PROCEEDINGS

FOURTEENTH ANNUAL

SOUTHEASTERN TURFGRASS CONFERENCE

GEORGIA COASTAL PLAIN EXPERIMENT STATION
and
ABRAHAM BALDWIN AGRICULTURAL COLLEGE
COOPERATING

TIFTON, GEORGIA

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PROCEEDINGS

Fourteenth Annual

SOUTHEASTERN TURFGRASS CONFERENCE

Tifton, Georgia

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UNIVERSITY OF GEORGIA COASTAL PLAIN EXPERIMENT STATION

In Cooperation With

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and

SOUTHERN GOLF ASSOCIATION

FOREWORD

The Georgia Coastal Plain Experiment Station appreciates the splendid cooperation of organizations like the U. S. Golf Association, the Southern Golf Association, and the many commercial concerns who, by their support, have helped finance what we think is an important part of the station's work. The pleasant and productive relations with many individuals has given a "warmth" to the grass breeding and turf work which has meant much to the staff members of those departments and to the station administration.

We hope that this Fourteenth Conference was successful for each participant. From our standpoint, it was a most inspiring meeting and I am sure will mean much in creating interest in a continually broadening field of turf research. There is much yet to learn. With your continuing help we will make an effort to add, between now and the Fifteenth Conference, a little more information to the field of "good turf and turf management."

Frank P. King, Director
Georgia Coastal Plain Experiment
Station

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THIRTY-FIVE YEARS OF TURF GRASS EXPERIENCE

O. J. Noer
Agronomist, Milwaukee Sewerage Commission, Milwaukee, Wisconsin

Some people become cynical with the passing of time. Pessimism is their approach to every problem, with "can't" or "no" as the answer to any new proposal. Others retain the enthusiasm of youth throughout their lifetime. They are the "do'ers" because they use past experience as the building blocks of the future. Their approach is exemplified by the first six letters in the last word of "turf grass management." The first three should be spelled with large capitals because MAN is the key to success. The next three should be spelled with small capitals because Age enables man to see management in its true perspective. Then the experienced man helps build a better future.

While at Wisconsin, we established fertilizer plots on an old pasture sod at the University farm. Nitrogen, phosphoric acid, and potash were applied liberally--singly and in combination. Clover sprang from nowhere very quickly on the plots receiving muriate of potash alone or in combination with phosphoric acid. Clover is prized in pastures, but is a weed on a golf course. After seeing these plots, one might think potash has no place on a golf course. But there was no clover on an adjoining plot where ammonium sulphate was used in addition at 400 pounds per acre. The logical conclusion of these tests would be to stress the importance of potash and phosphate on pastures to foster clover, but on golf courses emphasis is on nitrogen with only enough phosphate and potash to satisfy turf grass requirements for them.

When Tuckaway and Blue Mound courses were being built, pre-seeding fertilizer trials were established to determine the effects of nitrogen, phosphoric acid, and potash——alone and in combination——upon turf grass establishment. Lime was not used because the silt-loam soils were not acid. Seeding was at 125 pounds per acre with an 80-20 mixture of blue-grass and red top. Potash produced no visible effect. Apparently, the Miami silt loam provided all the potash the seedling grass required. The phosphate furnished 100 pounds of phosphoric acid per acre. Its use provided a surprisingly uniform stand of grass in striking contrast to the sparse growth and bare spots on the check plots. When ground cover is good, there is no problem in developing dense turf. The use of nitrogen in addition at 100 pounds actual nitrogen per acre speeded the development of good quality turf. Seeding at the new Blue Mound course was rather late in the fall. Where nitrogen and phosphate were used, good growth resulted before winter. Winter frosts killed the small seedlings on the unfertilized part of the fairway.

The new Royal Montreal fairways were seeded in the fall and the turf was excellent by June of the next year. Pre-seeding fertilization was at a ton per acre.

These examples show the fallacy of many laymen who believe the heavier the seeding rate, the better the stand of grass. Pre-seeding fertilization with lime, if needed, along with a moderate seeding later, is the secret of uniform grass coverage and quick development of turf.

Weed-free turf was developed on established fairways long before the discovery of selective herbicides. They have been useful tools but will never be the sole answer. Ammonium sulphate was the accepted exclusive source of nitrogen during the acid era of turf grass management. It curbed weeds and grew grass. But finally, soils became too acid even for the acid-tolerant grasses. Sulphate was blamed for the woes of 1928. After that, lime came back into favor and other nitrogen sources became popular.

When fairway watering started, its function was not understood. Club officials thought it the sole answer to good turf. Weeds and clover increased as the bluegrass and fescue began to disappear. At clubs like the Milwaukee Country Club, where some bent seed was used in the original seed mixture, fertilizer alone developed a dense turf which resisted invasion by knotweed and clover. In the absence of bentgrass, Poa annua, clover, and knotweed flourished. There was no solution until the discovery of selective herbicides.

White grubs destroyed all the turf on golf courses in the Philadelphia district soon after the Japanese beetle appeared there. It looked like the end of golf. B. D. Leach was assigned the task of finding a way to kill the grubs without destroying the turf. He developed the lead-arsenate treatment. There was less crabgrass, chickweed, etc. on lead-arsenate-treated plots. Because of this, Leach suggested at one of the Green Section meetings that lead arsenate was the way to control weeds. His statement aroused the interest of Dr. John Monteith, Jr., the Director of the Green Section, who assigned the task to Fred Grau.

Chlorates were tried first and a method was developed for using them. The fire hazard and the narrow safety margin on grass prevented their widespread use. Of all the other materials tested, arsenic acid and sodium arsenite proved best.

The Green Section progress report on selective weed control aroused the interest of Mr. Evan Begg, the Chairman, and of Horace Purdy, the Superintendent, at the Toronto Golf and Country Club. They made a special trip to Washington and were so impressed with what they saw that they embarked on a fairway weed-control program. The combination of arsenic-acid spraying and fertilization produced fine fairway turf, the equal of anything on this continent.

In the Chicago area, sodium arsenite was used effectively to rid roughs of dandelion, plantain, and buckhorn. The 8- to 12-pound rate discolored bluegrass severely, but it recovered. Spraying three to four times was necessary to obtain a satisfactory kill. The interval between sprayings was governed by weed recovery. New leaf growth was destroyed by spraying when they were 1 to $1\frac{1}{2}$ inches long. Death of weeds occurred when the supply of stored food reserves was depleted to the point where there was nothing left for the formation of next leaves.

Severe discoloration limited the use of arsenicals, especially on fairways containing a high proportion of good turf grasses. Tests were started in Milwaukee to compare the liquid and dry methods of treatment. It was necessary to use a carrier like Milorganite which would prevent sodium arsenite from absorbing atmospheric moisture. It is hygroscopic, like calcium chloride. The sodium arsenite was ground exceedingly fine and an additional drying agent was added.

Milarsenite was used widely and looked like the best answer to the problem of weed control, especially broadleaf weeds, knot or iron weed, chickweed, and clover.

Brynwood, in Milwaukee, was a good example of weed control and turf grass improvement on unwatered fairways where Kentucky bluegrass was the basic turf grass. The method was tested on one fairway first. Then the program was extended to cover the entire course. Milarsenite was applied twice in late summer or early fall at 400 pounds per acre each time along with 1,200 pounds per acre of additional Milorganite. They waited for fall rains before starting. The sodium arsenite eliminated weeds and the fertilizer created a dense turf of Kentucky bluegrass. Lately, fairways have been fertilized in the early fall and again at a slightly lower rate during the last half of June because some rain falls by early July. A little 2,4,5-T has been used in June to check clover. These unwatered fairways stay green all season in a normal summer. Even in a dry season, turf is off color for a few weeks only.

Sodium arsenite, fertilizer, and seed have been useful tools in the renovation of watered fairways on courses where bluegrass and fescue disappeared because of close cutting and heavy watering. At first, sodium arsenite or Milarsenite was used three to four times during late July and August at 7- to 10-day intervals. Seeding was with bentgrass at rather light rates just before the last treatment of sodium arsenite.

Dave Bell, at St. Clair Country Club in Pittsburgh, did everything in a big way. He sprayed one fairway with sodium arsenite at 30 pounds per acre in late August. About a week later, he used bent seed at 100 pounds per acre and sprayed again immediately with sodium arsenite at 5 pounds per acre. This method was so good that all fairways were renovated.

More recent renovation starts with 2,4-D and 2,4,5-T in June to control broadleaf weeds and clover. Then sodium arsenite is used at the heavy rate in late August, followed by seeding with bent (usually a mixture of 40% Astoria, 40% Highland, and 20% Seaside) at 80 to 100 pounds per acre, or with Merion Kentucky bluegrass at 40 to 80 pounds per acre. The fairways are fertilized, aerified, and spike-disked before seeding and sodium arsenite is used again at about 5 pounds per acre right after seeding.

The discovery of 2,4-D was heralded as the final answer to weed control. It worked well on broadleaf weeds, but not on clover, chickweed, or knotweed after the seedling stage. Spraying once was enough instead of the three or four sprayings required with sodium arsenite. Then came 2,4,5-T for clover, and now 2,4,5-TP is said to be the answer for chickweed.

After seeding the first 2,4-D test plots on a visit to Washington, D.C., similar trials were started along the edge of a fairway at the Milwaukee Country Club. Part of the plot was fairway turf and part rough. There was no injury in the rough, but discoloration to the closely cut bent fairway turf was enough to deter Booterbaugh from over-all spraying of fairways. He spot-treated the occasional broadleaf weeds. Sodium arsenite has been used to control chickweed except one fall after Booterbaugh left the Club. The then Chairman insisted on spraying the fairways in the fall two times to control chickweed. Damage to the bentgrass was severe and control of chickweed was unsatisfactory.

When players at the Milwaukee Country Club started to complain about the yarrow in the rough, there was no good control method. A start was made with sodium arsenite. Good kill was secured by spraying four times in the fall and twice more in the spring. Then we were told about 2,4,5-TP. Excellent control of yarrow was obtained with one spray at $1\frac{1}{2}$ pounds actual per acre. Bluegrass was discolored but recovered. Damage to bent on fairway plots was severe to the point where some was killed.

Chickweed kill is said to be excellent with 2,4,5-TP. In view of the damage to bent at Milwaukee, it would be wise to make limited test applications before embarking on wholesale treatments.

Toward the end of the acid era in turf management, the value of an acid soil was questioned. Joe Valentine used some hydrated lime on one-half of the Washington bentgrass nursery at Merion Country Club. The effect was striking where there was a severe attack of dollarspot several weeks later. There was no disease on the limed portion of the plot. Lime has never been called a fungicide. The benefit from its use was secondary. The sturdier grass was able to resist the disease.

On a June-day visit to a club in Boston, there was a narrow green strip of turf in the rough around each green. Weather had been dry for about three weeks. When the National Open Golf Tournament was played on the course 20 years before to the month, lime was used to show spectators where they were to stop. Benefits persisted for 20 years on a soil testing in the range of pH 5.0 to 5.5.

Disease has been associated with fertilization, especially nitrogen. Overdoing nitrogen was blamed for the severe attack of all diseases. This proved true of brown patch, and snow mold especially with late fall nitrogen use. Those who starved greens had less brown patch but were plagued with dollarspot. Fungicides were not too effective. By the wise use of nitrogen, disease is reduced and can be controlled with lighter fungicide doses.

Clover became a serious problem on greens where grass was deprived of nitrogen in a vain attempt to lessen disease. Chemical control seemed like the solution to some. Increased turf density by nitrogen feeding proved to be the better answer.

Leaf spot played havoc with the greens at a Buffalo country club in a space of several hours. Actidione and PMAS were used on part of two greens without benefit. Leaf spot was secondary and not the primary cause. The soil was strongly acid and low in magnesium and potassium. Also, the turf was badly thatched. Dolomitic lime was used and the fertilizer program was modified to include the use of some potash along with cross-aerifying and Verti-cutting. Leaf spot ceased to be a real problem and fungicides gave a good account of themselves.

Iron chlorosis has been, and is becoming more, troublesome. Much of the so-called "scald" may have had its start from iron chlorosis. The sickly yellow leaves fall prey to leaf spot and related diseases. Overwetness, high content of organic matter, an alkaline reaction along with high phosphorus levels--alone or in combination--are associated with iron chlorosis. Turf loss can be prevented by the prompt use of iron sulphate (copperas) at the first sign of sickly yellow color. The secret is to deposit the iron sulphate on the leaf and not wash it into the soil. Burning will not occur with 2 ounces iron sulphate per 1,000 square feet. The amount of spray water should not exceed 5 gallons per 1,000 square feet.

The plot of Piper Velvet bent at the Arlington Turf Garden collapsed suddenly in mid-summer one year. The loss was puzzling at the time. It was iron chlorosis, in all probability, at a time when nobody recognized it. Velvet is one of the first to suffer from iron chlorosis.

Opinions differ about the best kind of soil for greens. Currently up to 85% sand is being recommended. Unquestionably too little sand has been used in the past, but the pendulum may have gone too far in the sand direction. A mixture by volume of two to three parts sand, one part good loam soil, and one part fibrous humus should prove satisfactory.

A uniform soil profile is very important. Imbedded layers of sand, peat, or clay are bound to cause trouble. Conditions for growth can be improved by cross-aerifying and top-dressing with the right soil mixture. The best plan is to build the right kind of soil. Attempts to modify soil texture by dressings of pure sand or peat are mistakes.

Excessive surface thatch is a development of recent years. Infrequent mowing and discontinuance of top-dressing have favored thatch development. Light applications of lime, increased use of nitrogen, along with cross-aerifying and Verti-cutting have been the best way to reduce thatch. Top-dressing should be resumed when it will make contact with the soil. Control by top-dressing alone will not succeed if applied on top of thick thatch. By burying the thatch, it may make matters worse.

Warm-season grasses did not receive much attention in the early days. Hall, at Savannah, and Hoerger, in Miami Beach, were among the first to search for better bermudagrasses. U-3 is said to have been one of Hall's selections. Gene Tift was a finer-textured bermuda in the Hoerger turf-grass nursery.

Real progress dates back to the start at Tifton. This pioneer Southern Station has been responsible for the development of many good bermudagrass strains. Outstanding work with other grasses, fertilizers, and turf-grass diseases are additional Tifton accomplishments.

Florida and Texas have started turf-grass work, and other states have taken an interest in the problems associated with turf-grass management, so there is a bright future everywhere in the South.

Weed control has prospered, especially on Southern golf courses. Crabgrass and dallisgrass have succumbed to sodium arsenite or disodium methylarsonate alone or in combination with 2,4-D. Success has been a matter of checking these weeds and fostering growth of bermudagrass with lime, if needed, and then an adequate fertilizer program.

Lately, pre-emergence weed control has been advocated. The practice seems questionable when crabgrass and other weeds are the main or sole ground cover. The better way is to wait for summer, check the crabgrass, and grow bermuda. Then when there is a good cover of bermuda, pre-emergence control may be feasible.

Through the years, it has been my good fortune to attend and participate in many turf-grass conferences. At the start, attendance was with a selfish motive because it is the best way to learn of developments in the turf-grass field. In the early days, it was simple because the Green Section plots at Arlington, Virginia, were the only ones devoted to fine turf grasses. At least a full day was spent there two or three times a year. Now, there are turf-grass investigations in many places. This means progress at an accelerated rate.

Nobody should abandon a program which is successful. The wise man tests a new development in a limited way first. Then he fits it into his program if results justify.

Although I retire on June 1, 1960, my interest in turf grass will not cease. I hope to keep my contacts with you in one way or another. In closing, I wish to thank each and everyone of you for the many nice things you have done for me through the years. I am grateful for the things you have taught me, especially in the field of practical grass management.

AVOIDING BUILT-IN HEADACHES

Fred V. Grau
Agronomist, Hercules Powder Company

This topic is being presented in capsule form so that each person participating may fill in details according to his experience and training. The subject is applied here to golf courses, but the principles involved are valid for any turf-grass installation.

In order to accent the positive, the subject might have been listed as "Providing Build-In Maintenance." Industrial and Engineering Chemistry for April, 1959, carried this note: "When you DESIGN a new plant or REVISE an existing layout, see that it provides adequate maintenance facilities". This referred to chemical plant installations, but the principle is identical with golf course installations.

The Roanoke (Virginia) Times for May 6, 1959, carried this statement by W. S. G. Britton, Assistant Maintenance Engineer for the Virginia Department of Highways, "We must plant our highways with built-in maintenance." The parallel with golf courses is obvious.

Built-in headaches are "Conditions created during construction which make effective maintenance difficult or impossible."

The reasons for this presentation are the many golf courses, some of them quite new, that are constant sources of dissatisfaction and irritation to owners and members, and especially to the golf course superintendents who are expected to maintain them in peak condition against impossible odds. The feeling is widespread and there is a firm conviction that if the efforts of PLANNERS, ARCHITECTS, BUILDERS, AND GOLF COURSE SUPERINTENDENTS could be coordinated and integrated, golf courses could be built at no additional cost with built-in maintenance features. The true beneficiaries of the easy-to-maintain courses are the golfers. The ill-conceived and poorly built course demands constant "fussing" and "wet nursing", which interferes with golf to an unwarranted extent. Maintenance of the well-built course becomes routine and interruption of golf is at a minimum.

At the Mid-Atlantic Turfgrass Conference in Baltimore in January, a panel of five superintendents (Gumm, Sappenfield, Lamp, Burt ____, Yingling ____,) laid it on the line concerning built-in headaches. At the G.C.S.A. Conference in Houston, the panel of Architect Cobb and Superintendents Bidwell and Danner wasted neither time nor words in spelling out the headaches to avoid. It was my good fortune to have been moderator of both panels, thereby accumulating valuable guides which are being passed on to you. James E. Thomas, President of G.C.S.A., had a great deal to do with arranging both sessions, aided and abetted by George Cobb. It is hoped that G.C.S.A. may prepare and publish a guide to Built-In Maintenance. It is needed.

Summary of headaches to avoid:

1. Sketchy planning - lack of attention to details.
2. Poor design, not suited to site nor to expected play or the players who will use course.
3. Impractical, outdated, and unrealistic specifications.
4. Insufficient funds allotted for doing the job right the first time, which leads to cutting corners.

5. Failure to have qualified superintendent on job, with authority, to assist in writing specs, supervising construction, and protecting club's interests.

6. Being in too big a hurry to open, not giving full time for soil to settle and turf to mature.

7. Failure to provide adequately for integration of all phases of drainage - air, surface, internal, sub-surface. To neglect any one phase is to nullify the others. Dumping all surface water onto a narrow approach where traffic concentrates is a serious error.

8. Attempting to achieve uniform blending of materials on the site. Agreement is virtually unanimous in favor of off-site mixing.

9. Shallow soil. Robbing of topsoil from approaches and fairways is false economy. Too much organic matter in soil.

10. Abrupt grade changes, necessitating heavy expense for hand maintenance. Long, smooth, flowing lines for maximum use of mechanical equipment are best.

11. Lack of space - for cupping area, for turning mowers, for operating machinery between green edge and bunker, for cart traffic, for foot traffic on and off, for tee-marker changes.

12. Inadequate seedbed fertilization. It is false economy to make light applications of readily-available fertilizers that are gone before the turf is well established.

13. Water system not in operation before grass is planted.

14. Excessive seeding rates. Reports of doubtful performance of Penncross bent have been traced to seeding rates of 4 to 6 pounds to 1,000 square feet. One-half to 1 pound is ample.

15. Too much temporary work to get course in play - fast. Best plan is - Do it right the first time! Superior perennial grasses are economical to plant and maintain.

16. No nursery.

17. Hidden Horrors - Using stumps and rocks to fill gullies as a base for greens and tees is unsound practice.

18. Guessing on pH and nutrient levels. Soil-testing services are available.

19. Tees elevated the wrong way and tile lines installed with no outlets.

20. Failure to secure competent personnel in all phases of planning, design, construction, and maintenance.

All right, you say, we know all that. You've told us nothing new. How come then all greens on a new course have to be rebuilt a year after opening? The superintendent is blamed for not knowing his job. But knowing the competence of the superintendent and knowing how the greens were built, responsibility rests upon those who designed and built the course. The lessons "learned" were ineffective because subsequent courses have the same built-in headaches. Apparently the "truth" is not reaching owners and building committees of country clubs who give approval to plans and designs without knowing whether or not they are realistic.

We have before us a real challenge to integrate all phases of putting a new golf course into play, minus the built-in headaches with which we are too painfully acquainted. It would appear that golf-course superintendents are in a key position to bring about a sensible resolution of difficulties.

It would appear that a printed guide for achieving built-in maintenance will have universal enthusiastic acceptance by PLANNERS, DESIGNERS, ARCHITECTS, BUILDERS, AND SUPERINTENDENTS.

PRINCIPLES OF IRRIGATION

George N. Sparrow
Agricultural Engineer, Soil and Water Conservation Research Division, Agricultural Research Service, USDA and the Georgia Coastal Plain Experiment Station, Tifton, Georgia.

Irrigation is man's method of supplying moisture to the soil for plant growth from a water supply available to him when the weather has failed to provide adequate rainfall. Sprinkler irrigation is one of the more favored modern devices because it is adaptable to almost any set of circumstances and because of the ease by which rates and amounts of water application can be controlled. Certain principles apply to sprinkler irrigation, as to any other method. Since pumping and other costs are normally involved in sprinkler irrigation, demands for water must be met with as much efficiency as possible.

Both the plants that are to be irrigated and the soil in which they are grown are major factors to be considered in irrigating. Irrigation is efficiently applied when plants are experiencing moderate moisture shortage and when as much water is supplied as the soil will retain to the depth of plant roots. Such irrigations minimize the required frequency of application, meet plant demands for water, encourage good root development, minimize water wastage, and keep costs under reasonable control.

Unfortunately, ideal and somewhat theoretical principles of irrigation cannot be met with accuracy. The aim in irrigation is to approach an ideal scheme of supplying and maintaining optimum soil moisture for plant growth. In so doing, both under-irrigating and over-irrigating are to be avoided and irrigations are to be kept as infrequent as is practical.

Soil moisture is lost by plant transpiration and by evaporation from the soil surface. Soil water must be replaced, if plants are to remain vigorous, before moisture has been reduced to damaging levels. Although devices are available for determining soil moistures, they usually require careful attention. Observations of plants will normally serve as a satisfactory gauge of their need for moisture. When wilting of plants becomes evident, water is usually needed. It may be assumed then that the water available to the plants is equivalent to not more than half the available water-holding capacity of the soil.

Available water-holding capacity is that amount of water which a given soil will hold in approximate equilibrium with the force of gravity, above the permanent wilting point, to any specified depth. Water which is not held in place by surface tension to soil particles will drain on down to lower levels. The permanent wilting point is that low level of soil moisture at or below which the forces involved in plant osmosis can no longer extract moisture. In this case, the films of water around soil particles are so thin and are held so tightly in place that the water is not available to plants.

Because there is less area of surface of the soil particles in a light soil than in heavier ones, the water-holding capacity of light, sandy soils is much lower than that of the heavier clay loams. A sandy soil may hold only 1 inch or less of available water per foot of depth. A clay loam, on the other hand, may have a water-holding capacity of as much as 3 inches of water per foot of depth. So irrigations need to be provided more frequently during dry periods on the lighter soils than on the heavier ones.

The rooting depth of plants controls the zone of concern with water-holding capacity. Rooting depths are difficult to determine. If a grass sod is carefully excavated, some indication of rooting depth can be ascertained by measurement. However, tiny hair roots often extend a considerable and unknown distance below the visual rooting. Hair roots are usually broken off in excavating. Root depths are, therefore, usually estimated, frequently on the basis of knowledge of the plant specialist. Soil structure and the existence of restrictive layers, such as hard pans or plow soles, affect and sometimes deflect plant roots.

When a reasonably accurate determination of the depth of plant roots has been made, possible water storage in that zone may be considered as constituting the maximum water ever available to the plants at any one time. Irrigations should replenish the storage to its stable capacity. Under-irrigating replenishes only the upper portion of the zone, thus encouraging shallow root development and resulting in proportionately higher losses by surface evaporation. Over-irrigating causes downward movement of excess water beyond the point of plant usage and may result in losses of fertilizers carried in solution.

In a hypothetical problem, let it be assumed that plant roots go to a depth of 18 inches and that the soil is a sandy loam with an available water-holding capacity of 1.6 inches per foot of depth. Further assuming that slight wilt of the plants indicates that half of the available water has been lost to transpiration and evaporation, then half of the 2.4 inches of water-holding capacity in the root zone, or 1.2 inches of water, must be applied to the soil by irrigation. But some of the water applied by sprinkler is lost by drift, evaporation, and other means before it reaches the soil. Often a factor of 75% efficiency is applied to cover possible losses. In that case, the total amount of water which would be distributed during the irrigation should be 1.6 inches.

The type of soil and its vegetative cover control the rate of infiltration of irrigation water into the soil and the rate of its passage downward through the soil. Permanent grass sod encourages higher rates of infiltration and downward passage (permeability). In very light, sandy soils with sod cover, water may be applied safely without runoff losses as rapidly as 1 inch per hour, while clay loam soils may not take up water at more than $\frac{1}{4}$ inch per hour. However, the rate at which soil takes up water at the beginning of irrigation is not necessarily the rate it will absorb water later in the irrigation. There may be changes in soil structure with depth, which will slow down absorptive rates as irrigation progresses. If absorption slows down, then the later rate should control the rapidity of application.

Organic material—in the form of vegetative residues, peat moss, manure, et al—incorporated into the soil increases initially the rate at which a soil will take up water to the depth of the incorporation. Such a practice may be desirable in the establishment of a grass sod. However, such organic materials disintegrate by bacterial action and oxidation processes quite rapidly in warm, humid climates. Perennial sods tend to replace the losses by disintegration through the medium of natural root attrition and of plant disposition of dead leafage. It is doubtful that surface applied organic material on a perennial sod materially increases water-holding capacities except through possible beneficial effects on the growth and vigor of the grass.

In summary, an efficient irrigation system should be so designed that it will (1) apply water rapidly but not in excess of the absorptive capacity of the soil, (2) cover adequately the entire surface being irrigated, (3) have the capability of completing an irrigation before plants suffer materially from shortage of moisture, and (4) have controlled water pressure from a reliable source of water.

Panel Discussion on

GOLF-COURSE MAINTENANCE

Mr. James Moncrief, Discussion Leader
Southeastern Agronomist, U.S. Golf Association Green Section, Athens, Ga.

The last 10 to 15 years has been more toward full mechanization of golf-course maintenance, especially so where the job can be accomplished economically. Due to the cost and competition of labor, many golf courses have been forced to invest in good equipment. This has also caused the golf-course architects to pay more attention to the maintenance cost when constructing a golf course.

More golf courses are having chemical analyses run on their soils in the past five years. This should be, as there are more golf courses now than five years ago. In most cases, however, where chemical analyses are being made on soils from greens, a reading of insufficient potash is the usual result. Where bermudas are used, the following fertilization program has given excellent results:

Fertilizer for greens should provide nitrogen (N), phosphorus (P_2O_5), and potash (K_2O) in the ratio of 3-1-2. Use 2 pounds of nitrogen per 1,000 square feet per month on bermudagrass in hot weather and 1 pound per month during cool months, when the greens have been overseeded with cool-season grasses. This practice will provide about 18 pounds of N per 1,000 square feet per year.

If the 3-1-2 ratio of materials is used, you will apply 6 pounds of P_2O_5 and 12 pounds of K_2O. These nutrients do not leach readily and may be applied in spring and fall when weather is cool.

Some superintendents add a little potash during the summer months. Amounts up to ½ pound of muriate of potash (60% K_2O) per 1,000 square feet may be applied during the summer if it is watered-in promptly.

There has been much discussion on top-dressing of the greens. There is definitely a need in top-dressing of the greens where a good putting surface and healthy grass is required. The top-dressing material should be sterilized to eliminate weed seed and other undesirable pests. Many people have the idea that good soil mixtures are only for bent greens. Good soil mixtures are desirable for better growth of bermudagrass. Also, the construction of the green is very important and the following 6 steps have been giving excellent results:

1. Contour the subgrade just as the finished surface will be contoured. The base will be about 14 inches below the putting surface.
2. Lay 4-inch tile in a suitable pattern on the subgrade 10 feet apart to intercept the water in shallow trenches 8 inches deep. The soil from these trenches may be spread out between the trenches evenly so no pockets will be formed. You may lay the tile in a herringbone design. This allows the laterals to run into main lines which takes the water out and away from the greens. The drainage outlet should not be in front of the green.
3. Place a 2-inch layer of clean gravel (approximately ¼ inch aggregate) under the tile and then cover it completely. This layer of gravel should average about 4 inches thick, though it will be thicker over the trenches in which the tile is laid.

4. Place a layer of coarse sand about $1\frac{1}{2}$ inches thick over the gravel. This will keep the soil from working down into the gravel.
5. Add 10 to 12 inches of topsoil mixture. After settling, it should be thick enough to allow a cup to be set without cutting into the sub-drainage. This soil mixture should be a desirable mixture of sand, soil, and peat. This is one of the most important steps you make in building a green. The wrong proportions and you will make a "road surface".
6. Fumigate the soil after it is in place on the greens, using methyl bromide or Vapam. Follow the company's recommended rates of application and time before planting.

There has been much progress made in soil mixtures for greens in the past five years. It would pay anyone building a golf-course green to have a physical analysis run on their soil, sand, and organic matter. In this manner, you would know what proportion of each to mix for the best growth from your source of material. The physical analysis takes more of the guesswork out of what proportions to mix for a green. How the physical analysis performs will depend on the uniform mixing at the golf course. Much responsibility here is on the golf-course personnel. It is advisable to mix off the green site and haul to the green after thorough mixing.

We need to consider the cultivation of our greens more than we have in the past. As our population increases, we will have more golfers. This increase in traffic will cause compaction, which has been and still is a big problem. Frequent moving of the cup will help a great deal but a weekly spiking of the green has helped a great deal where excess traffic is experienced. A good aeration in the spring and early fall is a must.

To have a healthy turf at all times, we must have a good turf-management program 12 months of the year.

GOLF-COURSE MAINTENANCE
on

Fairways

Mr. Everitt Shields
Capital City Club, Atlanta, Georgia

It is my hope that my remarks regarding some of my fairway-maintenance problems and practices will be beneficial to you in some way on your turfed areas. My methods, failures, or successes do not guarantee you a succesful operation; however, it is my sincere hope that a discussion of these methods and experiences will prove to be thought-provoking.

Fairway fertilization, aerating, mowing, weed programs, and insect-control programs are individual problems. Each of you will have a different set of circumstances. Availability of money, too, often determines what and how something is done. When monies are appropriated, it is our responsibility to know what to do and how to do the job as economically and rapidly as possible with a minimum of inconvenience to the membership. It has always helped me to experiment, keep records, and be able to show results which I hope to sell to my Chairman. Be reasonably sure that you know what you are talking about, especially about the money required.

My fairway-fertilization program varies with what I think my grasses need. It has been my practice for many years to use a complete fertilizer as soon as I get a reasonable showing of bermuda in the spring. I prefer to apply this fertilizer to dew-covered plants, usually at 500 pounds per acre. True, I get a burn on the bermuda, but I also kill out many winter weeds, especially Poa annua. It is my theory that the burn on the bermuda shocks or awakens the plants to a much faster lateral growth when the plants start absorbing the nutrients. I know many of you will not subscribe to these thoughts, but be curious and try it experimentally, anyway. If I use organic on my fairways, I usually apply this after the grasses have recovered from the initial burning. It is my thought that in so doing, the organic response is better, owing to the P and K near the surface. My rate here is from 200 to 300 pounds per acre. I like to supplement organic feedings to weak turf areas, cart paths, and always to seedings or vegetative plantings of bermuda. I prefer my nitrate feedings, if used, as soon after Labor Day as practical. This is the only fairway fertilization that is watered in. It is my observation that fairway turf will hold up better in a moderately acid soil. A pH of 6 seems to give me a more uniform growth with the more desirable color for fairways and tees in my type of soil. I plan to spray my fairways this summer with iron sulfate and hope I can attain and keep the desired color with a minimum of growth. Experimentally, my tests looked good. Aldrin, mixed with complete fertilizer, did a good job for me last year at 3 pounds actual per acre.

The only reason I can think of for my being on the program this year is that Jim Latham would like to hear more about my crowfoot troubles. We had so much crowfoot on our fairways in the spring of 1958 that it was suggested that we sodium-arsenite them heavily enough to kill off all the vegetation and re-sow to bermuda. This would have been folly, as we would have killed only the germinated plants, and with my Club, I would have had to leave. You would have had to see my fairways in the spring of 1958 and again in the fall of 1959 to fully appreciate the job we were able to do.

In the summer of 1957, a series of tests were run at my Club. From these tests and from many, many talks I had with people whose advice I respect and other sympathetic souls who would listen to my problems, and from reading results of research, I decided on a program for 1958 which was sold to my Chairman. Fairways had never been sprayed at the Capital City Country Club, so this venture was going to cause a lot of comment. I did everything as near to recommended specifications as possible. We had a bad break on the weather, as there were 23 days in July on which it rained.

Our 1958 weed-control program was started June 23. We made 6 complete trips over approximately 65 acres of fairways by August 5. The first two trips were straight DSMA at 1 gallon per acre with the recommended sticker. The next four trips were DSMA and 2,4-D (40% amine) plus sticker at the recommended rates, which were varied from 1 to 1 1/3 gallons per acre on the DSMA, the 2,4-D from 16 ounces to 32 ounces per acre, water rate 70 gallons per acre. Our weeds were killed out and our bermuda's tolerance was severely tested. My fairways looked like I had had a killing frost on them from July to the middle of August. Fortunately, we were able to fertilize and water enough to put our fairways away in reasonably good shape in 1958. However, as our bermuda came back, so did the crowfoot, which seeded before frost. This meant 1959 was going to be another one of those years — and it was!

Our 1959 program was started June 4. We made 3 complete trips over our entire fairways with DSMA, 2,4-D (40% amine) plus the sticker, 49 gallons per acre of water, by June 16. Rates of DSMA were 1 to $1\frac{1}{4}$ gallons per acre and 16 to 32 ounces of 2,4-D per acre. I again solicited the most competent advice I could get for this operation, in fact, this time I got it in writing. On June 16, it appeared that we had eliminated 95% of our fairway weeds with a minimum of discoloration in our bermudas. I thought I had it made but on about June 20, we had a nice shower and before July 1, we had more crowfoot than we had originally. These were newly germinating plants; very few of the original plants survived. I tried spot-fertilizing on the wet grass and was able to kill a lot of the small plants. After the dew was gone, the men on this job were given 1 x 4 x 4 foot boards to push up heavily infested areas. Crowfoot triumphed. By July 15, we were having trouble mowing these weeds. In desperation, I decided to try some more experiments. I made several tests with the 5 accepted herbicides at different rates and combinations over the next two weeks. These tests made me brave enough to go back to straight 2,4-D.

By July 30, I had evaluated my findings and had approval to try once again to get rid of the crowfoot. My rate was to be 16 ounces of 2,4-D (40% amine) plus sticker to 89 gallons of water per acre. On July 31, we were able to mow the brittled crowfoot by going over just one time. Inspection indicated that the brittling had gone to the crown of the plant which, in turn, called for a roughing up, or dragging. I improvised a drag with a 9-foot section of cyclone fence, to which I later added two of the 6-foot drag mats. We matted and mowed until frost, trying in every way we could think of to get the crowfoot drug up and clipped off, which is the secret of the operation. This operation is to be expanded in 1960, as it is much cheaper with less injury to our bermudas. Most of our fairways were given the above rate of spray by August 10. With our last treatment on August 20 and 21, most of our fairways were re-sprayed but the 2,4-D rate was cut to 8 ounces - 89 gallons of water per acre. We had continued success in getting the crowfoot. I know these rates seem very light and possibly the residium from previous sprayings in 1958-59 was partly responsible and yet, this does not make sense, as we were killing new plants, so I don't know what the answer is for sure. We did not have any discoloration on our bermudas, not even on seedlings.

My conclusion from my 1958-59 work is that DSMA does a good job of eradicating crabgrass and dallisgrass, two pests that have plagued us for many years. I do not plan to use it for crowfoot though because it is too expensive. If your fairways have assorted weeds, DSMA plus 2,4-D, plus a sticker is your logical choice. Although 2,4-D is a dangerous herbicide to handle, it still has many advantages as a crowfoot killer. We all should know that temperature, humidity, age of plants, plant fertility, moisture content of the soil, and height of mowing are determining factors in the amount of material to use. Your spray equipment should be calibrated to minimize the possibility of any excessive burning. All of my sprayings were at 400 pounds pressure. My boom was reduced to five T-jets, which gave me a spray pattern of 10 feet and helped eliminate overlaps and skips. Our chemical manufacturers and spray-equipment manufacturers should get together and exchange ideas whereby both can do a better job for their users. There is no reason why we cannot get a better sprayer for our golf courses. The only reason for tolerating crabgrass and dallisgrass now is that monies are not made available for the purchase of equipment and materials for eradication. It is my hope that soon we will have a herbicide that will help us to control crowfoot. The pre-emergence TAT-42 sounds like a move in the right direction; however, here again, more experimenting must be done by the golf-course superintendent. Our maintenance requirements differ too much with those of an experiment station. From my experience with crowfoot, it is my conviction that we need a herbicide that will stop the plants from seeding or, better still, if the plant completes its cycle, produce a sterile seed. Light sprayings of 2,4-D would make mowing possible.

In closing, let me thank you for hearing me out. I hope that I am not the only one having troubles but if I am, you can at least have the satisfaction of knowing that we are making progress in our fight. For any success I have achieved as a superintendent, I am indebted to many turf-conscious friends. My Chairman and membership have respected my judgement and efforts. To continue our collective education in our profession, we must continue to exchange experiences and ideas. It has been a pleasure to address you.

GOLF-COURSE MAINTENANCE

The Transition Period in Bermuda-Ryegrass Greens

Mr. Palmer Maples, Jr.
Charlotte Country Club, Charlotte, North Carolina

Preparation to Plant Rye

Spike, Verti-cut, and topdress about 3 to 4 weeks before actual date of planting. Fertilize this early operation with P and K and lime, if needed. A lack of N will help to slow the bermuda down and give the rye, when planted, a better chance. Too, this early operation will give the spike holes time to heal over so the rye won't come up in the holes. Also, a heavy Verti-cutting to remove thatch can be countered some by the topdressing.

At the time of planting, the green should be Verti-cut again to whip up the previous topdressing somewhat and help to provide a better seedbed. The seed should be planted, another light topdressing applied, and then it helps to set seed by rolling with an empty roller. Wait as long after the seed germinate to cut as possible and then cut at 3/8 to 1/2 inch.

If diseases are a big problem, fungicide applications could be started while rye is getting a start, then apply as needed in the regular manner.

On greens where the green edges are a problem — grass thin to no grass — extra spiking and extra seed may help and possibly circling the green every other day should improve the situation.

After rye has been in for 3 to 4 weeks, applications of N can be made.

Transition Period

This is the time to get the bermuda back. I don't believe in shock treatments or taking rye out all at one time. At the first indication of any leaves on the bermuda is the time to start spiking or doing some sort of cultivation to encourage bermuda as much as possible. A disk-spiker is an excellent machine--with this, a green can be spiked and cut and there is little evidence of it. This spiking helps compaction and provides passages for air, water, and nutrients to the root zone of the bermuda. When the bermuda is coming in good, Verti-cutting the rye will help to thin it out. This combination of spiking and Verti-cutting with fertilization will help bring in the bermuda.

Summer Care

1. Keep the supply of nutrients available.
2. Watch water.
3. Control insects and diseases.
4. Topdress and Verti-cut to get the most leaves.

Summary

FOURTEENTH ANNUAL SOUTHEASTERN TURFGRASS CONFERENCE

Tifton, Georgia
April 11-13, 1960

TOTAL REPRESENTATION FROM EACH STATE:

Alabama	15
California	1
Delaware	1
Florida	26
Georgia	61
Kentucky	1
New Jersey	2
New York	2
North Carolina	10
Oklahoma	1
Pennsylvania	2
Puerto Rico	1
South Carolina	7
Tennessee	3
Virginia	1
Wisconsin	1
TOTAL	135

ATTENDANCE ROSTER

Name	Affiliation	City
ALABAMA		
Anderton, Wayne J.	Yielding Brothers Company	Birmingham
Berdeaux, C. G.	Box 500, Montevallo Rd., S.W.	Birmingham
Dugger, Robert Barr	Dugger's Grass Farms	Tuscumbia
Gilliland, Gordan	Yielding Brothers Company	Birmingham
Godwin, George E.	Dothan Country Club	Dothan
Hartwig, Lester H.	Amchem Products, Inc.	Union Springs
Kennedy, W. T.	Montgomery Country Club	Montgomery
Lang, J.D. Boots	Skyline Country Club	Mobile
Lawrence, M/Sgt. G.D.	Maxwell Golf Course	Maxwell Field
Ledbetter, Gene	Coosa Pines Golf Course	Coosa Pines
Metcalf, Herbert J.	Herb Metcalf Company	Dothan
Nordan, William W.	Nordan's Grass Farms	Abbeville
Norrie, Bill, Jr.	Mobile Country Club	Mobile
Roberts, James D.	Yielding Brothers Company	Birmingham
Sturkie, D. G.	Auburn University	Auburn
CALIFORNIA		
Clock, John	Vice President, US Golf Assn.	Long Beach
DELAWARE		
Rennie, Wayland W.	DuPont Company	Wilmington
FLORIDA		
Billett, Robert W.	O.E. Linck Co., Inc.	Hialeah
Bolton, Howard	Irwin Grain Company	Kendall, Miami
Boyd, A. Pollack	Southern Golf Association	Pompano Beach
Burke, R. E.	DuPont Company	Winter Park
Byrd, Glen E.	Miami Shores Country Club	Miami 47
Dawson, Tom, Sr.	Palm Beach Country Club	Palm Beach
Dilsaver, Carl E.	PGA National Golf Club	Clearwater
Duke, W. A.	Russell Daniel Irrigation Co.	Havana
Edge, Ross	Eglin Air Force Base Golf Course	Eglin A.F.B.
Edwardson, John	University of Florida	Gainesville
Hines, "Rube", Jr.	Sunset Golf & Country Club	St. Petersburg
Horn, G. C.	University of Florida	Gainesville
Irwin, Jack D.	Irwin Grain Company	Kendall, Miami
Linderman, Harvey	Mt. Lake Golf Course	Lake Wales
Luke, Marion I.	Golf Course Superintendent	Delray Beach
Nichols, Tom	Zonolite Company	Orlando
Pace, Charlie	Royal Palm Yacht & Country Club	Boca Raton
Palmer, Walter	Tequesta Country Club	Tequesta
Powell, Wilson E.	Boca Raton Hotel & Club	Boca Raton

FLORIDA (Continued)

Name	Affiliation	City
Reemelin, Ben	Zaun Equipment Company	Jacksonville
Schmeisser, Hans	Fort Lauderdale Country Club	Ft. Lauderdale
Schmeisser, Otto	Gulf Stream Golf Club	Delray Beach
Shaw, C. C.	Hector Supply Company	Miami
Smith, Claude A.	Arvida Corporation	Boca Raton
Willcox, Ward W.	Lakewood Country Club	St. Petersburg
Wilson, John R.	Nelson Supply Co., Inc.	Jupiter

GEORGIA

Name	Affiliation	City
Akridge, Dorsey	Pinecrest Country Club	Pelham
Barnhart, George E.	Cherokee Town & Country Club	Atlanta 5
Bartlett, Heard	Pine Needles Country Club	Fort Valley
Baumgardner, T. M.	Sea Island Company	Sea Island
Bolt, C. M.	Jacobsen Manufacturing Co.	Griffin
Bolton, Ed	Ga. Tech Athletic Assn.	Atlanta
Booterbaugh, E.	Druid Hills Golf Club	Decatur
Branch, Donald J.	Columbus Country Club	Columbus
Burnam, Joe W.	Stovall and Company	Atlanta 18
Burton, Glenn W.	Ga. Coastal Pl. Exp. Station	Tifton
Bynum, Gordon L.	43 Mathus Drive	Columbus
Carter, R. L.	Ga. Coastal Pl. Exp. Station	Tifton
Cliff, William L.	Thomaston Country Club	Thomaston
Culpepper, Sam H.	Ga. Inst. of Technology	Atlanta
Deal, Elwyn	Ga. Coastal Pl. Exp. Station	Tifton
Dipolito, Sgt. F.R.	Marine Corps Sup. Center Golf Course	Albany
Douglas, Lawson E.	Augusta Golf Club	Augusta
Dudley, J. W.	Athens Country Club	Athens
Evans, Thurlow, Jr.	Stovall and Company	Atlanta
Fleming, T. E.	Ga. Crop Improvement Assn.	Athens
Glover, Forrest	Gold Nugget Products	Cairo
Green, C. M. "Doc"	Okefenokee Country Club	Waycross
Greene, Roger O.	Golfland, Inc.	Macon
Hammond, Curtis G.	Golfland, Inc.	Macon
Holden, P. L.	W. A. Cleary Corporation	Smyrna
Jackson, James E.	Ga. Coastal Pl. Exp. Station	Tifton
Jensen, Ray	Southern Turf Nurseries	Tifton
Johnson, Dewey W.	Evans Implement Company	Atlanta
Jones, J. Herbert	J. Herbert Jones Tifgreen Turf Nursery	Cartersville
King, Frank P.	Ga. Coastal Pl. Exp. Station	Tifton
Kraft, Art	Forest Heights Country Club	Statesboro
Lam, John	Coosa Country Club	Rome
Lambert, Jimmy	Evans Implement Company	Atlanta
Lambert, Paul W.	Stovall and Company	Atlanta 18
Lawrence, Lester	Country Club	Fort Benning

GEORGIA (Continued)

Name	Affiliation	City
Moncrief, James B.	U.S.G.A. Green Section	Athens
Morcock, Cooper	Nitrogen Div., Allied Chem. & Dye	Atlanta 3
McGowan, D. R.	Valdosta Country Club	Valdosta
McKendree, Marion	Sea Island Golf Course	St. Simons Island
McMullen, LeRoy	Wyandotte Chemicals	Atlanta 5
Nordan, Lyman	Patten Seed & Turfgrass Company	Lakeland
Patrick, Frank, Jr.	Toro Turf Supply	East Point
Phillips, Richard L.	Sand Hill Golf Club	Ft. Benning
Presley, Alton E.	Dallas Lawn Farms	Dallas
Rambo, Sam	Merrybrook Turf Farm	LaGrange
Riley, Ben	Pinecrest Country Club	Pelham
Roquemore, W. A.	Patten Seed & Turfgrass Company	Lakeland
Shields, E. A.	Capital City Country Club	Atlanta 19
Smith, Joe W.	Evans Implement Company	Atlanta
Sperry, R. F.	American Legion Golf Course	Albany
Strong, John J.	Patten Seed & Turfgrass Company	Lakeland
Todd, Leamon W.	Glen Arven Country Club	Thomasville
Walls, Carroll E.	DuPont de Nemours & Company	Atlanta 5
Ward, Joe	Superintendent, Box 884	Macon
Wells, Homer D.	Ga. Coastal Pl. Exp. Station	Tifton
White, Don	Southern Turf Nurseries	Tifton
Williams, Jack	Toro & Turf Supply	Atlanta
Williams, L. G.	Cairo Country Club	Cairo
Wilson, Perry	Forest Heights Country Club	Statesboro
Woods, Robert, M/Sgt.	Armed Forces Golf Course	Augusta
Wright, Harry	Peachtree Golf Club	Atlanta 19

KENTUCKY

Capps, H. J., Jr.	Jacobsen Manufacturing Company	Louisville 5

NEW JERSEY

Cleary, Leo	W. A. Cleary Corporation	New Brunswick
Wiley, Bob	Aero-Thatch, Inc.	Rahway

NEW YORK

Chapin, William C.	U.S.G.A. Green Section	Rochester 1
Tavener, Bill	Agrico	New York 7

NORTH CAROLINA

Campbell, Don B.	Cherry Point Golf Course	New Bern
D'Lamater, Robert J.	Cherry Point Golf Course	Cherry Point
Kuykendall, Lester	Henry Westall Company	Asheville

NORTH CAROLINA (Continued)

Name	Affiliation	City
Land, Harold N.	c/o Tanglewood Park	Clemmons
Mann, W. E.	Camp Lejune	Jacksonville
Maples, Palmer, Jr.	Charlotte Country Club	Charlotte
Miller, Douglas D.	E. J. Smith & Sons Company	Charlotte
Pittman, David E.	Seymour Johnson A.F.B. Golf Course	Seymour Johnson AFB
Welch, Jim	E. J. Smith & Sons Company	Charlotte
White, R. L.	Mallinckrodt Chemical Works	Charlotte 7

OKLAHOMA

Stith, Wade	Lynde & Rowsey	Muskogee

PENNSYLVANIA

Dickinson, W. P.	Royer Shredder	Kingston
Mascaro, Tom	West Point Products Corporation	West Point

PUERTO RICO

Just, Luis Texidor	Golf Course Supt., Box 147	Dorado

SOUTH CAROLINA

Berlinger, M/Sgt. R. E.	Shaw AFB Golf Course	Shaw AFB
Goss, Frank P.	Sweetwater Country Club	Barnwell
Jeffords, M. K., Jr.	Southern Golf Assn. and USGA	Orangeburg
Ready, E. L.	Amer. Agric. Chemical Company	Johnston
Shown, Jack D.	Berkeley Country Club	Moncks Corner
Stewart, C. F.	Greens Superintendent	Columbia
Thurston, Herbert	Fort Jackson Golf Club	Fort Jackson

TENNESSEE

Boyd, Llewellyn	Southern Golf Association	Chattanooga
Moore, Robert C.	Chattanooga Grass Nursery	Chattanooga
Thorsberg, Arthur D.	Toro Manufacturing Corporation	Memphis 17

VIRGINIA

Savage, Hurley	James River Country Club	Newport News

WISCONSIN

Noer, O. J.	Milwaukee Sewerage Commission	Milwaukee