacement of sod, valve and sprinkler installation and finally, recommended operational procedures. Plans should also include schedules of all pipe, valves, fittings, sprinklers and other equipment necessary to accomplish the work as detailed in the plans and specifications.

Using the System - Things to Consider. This is a big and complex subject and only a few highlights can be discussed here.

If an experienced designer and contractor have been employed in the installation of the system, they can offer much good advice as to the best procedures for use of the system. A capable, experienced superintendent will quickly learn how to use it efficiently and to best purpose. The types of grasses to be encouraged or discouraged will be a big factor. The tendency is usually to water too much initially in particular areas with a new system and only experience can be the teacher in this respect.

General advice normally given to start off the use of an over-all automatic system under average conditions is to set the controller and clock for the first month or so to a maximum of 1/4 inch of water per hour, as most soils will absorb this much without runoff. If a fairway sprinkler delivers 60 gallons of water per minute to an area 180 ft. in diameter at about 70 lb. pressure at the sprinkler head, approximately 1/4 inch of water per hour will be applied. After some experience and observation at about this rate of watering, the experienced superintendent can soon learn to adjust his system up and down for the various areas and needs of his course. Rainfall, topography, soil and drainage conditions, type of grasses and other factors will, of course, enter into the daily decisions in regard to water use.

Somewhere in the range of 70 lbs. pressure at the sprinkler head seems to be best for most types of sprinklers now in general use. Higher pressures tend to cause fogging and excessive sprinkler wear. Alternate fairway heads should always be operated to prevent double watering of areas between sprinklers on the same night.

An adequate over-all watering system is a necessary tool for the successful management of fine, specialized turfgrass from tee through green, such as is generally expected as a matter of course by today's golfers. However, like any tool, it is only as good as the judgment and the know-how of the man handling it and the more we learn about the proper use of this greatly improved tool, the better our results will be.

Talk by Mr. Harry Wright:

When we really got serious about a water system at Peachtree, my Club President appointed one man to get plans, types, and prices. An irrigation contractor was hired to draw up a set of plans; another set was obtained from a sprinkler-manufacturing company. Then we hired a consulting engineer to check these two plans. He changed them to what we think is a very good system. We wanted fully automatic, so I went to Sea Island and Marion McKendree showed me his system in operation. He also told me the problems of a hydraulically operated system. While with Marion, I decided that we did not want that if electric was better. Then I went to see Palmer Maples' system, which is electric. He seemed to be happy, so we went electric. Then the engineer and I went to Dallas-Ft. Worth and Charlie Gregory showed us 5 systems that were completely automatic, electrically controlled. These systems also used transite pipe for all mains, so we chose transite and galvanized. Charlie Gregory looked at our finished plans and told us it was as good as he had ever seen. After all the research, we believe we have a hydraulically sound system. Incidentally, our system will put one inch of water on all fairways in three nights. Fairways are manual and greens and tees are automatic. Cost kept us from going fully automatic. We are using 48,300 ft. of pipe, 318 quick-coupling valves, and 115 pop-up sprinklers. As you can see, we are watering quite a large area.

Several problems come up after installation starts:

(1) Trying to keep your existing system in operation. We line it off. If the contractor hits it, he pays for repair. If it isn't marked and he hits it, we pay for repair. Our contractor has a rock clause; we pay for that. This can cost money. When an air hammer comes in, make sure it is large enough to do the job.

(2) Transite has to be put in a certain way; this has to be watched. Only a 5% bend is allowed. Hand tamping sides of pipe is required. Mechanical tamping should be required after trench is half filled and again, when completely filled. All turns are blocked with concrete.

(3) Double-swing joints for risers should be used. If I had it to do over, I would make sure these swing joints and risers were painted with a rust-preventative paint. Of course, this has to be in the contract at the beginning.

(4) Wire connections are certainly important. They have to be waterproof. We are placing the wire on the opposite side of the trench from the riser, so if we have to dig a riser, we stand a better chance of not cutting the wire. Lots of slack should be in the wire because back-filling and tamping can tighten it up.

If automatic, the type pop-up you use is important. Cam-driven was highly recommended to us. No doubt, some of you are partial to impulse drives or gear drives. Several people make electric-control valves and lots of them are as good as the other. There are many sprinkler manufacturers; they are all good, so take your choice. All I can say on this is, Get the size sprinkler your system was designed to use.

When installation begins, you have to decide whether to take up the sod and replace it or take it up and use it some place else and plant the trench later, or just forget the sod and plant later. On fairways, we removed the sod and used it on bare areas. Greens we removed and replaced the sod. A small trencher is used around greens.

The contractor should clean up behind his work as soon as possible or you will wind up like Peachtree — a sea of mud.

Talk by Mr. Jimmy Dudley:

Irrigation - Athens Country Club - Manual system with perimeter pop-ups.

I suppose our manual system was adopted more for a financial reason rather than anything else. We simply did not have the money to think of automation four years ago, when ours was installed.

The system is fed from a 10-acre lake fed by springs and a creek when drouth conditions require it. We use a 75 H.P. motor and centrifugal pump that delivers 750 gallons per minute. We have an auxiliary 10 H.P. pump that keeps constant pressure on the system and allows us to do light watering around greens and tees when necessary.

Our Fairways and Roughs Contain:

183 snap couplers that deliver 60 gallons per minute to 12 sprinklers. It takes one man 8 hours per night for three nights to put one inch of water on the 55 acres of fairways and roughs under irrigation. We estimate our irrigation will be used 10 times per year to supplement the average rainfall in Athens of 40 inches. Based on the above, our labor cost for the year for fairway irrigation amounts to $300.

Greens and Tees

Depending upon the size, our greens contain 4 to 8 perimeter pop-ups along with a single, individually-controlled snap coupler at each green. The majority of the time, our greens are watered by opening all the pop-up valves at one time, cutting on the large pump, running it for 30 minutes to one hour, and shutting down. The total time involved to open up, water, and close the valves usually amounts to 2 hours. This is done in the early morning. The snap coupler is used to hand water, syringe, and wash in top-dressing and fertilizers.

Tees

Tees are equipped with snap couplers. This watering is usually done at night in conjunction with the fairway irrigation or when this system is not in use, with the auxiliary pump in the early morning hours.

Our system has proven satisfactory and economical. Our biggest mistake was in using an existing 6-inch drain at the bottom of the lake for the intake pipe to the pump. We ran into a terrific iron-rust problem from decayed vegetation in the bottom of the lake that would stain flag poles, markers, benches, etc. However, since raising this intake to a 5-foot depth, we have experienced no more difficulty from staining.

POWER USED FOR PUMPING WATER

Willis E. Huston, Extension Engineer
Cooperative Extension Service, Athens, Georgia

Electric motors and internal-combustion engines are the sources of power for pumping water. Which sources are best suited, depend on certain physical and environmental factors. The factors most apt to influence selection are:

(1) Availability of electricity and fuel

(2) Amount of horsepower required for pumping

(3) Initial costs and seasonal use

(4) Single-phase or three-phase power availability

(5) Portability desired in pumping setups

(6) Type of power transmission

The following table suggests types of power suitable when only the brake horsepower requirements of the pump are considered. Actually, the operator's choice must also be considered.

	Electric Motors		Internal-Combustion Engines				
BHP	3-phase	Single-phase	Diesel	Gasoline	LP-G	Natural Gas	Distillate
5	Yes	Yes	---	Yes	---	---	---
7.5	Yes	---	---	Yes	---	---	---
10	Yes	---	---	Yes	Yes	Yes	---
20	Yes	---	---	Yes	Yes	Yes	Yes
40	Yes	---	Yes	Yes	Yes	Yes	Yes
75	Yes	---	---	Yes	Yes	Yes	---
100	Yes	---	Yes	---	---	---	---

Electric Motors. An electric motor, properly selected and protected, can be expected to supply trouble-free power for 20 to 30 years. It can be operated from no load to full load without damage. Protections which the operator must provide if he is to receive this performance include dry mountings, rodent protection, good ventilation, adequate shelter from the elements, and safety devices against overloading, under-voltage, or excessive heating.

Factors which influence the selection of electric motors are:

(1) Relatively long life

(2) Low maintenance costs

(3) Dependability

(4) Ease of operation, controlled by electric switches

(5) Delivers full power throughout life

(6) Single-phase energy limits size to 5 horsepower

(7) Power interruptions

(8) Electric supply line needed to all pumping stations

(9) Constant speed -- changing speed of pump can be accomplished by using a belt drive and changing pulley diameters.

An electric-driven pump on a sprinkler system should be equipped with a main line flow-control valve, such as a gate valve. This permits controlling line pressures and prevents overloading of motor during filling of sprinkler-distribution system.

The most common type of motor used on pumping plants is the 60-cycle, 220-440 volt, three-phase, squirrel-cage induction motor. The speed of these motors under full load is nearly constant. The 1760 rpm motor is the one most commonly used, however, motors operating at speeds of 860, 1160, and 3500 revolutions per minute are also common. It is important, therefore, that in direct-connected units, the pump be selected that operates acceptably at the motor speed. Pump manufacturers carefully consider this and provide the market with so-called "package units." Such units will give optimum performance because pump and motor selection has been carefully made.

Single-phase motors are usually limited to loads up to 5 horsepower. Such limitations on horsepower greatly affect irrigation acceptance inasmuch as most sprinkler systems require horsepower above this limit. With the advent of rural electrification, the concept of energy utilization did not go much beyond the incandescent lamp. Today, farmers everywhere are finding new uses for this efficient servant and are demanding three-phase power. Multiple-phase lines are more prevalent in the Western states than the Eastern. Although expensive, the re-phasing of rural lines from single phase to three-phase will greatly increase the number of farms using irrigation.

The efficiency of electric motors is high. Three-phase motors are inherently more efficient than single-phase. Some of the larger motors, 30 hp or higher, will operate at above 90% efficiency. Standard motor sizes for three-phase are 2, 3, 5, 7 1/2, 10, 15, 20, 25, 30, 40, 50, 60, 75, and 100. Higher horsepowers are available.

Vertical hollow-shaft motors are available for deep-well turbine pumps. These motors are equipped with a top cap to facilitate impeller adjustment. Two types of couplings are available for turbine pumps, the selection being dependent on the method of lubrication used for the pump.

Nonreverse coupling is recommended when the pump has water-lubricated, line-shaft bearings, which might possibly be damaged if the shaft were turning when there was no water surrounding the bearings. This condition occurs when the motor is stopped and the water column in the well drains back through the pump impellers, causing the pump to rotate in the reverse direction as a waterdriven turbine.

Self-release coupling is used when "back spin" upon shut down is not objectionable. Pumps which use self-release couplings normally have oil-lubricated line-shaft bearings or, in some cases, have check valves in the system, which prevent water flow in the reverse direction through the pump.

Whenever an electric motor is used, some means must be provided for starting it. Depending upon the requirements of the power supplier, the motor will need either a full-voltage starter or a reduced-voltage starter. Only after determining the horsepower rating of the motor and whether reduced-voltage starting is required, can the proper starting equipment be selected.

Internal Combustion Engines. Under this heading, two general types of engines are considered: spark-ignition or all engines in which combustion takes place when the fuel-air mixture is ignited by an electric spark; and compression-ignition engines, better known as diesels. Both types of engines have certain common characteristics.

Often the amount of power required to operate the various accessories on an engine is thought to be negligible. Actually, such items as the fan, generator, water pump, etc. may consume as much as 10% of the horsepower output of the engine.

For continuous operation, 20% of the maximum horsepower should be allowed when the engine is derated. Irrigation pumping is continuous loading operation, and horsepower curves represent the continuous horsepower which should be demanded of the engine at sea level and 60° F. Sea level and 60° F. temperature are universally recognized as "standard conditions of operation."

Since the majority of pumping installations will not be operated at 'standard conditions,' corrections for altitude and temperature must be made. For internal-combustion engines, altitude corrections of 3% for each 1,000 feet increase in elevation above sea level is recommended, whereas 1% loss in power will occur for every 10° F. temperature increase above 60° F.

Irrigation-pumping plants operate long periods without supervision. Such operation is possible because of safety controls, which automatically shut the engine off if the oil pressure drops, if the coolant temperature becomes excessive, if the pump loses its prime, or for some reason, the discharge pressure head drops.

Probably the most popular type of engine in the 25 or lower continuous horsepower bracket is the air-cooled engine. These engines are selected just the same as are the liquid-cooled and are equipped with safety controls, including a high temperature shut-down, just as are the liquid-cooled engines.

Calculated Performance Standards For New Deep-Well Pumping Plants

Energy Source	Rated load hp-hr. per gallon for representative power units	Performance standard in whp-hr/gallon 1/
Diesel	14.75	11.06
Gasoline	11.30	8.48
Tractor Fuel	11.08	8.31
Propane	8.92	6.69
Natural Gas	81.9 per 1000 cu. ft.	61.4 per 1000 cu. ft.
Electric	88% efficient	0.8854 per kw-hr.

1/ Based on pump efficiency of 75%.

Maximum Fuel Requirements For A Good Pumping Plant

Flow of water in gallons/ minute	Lift in ft.	Water hp.	Propane	Diesel	Gasoline or tractor fuel	Natural Gas	Electricity KWH
	100	13	2	1 1/4	1 1/2	210	14
500	150	19	2 3/4	1 3/4	2 1/4	310	21
	200	25	3 3/4	2 1/4	3	410	29
	100	18	2 3/4	1 3/4	2	290	20
700	150	27	4	2 1/2	3 1/4	430	30
	200	35	5 1/4	3 1/4	4 1/4	580	40

SOURCES OF WATER FOR IRRIGATION

James B. Moncrief, Agronomist
U.S.G.A. Green Section, Athens, Georgia

Archaeology of prehistoric peoples indicates that water, the most abundant and most widely used of all compounds, occurs in vast quantities in nature in solid, liquid, and gaseous states, covering nearly three-fourths of the earth's surface. It is essential to the existence of animal and plant life, constituting about 70% of the human body and about 90% of the weight of many plants. In the form of vapor, water is always present in the air, even over the driest deserts. At ordinary temperatures, water is in an odorless, tasteless liquid. It boils at 212° F. or 100° C. and freezes at 32° F. or 0° C. This can be influenced by altitude or added materials. Water is used as the standard substance in defining the units of heat. Water is a very stable compound, being easily formed from its elements and resisting decomposition when heated to 2500° C. It decomposes only to the extent of 2%.

The purest of natural waters is rain, which in falling through air, dissolves and collects small quantities of the fine particles of mineral and vegetable matter, and air gases such as N, O, CO_2, and NH_3. When the rain reaches the earth, some of it flows into ponds, streams, and lakes, some sinks into the earth, some evaporates into the air. Water that drains from land surface into bodies of water usually contributes considerable quantities of suspended matter, while water that percolates through the ground contributes much of the dissolved mineral impurities found in natural water.

For drinking, water should be clear, colorless, odorless, pleasant-tasting, and should not contain excessive soluble minerals, and be free from pollution.

Hard water is unsuitable for boilers and various industrial uses. Water used for irrigation purposes should not be high in dissolved matter, particularly in an alkaline substance, because the minerals left after the water has eventually evaporated may accumulate in such concentration as to become injurious to plants.

According to 1955 reports, more than half of the water consumed in the U.S., an estimate of 20,000,000 gallons daily, comes from underground. This figure is very low for 1965, since now it is estimated (350×10^9 gallons) 3,500,000,000,000 gallons of water is used per day. In some communities, the underground water supply is being drawn on to such an extent that there is danger that the supply may, in time, become exhausted. In many areas, the water-table levels have dropped 40 feet or more in 10 years. The necessity of providing adequate legislation to safeguard against the rapid draining of these resources is borne out by the following facts: 65,000 gallons of water are needed to produce a ton of steel, and it is estimated that about 50,000,000 gallons of water per plant will be needed daily in production of synthetic gasoline from coaler shale. In some Western states, for every new acre irrigated, an acre has to be retired. Here in the Southeast, we are blessed with water, but we are polluting it fast. The human race is known for its exploits of polluting its sources of water.

Our consumption is growing everyday as we are gaining more than 7,000 people daily to our population. Water shortages are becoming more serious in a real extent as well as severity. One answer is desalination of sea water. In large-scale projects in which nuclear reactors were used, fresh water perhaps could be obtained at about 6¢ per cubic meter (22¢ per 1,000 gallons) at sea level and at the plant. Distribution of this water to points distant from the sea would entail very large additional expense.

An alternative approach is that of effectively utilizing part of the continent's natural water supplies. For example, in the northwestern section of North America, more than 800 x 10^9 cubic meters of water flow almost unused to the sea each year. Use of the potential supplies would solve most of the continent's water problems for as long as 100 years. Unit cost of the water, delivered inland, would be a small fraction of that of desalted water even at sea level. Through a series of dams, lifts, tunnels, and canals, water from Canada and the northwestern United States would be conducted to the Great Lakes and to the southwestern United States and Mexico. By this means, the level of the Great Lakes would be regulated and maintained and the amount of power generated at Niagara Falls and related sites would be increased. The canal conducting the water to the Great Lakes would be navigable, and huge blocks of hydro-electric power would be generated en route.

In the West, large areas in Utah, Nevada, Arizona, New Mexico, and other states, as well as three states in Mexico, could be irrigated. In Mexico alone, eight times more area could be served than will be supplied in Egypt by the Aswan High Dam. The needs of southern California also would be met. In all, 33 states would obtain some form of benefits from the plan. Canada would receive the equivalent of about $2 billion a year. The cost of the development is estimated at $100 billion; 20 years would be required for construction after authorization.

Much of the water would be drawn from the Peace and the Yukon Rivers. One of the features of the plan is a large storage lake in the Rocky Mountain Trench, just west of the Continental Divide; the lake would extend 800 kilometers northwest into Canada from the vicinity of Libby, Montana. A large storage basin is crucial, since most of the river flow of the region occurs during spring and summer. This projected flooding of Canadian territory could prove to be a major point of friction, even though the region is sparsely settled. In any event, past experience suggests that there would be long delays before the necessary international agreements could be formalized.

However, many of the benefits for the United States could be obtained in a way not mentioned in the report. A substantial fraction of the flow of the Columbia River could be intercepted near Hanford, Washington, and at other points and lifted and caused to flow eastward and also southward through tunnels and canals. Very cheap electric power, furnished by huge nuclear reactors, could be used. The present NAWAPA concept is grand and imaginative. It is to be hoped that the Canadians will join us in this great project, but alternatives should be studied*.

The per-capita use of water is over 140 gallons per day and this is broken down as follows:

1. 50 gallons, residential uses such as lawns, washing, commodes, dishes
2. 50 gallons, industrial uses

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*SCIENCE, 8 January 1965, Vol. 147, Number 3654, Abelson, Philip H.

3. 20 gallons, commercial business - such as cleaning shops, stores, banks, etc.

4. 10 gallons, public uses, such as swimming pools, fighting fires, etc.

5. 10 gallons, lost in leads and maintenance. It is now realized that adjusting the water to the desired temperature accounts for more waste of water than leaks in homes.

Consider the soil as a storage reservoir. The storage capacity within the root zone is determined by the rooting depth of the grass and by the difference between the amount of water retained by the soil after irrigation (approximate field capacity) and that remaining when the grass wilts (wilting point). The water held by soil between field capacity and the wilting point is called "readily available water." Grass will not suffer a water deficit as long as roots are in contact with available water. Sandy soils will hold 1/2 to 3/4 inch of available water per foot depth of soil, loam about 1 1/2 inches, and clays about 2 1/2 inches.

How long will the supply of available water in the soil reservoir last? This depends upon weather conditions, particularly light intensity, temperature, humidity, and wind. Trees may compete with grass for water and increase the drain on soil-moisture supply. The rate of water use differs from day to day and place to place. Even on a single piece of turf, water consumption may vary considerably according to exposure. Thus, one cannot give accurate figures for water use.

MECHANICS OF FERTILIZING GOLF COURSES THROUGH IRRIGATION EQUIPMENT

Panel Discussion

Moderator:	Dr. Glenn W. Burton, Principal Geneticist Georgia Coastal Plain Experiment Station and Member, USGA Green Section Committee
Panel Members:	Mr. J. Cooper Morcock, Allied Chemical Corporation, Nitrogen Division, Atlanta, Georgia
	Dr. Carroll Walls, DuPont de Nemours Company, Columbia, South Carolina
	Mr. R. L. Carter, Soil Scientist, Georgia Coastal Plain Experiment Station

Resume of Panel Discussion by Glenn W. Burton

It is now possible to supply in water solutions the plant nutrients required to grow grass. Irrigation systems in use on most golf courses, however, do not apply water uniformly and cannot apply fertilizer any more uniformly than the water carrying it. Thus, irregular application and the streaking, over-fertilizing and starving, that would be associated with applying fertilizer through the irrigation system, appear to be the main objections to this practice. It is also recognized that fertilizer, moving through the irrigation system, will cause some corrosion to metal parts. Although no one could suggest the amount of damage one might expect, the practice of applying fertilizer materials through an irrigation system would certainly shorten its life.

A poll of those in attendance revealed that no one was currently trying to apply fertilizer through their irrigation systems. The increased cost of an irrigation system capable of applying water uniformly enough to use it as a medium for fertilizer distribution would seem to offset any saving in labor that might accrue from this practice.

Resume of Panel Discussion by J. Cooper Morcock, Jr.

In recent months, the fertilizer industry has developed economical machinery for dissolving potash and mixing it with soluble nitrogen and phosphorus to make complete liquid fertilizer. Any desired ratio of N-P-K in a completely liquid state can be economically manufactured. Most minor elements can be incorporated in the solution, if desired. Small liquid fertilizer plants are rapidly being installed to meet the growing demand.

Since this type of fertilizer is a true solution without any solids or colloids in suspension, no agitation is used to keep it in solution. It can be introduced directly into any irrigation system. By using a calibrated-solution container, a valve, and rubber hose, any desired amount can be sucked into the water on the intake side of the irrigation pump or through a ventura valve into the discharge-pipe line. Proper valves, etc. can be had from any irrigation equipment supplier and cost will likely range from $6.00 to $20.00, depending on the container used. Any quantity of fertilizer can be introduced from a cupful to a ton or more per acre.

The accuracy of distribution of the fertilizer will be identical to that of the irrigation water.

Because of the extremely dilute state of the water plus the fertilizer, little, if any, additional corrosion of equipment will occur. The last portion of the water applied will contain no fertilizer, so there will be no residual chemical action on irrigation equipment.

Because golf courses are watered frequently and because only a valve has to be opened and closed to apply soluble fertilizer, there is no practical reason for attempting to use insoluble, so-called "long lasting" forms of nitrogen, such as ureaforms and natural organics.

Golf-irrigation systems are designed to water grass where grass growth is most needed — and that is where complete fertilizer is also needed. Putting required plant nutrients with the water is a practical, clean, labor-saving, economical practice that is destined to grow.

Resume of Panel Discussion by Carroll Walls

There are materials, liquid complete fertilizer mixtures, available today that could lend themselves to sprinkler irrigation. However, there are drawbacks to using these materials from the standpoint of corrosion and at present, the lack of uniformity in applying the water over the surface of the golf course.

This lack of uniformity might cause unsightly streaking or semi-circles on the outer fringes. You could also have "water runs" of fertilizer materials where excessive amounts of water are used. Probably urea or nitrate nitrogen would be preferable for sprinkler irrigation, since these forms of nitrogen move readily into the soil and are very soluble.

The question of applying the ureaform types of nitrogen fertilizer compounds was stated in these terms. The "Uramite" and "Nitroform" are now being applied through spray equipment being used on greens and tees without difficulty. The two ureaforms are very finely ground particles of the original granular products. However, whether they could work through a regular irrigation system is doubtful unless the operator took precautions to put clean water through the lines after application of the ureaforms.

Another disadvantage to fertilizing through the irrigation would be the frequent feeding, thus, probably allowing the root system to be quite close to the surface of the soil. This could be a serious problem during very cold winters or prolonged droughts, particularly where the irrigation system went out of action.

<u>Resume of Panel Discussion by R. L. Carter</u>

The dissolving of soluble fertilizers in water or the use of liquid fertilizers and applying the solution through a sprinkling system should be a quick, economical, and effective means of applying fertilizers on golf courses. One of the problems involved is the uniformity of the application. The sprinkler system must be so arranged that approximately the same amount of water is being applied to the area to be fertilized. Single lines of sprinklers, for example, located only down the center of the fairways would not deliver a uniform rate of water to the entire area. Provision must be made for overlapping the area as recommended by the irrigation-equipment manufacturers to insure uniform applications.

If uniformity of water application can be achieved, then the use of soluble fertilizer materials is fairly simple. The solutions can be introduced into the system either by going through the pump directly or using an injector system in which the fertilizer materials do not pass through the pump. The use of the injector system should cut down on the corrosion problem of the pump mechanism.

In applying fertilizer materials through irrigation systems, the normal procedure would be:

1. Wetting the area first with water without fertilizer.
2. A period of at least 30 minutes during which the fertilizer is applied through the irrigation system.
3. Operation of the system with water in order to rinse the fertilizer materials out of the system and to leach the fertilizer materials downward in the soil to the desired depth of the root zone.

WATER AND TRAFFIC PROBLEMS

Tom Mascaro, President
West Point Products Corporation, West Point, Pennsylvania

Water in the soil, although vital to plant growth, is the primary aid to soil compaction. It is very difficult to compact a dry soil. However, soil with adequate moisture will compact quite readily. Water is the lubricant that allows the soil particles to slide together into a compact mass. The turfgrass manager must recognize this effect and do all he can to minimize compaction through the intelligent use of water and also through the establishment of good cultural practices.

To do this, one must study the many factors that influence the movement of water in the soil. We can separate these factors into the following categories:

NATURAL FACTORS

1. The Soil Profile
2. Soil Texture
3. Sub-surface Drainage
4. Surface Drainage
5. Seepage

MAN-MADE FACTORS

1. Original Construction
2. Poor Soil Mixtures
3. Thatch and Layering

MAN-MADE FORCES

1. Use of Maintenance Equipment

2. Human Traffic

3. Golf Cars

Returning to the first category, the natural factors, we must consider:

1. The Soil Profile. It is important that the turfgrass manager know what lies beneath his feet. A thorough understanding of the soil profile will reveal many characteristics that indicate whether water will move through the soil freely or will be held because of clay, layering, thatch, etc.

2. Soil Texture. Soil texture means the amount of sand, silt and clay contained within the soil, properly mixed for friability. Soil textures that are poor can be modified very often through the intelligent use of soil amendments and through cultivation. Cultivation mixes the soil amendments with the soil and also helps make more use of the natural organic matter that is derived from the grass roots.

3. Sub-surface Drainage. Sub-surface drainage is extremely important. If it is poor, excess water remains in the soil and on the surface to block the availability of air for the roots. Surface drainage is equally important and for the same reasons. Standing water must be removed quickly from turfgrass areas.

Under the second category, man-made factors, we have:

1. Original Construction. In original construction, problems are sometimes built in. Soils are manipulated when they are too wet, creating hard pans, which restrict the movement of water. Extremely heavy equipment also contributes

to heavily compacted soil when original work is being done. It goes without saying that soils of good texture should be used originally.

2. Poor Soil Mixtures. Poor soil mixtures can adversely affect the movement of water. Soils can be too sandy and drain too quickly. They can be too clayey and drain poorly.

3. Thatch and Layering. Thatch and layering both have a pronounced effect upon the movement of water in the soil. Thatch retains too much water at the surface which, in turn, restricts root growth and also makes an ideal breeding place for disease because of restricted air and water movement. Layers within the soil profile create false water tables through which water cannot pass.

The third category, man-made forces, that affect the availability of water and its proper movement in soils, are:

1. The Use of Maintenance Equipment. The rolling wheels of maintenance equipment knead the soil so that compaction is very severe near the surface. Vibration from mechanized equipment also contributes to the firming of the soil.

2. Human Traffic. Although not heavy in actual weight, human traffic contributes a great deal toward compaction. The roll of the foot at various speeds has a puddling effect upon the soil surface and it effectively seals soil over a period of time, so that water movement is restricted. In recent years, golf cars have come into the picture and figures indicate today that nearly 200,000 cars are in use on golf courses. This is one of the most severe forms of compaction, since they are used constantly regardless of weather and soil moisture.

The experimental work done here at Tifton, under the direction of Dr. Burton, shows without a doubt the severity of this form of traffic. Soils here at the Experiment Station, which are a natural sandy loam, were severely compacted in the experiments with golf cars.

To summarize, added to the natural forces that contribute to soil compaction, are the many man-made ones. Soil compaction can be overcome but it is a continuing process, since the compacting forces are constantly at work. The first step in controlling the problem is a knowledge of the soil itself and its drainage. If both of these are complete, then a good maintenance program will keep them that way. Such a program must include cultivation in order to control compaction as it develops.

If soils and/or drainage are poor, steps must be taken to improve them. Once this is done, the maintenance program that is continuously carried out will help offset all the forces that work against you.

SOIL PROBLEMS ON THE GOLF COURSE

R. L. Carter, Soil Scientist
Georgia Coastal Plain Experiment Station

There are many and varied problems which arise on golf courses, involving soil chemistry and soil physics that are not evident on other areas managed for turf. This is particularly true of the golf-green areas, which are both intensively used and managed. For this discussion, the soil-physical problems will be set aside and only the chemical problems, particularly involving the use of fertilizers, will be listed.

pH Levels

In testing the soil chemically in the laboratory, the pH of the soil is one of the basic determinations. The pH test alone often gives a clue to the problem involved. On golf greens particularly, there can be extreme variations in pH, ranging from very acid to very alkaline. If high rates of acidic-nitrogen materials are used frequently, the pH can drop rapidly to levels of pH 5.0 or below. When this occurs, the full effectiveness of nitrogen applications is not realized. This is due to inability of ammonia forms of nitrogen to be converted to nitrate at extremely low pH ranges and, thus, become available for plants. The availability of other elements is also affected adversely if the pH rises to levels above 7.0 or higher. In many areas near the Eastern coast, the materials used for building greens may have high levels of lime or some form of calcium carbonate.

Figure 1.

Soil pH Levels

Course and Area	Date Tested: 3/60	4/61	4/62	10/62	4/63	4/64	4/65
Plantation - Fairway	5.3	5.6	5.9	5.4	6.8	5.9	5.4
Retreat - Fairway	5.8	6.4	6.2	6.3	6.5	6.1	5.7
Seaside - Fairway	5.7	5.7	6.4	6.1	6.6	6.1	5.5
Plantation - Tee	5.8	6.2	6.2	5.9	6.7	6.2	-
Retreat - Tee	5.9	6.4	6.2	6.2	6.4	5.9	-
Seaside - Tee	6.1	6.5	6.3	6.1	6.9	6.2	-
Plantation - Green	6.2	6.5	6.1	-	7.2	6.3	5.8
Retreat - Green	6.0	6.4	7.4	-	6.8	6.3	5.7
Seaside - Green	6.0	6.4	6.6	-	6.9	6.3	6.0

From data presented in Figure 1, one can see how the pH levels ranged on three of the Sea Island courses over a six-year period. Since 1962, a regular application every spring of 25 pounds of dolomitic limestone per 1,000 square feet on the greens has apparently maintained the pH at a desirable level.

If one is confronted with a problem where the pH level tends to stay at 7.0 or above, then the only course is to add small amounts of sulfur (5 to 10 pounds per 1,000 square feet) to lower the pH level.

Phosphorus Levels

The phosphorus level on both fairways and greens can easily be kept at a suitable level with the ordinary applications of mixed fertilizer materials. Where materials such as Milorganite are used regularly on greens, the phosphorus level usually remains extremely high. On fairways in the sandy soils of the Southeast, applications of complete fertilizers in the spring, such as a

10-10-10 or 5-10-15, will maintain the phosphorus in the soil at medium to high levels. Since phosphorus does not leach readily, it is relatively easy to maintain the phosphorus in the soil at a medium to high level.

Figure 2.

Soil-Phosphorus Levels. (Lbs./A. of P. L = 0-30, M =31-60, H = 61+)

Course and Area	Date Tested						
	3/60	4/61	4/62	10/62	4/63	4/64	4/65
Plantation - Fairway	98	132	110	158	180	180	180
Retreat - Fairway	74	103	66	158	180	180	180
Seaside - Fairway	98	132	116	158	180	180	180
Plantation - Tee	89	132	110	158	180	180	-
Retreat - Tee	68	132	78	158	180	180	-
Seaside - Tee	98	132	116	158	180	180	-
Plantation - Green	98	132	111	-	180	180	180
Retreat - Green	98	132	107	-	180	180	180
Seaside - Green	98	132	116	-	180	180	180

Figure 2 shows the level of phosphorus on three of the Sea Island courses over a six-year period. Since 1962, the phosphorus levels have remained high on both fairways and greens following the general fertilizer applications previously outlined.

Potassium Levels

The maintenance of adequate potassium levels on greens and fairways is, in part, related to the nitrogen applications being used. Where greens are mowed so frequently and clippings removed, the removal of potassium in the plants is quite high. Also, the frequent watering required tends to leach out a part of the applied potassium. One successful plan on greens has been to add 5 pounds per 1,000 square feet of muriate of potash or sulfate of potash every 6 weeks during the summer.

On fairways, the use of a 10-10-10 or 5-10-15 in the spring and 15-0-15 in the fall appears to be adequate on the sandy soils of the Southeast.

Figure 3.

Soil-Potassium Levels

Lbs./A. of K. L = 0-60, M = 61-150, H = 151+

Course and Area	Date tested						
	3/60	4/61	4/62	10/62	4/63	4/64	4/65
Plantation - Fairway	89	80	132	136	264	80	168
Retreat - Fairway	93	63	88	100	264	60	156
Seaside - Fairway	143	83	44	104	168	108	240
Plantation - Tee	143	125	48	148	264	92	-
Retreat - Tee	106	56	64	100	216	64	-
Seaside - Tee	192	96	64	84	280	88	-
Plantation - Green	199	75	48	-	112	112	132
Retreat - Green	116	70	52	-	168	60	64
Seaside - Green	269	70	40	-	204	72	84

The results of such a program are indicated in Figure 3, which shows the potassium levels at Sea Island over a six-year period. It should be noted that since 1962, this type of program has served to maintain the potassium level adequately. The high levels indicated on October, 1962, are evidence of the success of this program. The samples reported on April of 1962, 1964, and 1965 were taken before the spring fertilization program was started. The sample on April, 1963, was taken after fertilization had begun.

In summary, it is apparent that with a reasonable and logical approach to the maintenance of pH, P, and K levels on greens and fairways, one can successfully maintain good grass cover on these areas. The regular use of soil-testing information, as evidenced by the program at Sea Island, can be of value and assistance to a turf-maintenance program if properly interpreted and used. Soil tests are performed at Athens, Experiment, and Tifton, Georgia. This service is free to all Georgia-located operations. In other states, the soil-testing services are provided and should be contacted if their services are desired.

OVERSEEDING BERMUDAGRASS GREENS WITH COOL-SEASON GRASSES

Panel Discussion

Moderator: Mr. Jimmy W. Dudley, Greens Chairman
Athens Country Club, Athens, Georgia

Panel Members: Mr. Charlie Danner, Superintendent
Capital City Country Club, Atlanta, Georgia

Mr. T. M. Baumgardner, Member
USGA Green Section Committee and
Vice President, Sea Island Company,
Sea Island, Georgia

Resume of Panel Discussion by Jimmy W. Dudley

I believe I can express our experience best to you by reading a copy of my instructions to our Greens Superintendent, showing you a chart of our planting schedule, and giving a short conclusion of our results.

I. Planting Schedule - Fall, 1964 - Greens

A. On Wednesday, September 23, Spray MH-30 on all the greens with the exception of the bentgrass plot. Cover this with a polyethylene sheet to prevent drift of MH-30. Use 3/4 gallon (rate 2/3 oz. per 1,000 square feet) (85 oz. or 5 1/3 pts.) material in 190 gallons of water (to prevent spillage from 200-gallon tank). Spray on greens in two directions. Hold boom high to prevent too much in one area. Do not apply in the hot sun. Spray in early morning only. Do not water in.

B. On Monday, September 28, start planting.

1. Close one nine at a time.

2. Verticut, sweep, and cut greens.

3. Sow seeds in many directions, particularly the bent and Poa trivialis. Use shoulder Cyclone for Seaside bent and Poa trivalis.

4. Spray seed with Captan 50-W. Use 50 lbs. Captan in 200 gallons of water on 1/2 greens in two directions (rate 1 lb. per 1,000 square feet).

5. Top-dress and drag.

6. Start hand watering three times daily. If you use perimeter irrigation, watch the wind. Remember - don't drown the greens the way we did one year, and cause disease.

7. Keep mowers real sharp. Raise to 3/8 inch and change to split rollers to prevent pushing over the tender grass.

C. Plant and fertilize with the attached schedule.

II. <u>Results</u>

For the third consecutive year, we have experienced good results with our overseeding program. With the use of foliage-feeding nitrogen, we have maintained color throughout the winter months.

The use of small, temporary greens 30 feet in diameter, used during the stress times of frozen greens and frost, was a big help in public relations, and from winterkill damage to the bermuda. The cost was less than $50.00 to plant and we never had to close our course. I believe it deserves your consideration.

Schedule - 1964

Hole No. in order of planting	Sq. ft. in green	Pennlawn fescue- 10 # per 1000 sq.ft.	Seaside bent- 1# per 1000 sq.ft.	*Poa trivialis*- 4# per 1000 sq.ft.	Rye grass - 15# per 1000 sq.ft.	On Fri., Sept. 25th, 4-12-12	With planting-Milorganite
9	4800	48	4 1/2	19	75	100	80
6	4000	40	4	16	60	80	62
1	5000	50	5	20	75	100	80
3	5500	55	5 1/2	25	75	110	88
2	8500	85	8	35	125	170	132
5	5000	50	5	20	75	100	80
7	5000	50	5	20	75	100	80
8	3800	38	4	15	60	75	60
4	5500	55	5 1/2	25	75	110	88
18	6000	60	6	25	90	120	96
17	5500	55	5 1/2	23	75	110	88
10	4000	40	4	16	60	80	62
16	5500	55	5	23	75	110	88
11	4500	45	4	18	65	90	70
15	4000	40	4	16	60	80	62
12	4500	45	4 1/2	16	65	90	62
14	8500	85	8	35	125	160	132
13	4500	45	4 1/2	16	65	90	62
Big practice	10,000	100	8	40	150	200	160
Little practice	5000	50	None				
TOTALS		1041	100	423	1525	2075	1632
Cost per lb.		52¢	$2.50	44¢	8¢	2.5¢	3¢
		$541.32	$250.00	$186.12	$122.00	$51.88	$48.96

Total Overseeding Cost: $1,200.28

Resume of Panel Discussion by Charlie Danner

Overseeding the greens at Capital City started on October 7th. No aerifying or verti-cutting was done at this time; instead we depended on our two power spikers. The greens were spiked with power spikers 6 to 8 times in different directions. The greens were then mowed at 2/16. This close mowing seems to shock the bermudagrass to the point that the bermuda is slow to recover and, thus, the problem of the bermuda recovering and crowding out the seeded grasses is lessened.

SEED MIXTURE - We used a mixture of 15 lbs. ryegrass, 8 lbs. Pennlawn fescue, 4 lbs. *Poa trivialis*, and 1 lb. Seaside bent to each 1,000 feet. The rye and Pennlawn fescue were seeded under the top-dressing. The greens were then top-dressed with 1/4 inch of sterilized top-dressing. After top-dressing, the *Poa trivialis* and Seaside bent were seeded on top of the top-dressing. All seeds were put on 1/2 in one direction and 1/2 in the opposite direction to prevent streaking. After seeding, the greens were dragged with a wire mat in two different directions. We like the Pennlawn fescue, as it seems to hold the ball up. In spite of the green looking slow, the ball will roll fast.

PURCHASING SEED - Four years ago, we purchased seed that apparently was not cleaned of weed seeds such as chickweed, shepherds purse, and yellow cress. The following spring, we contacted a reliable seed dealer in Atlanta and advised him that we must have recleaned, weed-free seed and were willing to pay top prices for clean seed. We gave the dealer plenty of time and a firm order. This helped him to shop around and find the recleaned seed we wanted. We have not been bothered by weeds for the past three years.

WATER MANAGEMENT - Watering starts immediately following seeding. The greens are watered and kept on the moist side until the seeded grasses are well up. We feel quick germination is achieved by keeping the greens moist without becoming soppy or saturated. We may water each green as many as 4 times daily, putting on just enough water to keep it moist. After the grass is well up, the water is tapered off back to normal. We believe good management of water following seeding will result in quick germination and less inconvenience to the golfers. At Capital City, we are fortunate to have the perimeter system of sprinkler heads around all our greens. This makes the watering job easier and helps us to better manage water applied to the greens. Our system is manual and would be even better with a fully automatic system.

MOWING - During the week of overseeding, the mowers are overhauled and sharpened to the point that they are razor sharp. A sharp mower is a must at this time to prevent pulling up the young seedlings. Mowing with the mowers set at 3/8 inch starts as soon as any grass is up high enough to cut, usually about the 7th or 8th day after seeding. We cut at 3/8 for about a week, then gradually lower the height of cut to 1/4 inch. We cut at 1/4 until cold weather sets in, then raise to 5/16 through the winter months. Around March 15th, we lower to 1/4 and around April 1st, we lower to 3/16 and cut at this height until the transition back to bermuda.

FERTILIZING - At the time of seeding, an application of 0-14-14 at 30 lbs. to each 1,000 feet was made. This was put on and seeding followed. As soon as the grass starts to germinate, weekly applications of Milorganite are applied at 20 lbs. to each 1,000 feet. This supplies a little over 1 lb. of nitrogen each week.

We continue this until cold weather sets in, usually around the middle of November. After cold weather sets in, we apply Milorganite at 20 lbs. to each 1,000 feet whenever the weather warms up enough to fertilize, usually every 3 to 4 weeks. During the spring months, we fertilize every 2 weeks with Milorganite at the same rate. With each application, we alternate directions to prevent streaking.

FUNGICIDE APPLICATIONS - The week before seeding, we spray the greens with Parzate C Zineb fungicide at 4 oz. to each 1,000 feet. We like this fungicide, as Parzate seems to increase the effectiveness of other fungicides. We start our preventative-disease-control program as soon as the grass starts to germinate and spray every week until cold weather sets in. We use a broad-spectrum fungicide at 3 oz. to each 1,000 feet the first week and alternate the next week, using Thiram at 3 oz. and Mercury at 1 oz. to each 1,000 feet. The Thiram and Mercury are mixed and applied together. We keep alternating the broad spectrum and Thiram-Mercury every other week. During the winter months, we spray only when a spell of warm, humid weather sets in. High humidity with warm temperatures is our barometer to spray as a preventative. Whenever we suspect iron chlorosis, we add 2 oz. ferrous sulphate mixed with our fungicides to each 1,000 feet. Ferrous sulphate seems to be compatible with the fungicides we use.

CHANGE IN PROGRAM - The only change we would make if possible to do so would be to aerify, verti-cut, and top-dress after Labor Day. This would result in sandwiching the seed between two layers of top-dressing, which we believe would be helpful at seeding time. This part of the program is impossible for us at Capital City. Our lady members start their annual Club Championship

Tournament the day following Labor Day. We found out long ago, that to get along, one does everything the ladies ask for and do nothing to interfere with their golf at tournament time.

PREPARING FOR SPRING TRANSITION TO BERMUDAGRASS -- We believe late winter and early spring to be a critical time for ground moisture. High winds tend to dry the ground surface up fast. Lacking adequate moisture, the bermuda rhizomes suffer desiccation and may die, even at this late stage. This may happen when the greens have become dry and a late freeze comes. A late freeze with dried-out greens may result in cell rupture and loss of bermudagrass. Water management all through the spring to prevent desiccation is extremely important.

AERIFYING - Twice during the spring months we aerify the greens, using a straight punch-type aerifier. Our greens are large, so we aerify one-half the green one week and catch up the other half the following week. If the grass is in a vigorous, growing condition, the aerifier holes will disappear within a week. This leaves the golfers one-half green undisturbed and does not interfere with play. The plugs are removed from the greens and used to patch spots around the course. No top-dressing is done until well into the transition.

SPIKING - Every Monday, starting in late March, the greens are spiked in two different directions. We would like to do this more often, but due to heavy play, we find it impossible. We try to spike very week until we are through the transition. We know aerifying and spiking are helpful.

We can see a definite pattern of bermudagrass coming up through the aerifier and spike holes. At Capital City, we work toward having a gradual transition. We do nothing to hasten the transition, such as burning off the winter grass. If the bermudagrass is in a healthy condition, it will crowd out the winter grasses.

ATTENDANCE ROSTER

Name	Affiliation	City
ALABAMA		
Carnes, Robert H.	Park and Recreation Board	Birmingham
Dickey, George C.	Woodley Country Club	Montgomery
Dickinson, Tommy	Willow Point Country Club	Alexander City
Edmondson, Carl J.	Bonnie Crest Country Club	Montgomery
Godwin, George "Ed"	Birmingham Country Club	Birmingham
Graft, C. A.	Alabama By-Products Corp.	Birmingham
Latta, J. D.	Park and Recreation Board	Birmingham
Lawrence, Doyle	Maxwell Golf Course	Montgomery
Ledbetter, Bob	Green Valley Country Club	Birmingham
Moses, Cecil C.	Montgomery Country Club	Montgomery
Nelson, Bill	Green Valley Country Club	Birmingham
Nixon, M. C.	Nixon Grass Farm	Auburn
Nordan, W. W.	Nordan's Grass Farms	Abbeville
Rumore, Ross	Park and Recreation Board	Birmingham
Wendling, M. J.	City Recreation Department	Montgomery
BAHAMAS		
Burton, Tom	Patten Seed Company	Freeport, G.B.I.
COLORADO		
Cochran, John N., Jr.	Maxwell Golf Course Construction Co.	Denver
FLORIDA		
Adams, Don		Palatka
Allen, Paul E.	Paul E. Allen Company	Palm Harbor
Bair, Roy A.	Agricultural Consultant	West Palm Beach
Clarke, Sid	776 W. 54th Street	Miami Beach
Clarke, Stan	La Gorce Country Club	Miami Beach
Deatherage, A. M.	Daytona Beach Golf & Country Club	Daytona Beach
Derzypolski, Marion	Golf Course Superintendent	Tallahassee
Dilsaver, Carl E.	Miami Shores Golf Course	Miami Shores
Dowling, Elmo	Rainy Sprinkler Sales	Gainesville
Edge, Ross	Eglin Air Force Base	Niceville
Grondzki, Thomas J.	Ocean Reef Golf Course	Florida City
Gruis, Jake	O. M. Scott & Sons	Apopka
Hall, Joe W.	Joe Hall Sod Farm	Clewiston

Name	Affiliation	City
FLORIDA (Cont.)		
Holland, James S., Jr.	Ocean Reef Club	Homestead
Horne, G. C.	University of Florida	Gainesville
Horton, Edward Caron	Sunset Golf & Country Club	St. Petersburg
James, Bryson L.	Hercules Powder Company	Orlando
Johnson, Lawrence	Buckner Industries, Inc.	Jacksonville
Jones, William L.	Standard Sand & Silica Co.	Davenport
Kelly, M. V.	Ocean Reef Club	Key Largo
Lazaroff, Ted	Sara-Bay Country Club	Sarasota
Lover, Norwood G.	Hector Turf & Garden Supply	Miami
Lowe, Joseph C.	San Jose Country Club	Jacksonville
Lunsford, Walter P.	Cultivating Equipment, Inc.	Jacksonville
Mascaro, Charles	2490 N.W. 96th Street	Miami
Nixon, Rufus	Eglin A.F. Base Golf Course	Crestview
Norrie, W. M., Jr.	Scenic Hills Country Club	Pensacola
Ousley, J. E., Jr.	Ousley Sod Company	Pompano Beach
Pearson, C. R.	Lakewood Country Club	St. Petersburg
Perry, Bill	Winter Haven Golf Club	Winter Haven
Pursley, Walter L.	Pursley Grass Company	St. Petersburg
Roy, Grant	Cultivating Equipment, Inc.	Jacksonville
Schmeisser, Hans	6141 Jefferson Avenue	Hollywood
Schmeisser, Otto	Gulf Stream Golf Club	Delray Beach
Shepard, William	Riviera Country Club	Ormond
Smith, Carl K.	Lost Tree Golf Club	Lake Park
Smith, George	Westview Country Club	Miami
Sprogell, Frank T.	Paul E. Allen Company	Dunedin
Todd, Leamon W.	Sebring Golf Clurse	Sebring
Williams, Henry	Riviera Country Club	Ormond
Williams, James	Municipal Golf Club	Daytona Beach
Wilson, John P.	Ocean Reef Golf Club	North Key Largo
GEORGIA		
Anderson, Thomas E.	Flint Valley Farms, Inc.	Decatur
Baldy, Bill	H. G. Hastings Company	Atlanta
Barnhart, George E.	Cherokee Town & Country Club	Atlanta
Bates, W. D.	City of Atlanta	Atlanta
Bauer, A. A.	Berkeley Pump Company	Atlanta
Baumgardner, T. M.	Sea Island Company	Sea Island
Beck, Harley	Henderson Construction Co.	Chamblee
Boswell, Fred W.	City of Atlanta	Atlanta
Boyd, Edward E.	Par 56 Golf Course	Marietta

Name	Affiliation	City
GEORGIA (Cont.)		
Brodie, Bill B.	U.S.D.A. Nematology Investig.	Tifton
Bullock, R. L.	U.S.M.C. Supply Center	Albany
Burton, G. W.	Experiment Station	Tifton
Callicott, P. Duncan	University of Georgia	Athens
Carter, R. L.	Experiment Station	Tifton
Chason, W. B.	Patten Seed Company	Lakeland
Clements, Lee	Experiment Station	Tifton
Cochran, Bin	Johns-Manville Corporation	Atlanta
Cordell, Tom	Abraham Baldwin College	Tifton
Cummins, DavidG.	Georgia Experiment Station	Experiment
Daniel, Graham F.	Russell Daniel Irrigation Co.	Athens
Danner, Charlie	Capital City Country Club	Atlanta
Dorrickson, Max E.	Cherokee Golf & Country Club	Cedartown
Driggers, J. Clyde	Abraham Baldwin College	Tifton
Dudley, Jimmy	Athens Country Club	Athens
Ebright, R. C.	City of Atlanta	Alpharetta
Elder, C. G.	Kiwanis Golf Club	Reynolds
Elsner, J. Earl	University of Georgia	Athens
England, Henry G.	Bobby Jones Golf Club	Atlanta
Evans, Rufus	Dixie Turf Farms	Ty Ty
Evans, Thurlow, Jr.	Stovall and Company	Atlanta
Flanders, C. Dyson	Sea Island Company	Sea Island
Greene, Dan	Evergreen Memorial Park	Atlanta
Greenway, Carlos, Jr.	Landscape Architect	Alma
Hart, Richard H.	Experiment Station	Tifton
Hassell, Grady T.	Lawn and Turf, Inc.	Conyers
Hayden, Harold	Cowan Supply Company	Atlanta
Helm, Marshall S.	American Agri. Chemical Co.	Tucker
Henderson, Robert J.	Henderson Construction Co.	Chamblee
Hinton, Royce "C"	Marietta Country Club	Marietta
Holden, Preston L., III	Vineland Chemical Co., Inc.	Smyrna
Holland, H. R.	Crestwood Golf Club	Athens
Hesterman, J. L.	Third U. S. Army Hq.	Fort McPherson
House, Lee	Glen Arven Country Club	Thomasville
Howell, Dowse B.		Athens
Huston, Willis F.	University of Georgia	Athens
Inglis, Hugh	Ga. Crop Improvement Assn.	Athens
Jensen, Ray	Southern Turf Nurseries	Tifton

Name	Affiliation	City
GEORGIA (Cont.)		
Johnson, Dewey W.	Evans Implement Company	Atlanta
Johnson, Troy	University of Georgia	Athens
Jones, Larry B.	E. I. DuPont Company	Albany
Kincaid, Ed	Evans Implement Company	Atlanta
King, Frank P.	Experiment Station	Tifton
Kraft, Art	Forest Heights Country Club	Statesboro
Lambert, Jimmy	Evans Implement Company	Atlanta
Lambert, Paul W.	Stovall and Company	Atlanta
Land, Sam A.	Lawn and Turf, Inc.	Conyers
Lawrence, Lester	Main Officers Club	Ft. Benning
Lee, Harold E.	City of Atlanta	Atlanta
Legwen, W. A.	Pine Hills Country Club	Cordele
Mafor, J. R.	MCCM	Fort Benning
Mason, Jack D.	Mason's Grass Nursery	Augusta
McConnell, Don	Stovall and Company	Atlanta
McCranie, Baker	McCranie Brothers	Willacoochee
McGowan, D. R.	Southern Turf Services	Folkston
McKendree, Marion	Sea Island Golf Course	St. Simons Island
Moncrief, James B.	U.S. Golf Association	Athens
Moore, Hugh, Sr.	822 Residence Avenue	Albany
Morcock, J. Cooper, Jr.	Allied Chemical Corporation	Atlanta
Murray, D. E.	Valdosta Country Club	Valdosta
Neese, Jack	Country Club of Columbus	Columbus
Newton, J. P.	Georgia Experiment Station	Experiment
Norrie, W. M., Sr.	Idle Hour Country Club	Macon
Norris, Schafe	Athens Cemetery	Athens
O'Donnell, Edwin J.	U. S. Air Force	Savannah
Parker, Ed M	Columbia Nitrogen Corporation	Augusta
Parkman, Sammie B.	Foundation Seeds, Inc.	Athens
Porter, Nook	Berkeley Pump Company	Atlanta
Poss, Bobby	Russell Daniel Irrigation Company	Tifton
Powell, Jerrel B.	Experiment Station	Tifton
Rahaim, M.	Fort Benning Country Club	Fort Benning
Rampley, Kellie C.	City of Atlanta	Atlanta
Roquemore, W. A.	Patten Seed & Turfgrass Company	Lakeland
Savage, Hurley	Augusta Country Club	Augusta
Shields, E. A.	Standard Club	Atlanta
Skinner, Albert	Experiment Station	Tifton
Skinner, R. E.	Russell Daniel Irrigation Company	Athens
Smith, Gerald E.	University of Georgia	Athens

Name	Affiliation	City
GEORGIA (Cont.)		
Smith, Ralph V.	Southland Services	Athens
Sperry, R. F.	American Legion Golf Course	Albany
Stephens, Pauline	Press	Tifton
Thompson, Ashton A.	Ansley Golf Club	Atlanta
Watson, T. W.	City of Atlanta	Atlanta
Wells, Homer D.	Experiment Station	Tifton
Whittle, E. Don	Pine Hill Country Club	Cordele
Williams, Jack	Lawn & Turf, Inc.	Conyers
Williams, Roy L.	Route 1	Trion
Williams, T. G.	University of Georgia	Athens
Willis, Jerry Lee	City of Atlanta	Atlanta
Wilson, Perry	Forest Heights Country Club	Statesboro
Wishum, Bobby G.	Akron Irrigation	Tifton
Wright, Harry	Peachtree Golf Club	Atlanta
Yelverton, John L., Jr.	Akron Irrigation	Tifton
Zink, Harold L.	Armed Forces Golf Course	Augusta
ILLINOIS		
Gates, C. M.	Morton Chemical Company	Woodstock
Walling, Robert E.	Roseman Mower Corporation	Glenview
INDIANA		
Riddell, Homer	Eli Lilly Company	Indianapolis
LOUISIANA		
Bewick, L. F.	Velsicol Chemical Corporation	Monroe
NEW JERSEY		
Jones, Robert Trent	Robert Trent Jones, Inc.	Montclair
Kirby, Ron	Robert Trent Jones, Inc.	Montclair

Name	Affiliation	City
NORTH CAROLINA		
Campbell, Don B.	Cherry Point Golf Course	Cherry Point
Kee, Samuel James	Greenville Golf & Country Club	Greenville
Mabe, Cicero	Oldtown Club	Winston-Salem
Mann, W. E.	Camp Lejune	Camp Lejune
OHIO		
Norton, Douglas	Box 720	Springfield
PENNSYLVANIA		
Gallagher, John	AmChem Products Company	Ambler
Mascaro, Tom	West Point Products Corporation	West Point
SOUTH CAROLINA		
Conser, Paul F.	Velsicol Chemical Corporation	Columbia
McKain, Joe, Jr.	Camden Country Club	Camden
Skeen, James E.	Winyah Bay Country Club	Georgetown
Walls, Carroll E.	E. I. DuPont Company	Columbia
TENNESSEE		
Boyd, Llewellyn	Chattanooga Golf & Country Club	Chattanooga
Thompson, Charles E.	Chattanooga Golf & Country Club	Chattanooga
WISCONSIN		
Noer, O. J.	Robert Trent Jones, Inc.	Milwaukee

NINETEENTH ANNUAL
SOUTHEASTERN TURFGRASS CONFERENCE

Tifton, Georgia
April 12-14, 1965

TOTAL REPRESENTATION FROM EACH STATE:

Alabama	15
Bahama Islands	1
Colorado	1
Florida	42
Georgia	103
Illinois	2
Indiana	1
Louisiana	1
New Jersey	2
North Carolina	4
Ohio	1
Pennsylvania	2
South Carolina	4
Tennessee	2
Wisconsin	1
TOTAL	182