Fifth Annual
TURF CONFERENCE

ABRAHAM BALDWIN AGRICULTURAL COLLEGE

and

GEORGIA COASTAL PLAIN EXPERIMENT STATION

MAY 10-11, 1951

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May 9, 1951

TO THOSE ATTENDING FIFTH ANNUAL TURF CONFERENCE:

We have had bound together all but one of the talks given at this conference. It is hoped that these mimeographed speeches will be of some assistance to you for reference and study in your everyday problems after you return home. You will observe there are five blank pages in the back. They were put there for the purpose of taking notes on question and answer phase of the program on May 11.

Part of your registration fee was spent to prepare this booklet for you. Dr. Burton and I would appreciate an expression from you as to the desirability for doing this. If you want it I think this phase of the conference can be continued. If it is not worthwhile it can be dropped and the registration fee reduced.

T. M. Cordell, Dean
Abraham Baldwin Agric.College

BETTER TURF BY CULTIVATION

Talk for Tifton Turf Conference:

Tom Mascaro, West Point Lawn Products

Last year when I was in Mexico, I was driving through the countryside and noticed a Mexican boy plowing with a team of oxen. It was a wooden plow and, from every indication, was many years old. I asked the Spanish guide to stop and ask the boy why he was plowing. The boy answered that he didn't know why. All he knew was that his pappy plowed and his grandpappy plowed and his great grandpappy plowed. Although the boy knew the effects of plowing the soil were good, he didn't know why. We'll look into the reasons for plowing soil.

The growing plant takes in carbon dioxide through the leaves and breathes out oxygen. The roots take in oxygen and give off carbon dioxide If the pore spaces in soil are totally occupied by carbon dioxide and oxygen can't replace it, the plant will smother and die.

Plowing increases the pore space through the mechanical rearrangement of the soil particles, to allow for the free movement of air in and out of the soil. The renewal of air in the soil is governed by the following forces:

Changes in soil temperatures account for only 1/800 of the total normal aeration.

Barometric pressure accounts for only 1/100 of normal aeration.

Wind action accounts for only 1/100 of normal aeration.

Rainfall accounts for 1/12 to 1/16 of the total air and the balance of the air is accounted for by <u>diffusion</u>.

Diffusion is best explained in this manner -- gases are in a constant state of motion. When a gas jet on a kitchen stove is turned on, gas can be smelled in every corner of the room almost immediately. This

rapid movement of the gas through the room is called "diffusion". The gas moves through the air until it reaches equilibrium. In other words, it is evenly distributed throughout the entire area.

The same thing happens in soils. In soils of good tilth, where there is no compaction, carbon dioxide moves out of the soil by diffusion and oxygen moves into the soil in the same manner. The effect of compaction on the rate of diffusion is great.

In some of the work done, a column of kaolin and powdery loam soil was used. There was good diffusion through the material. When it was compacted, movement of air was reduced by 40%. A column of sand, which we always assume to have good aeration, when moistened to 40% of its total water-holding capacity, reduced movement of air by 40%. When this same sand was moistened to 80% of its total water-holding capacity, diffusion was stopped entirely.

In other words, an excessive amount of water stops the movement of air. A plant will wither and die from suffocation when the soil is too wet. This has been pretty well proven on turf areas where over-watering has been practiced.

Air in the soil also plays an important role in the life of the soil micro-organisms. The average weight per acre foot of some of the micro-organisms is as follows:

Bacteria	500 to 1000 lbs.
Fungi and Molds	800 to 1500 lbs.
Actinomycetes	800 to 1500 lbs.
Protozoa	200 to 400 lbs.
Algae	200 to 300 lbs.
Nematodes	25 to 50 lbs.
Worms and insects	800 to 1000 lbs.
Total Weight	4025 to 6250 lbs.

Dr. Hoffer of the American Potash Institute has reduced these figures to a more understandable form. He points out that the total weight of these micro-organisms would represent 402 ten lb. animals per acre. The oxygen requirement of this many animals is considerable. In order for the micro-organisms to live, there must be adequate air in the soil. We are concerned with soils under turf. We can't plow them up because the areas are in constant use, so we must try to cultivate and aerate these soils in some manner so as not to disturb the surface.

Many attempts have been made to overcome compaction and loosen the soil so that air and water could move freely through it. Hand-tampers with spikes in them have been used; sharp bladed knives and discs have also been used with some degree of success. In 1926, the hollow-tined fork was brought over from England. These tools resembling a spading-fork were used quite extensively and are still in use today.

Eb Steiniger of Pine Valley Golf Club in New Jersey, has perhaps the largest collection of implements to overcome compaction in the country. He has all sorts of spikers; proggers; straight discs, bent discs, knives and hollow-tined tools. All these implements were slow and cumbersome and would not do a very good job of aerifying the soil, although they would help some.

One implement he has is a hollow-tined affair. The hollow tines were mounted on a drum and the soil is supposed to pass through the tines into the drum where the soil is collected and disposed of. He used this implement over twenty years ago. It wasn't too successful because the hollow tines kept blocking up and the implement became a spiker rather than an aerating machine.

Other machines have been developed to overcome compaction. A hollow-tined implement on a reciprocating shaft was built in St. Louis and has worked with some degree of success. Drilling machines have also been used but they were slow and confined pretty much to small areas.

Spikers have also been used with varying degrees of success. However, beneficial effects of spiking are mostly confined to the first inch of soil. We know that a large spike that will go deep enough has a tendency to compact the soil. This is best illustrated by the sheep's foot roller which is basically a large spiking machine. The primary function of the sheep's foot roller is to compact newly graded areas.

In 1946 we developed a different type of implement--the Aerifier. The Aerifier employs curved, open spoons to remove soil cores from beneath the turf. As the implement is pulled forward, the motion of the spoons in the soil has a "cultivating action" which loosens soil around the openings.

The effect of this cultivating action can be seen in this soil profile sample, taken about three weeks after aerification. New roots are formed and occupy the voids of the loosened soil particles. These wax casts show clearly the effects of cultivating action as compared with drilled holes. The area was passed over with each implement. Melted paraffin wax was poured into the holes. When the wax solidified, it was carefully removed and the soil washed away. Wax spread out into the loosened soil in the Aerifier holes, just as roots do. Wax could not penetrate the glazed walls of the other holes--neither can roots.

In 1948 a golf club in Louisville, Kentucky ran comparison tests in the fall and samples were taken the following spring. The roots in

the hollow-tined holes had not penetrated the walls of the holes and were confined entirely within the small space made by the tine. Soil samples taken from the area cultivated with the Aerifier showed a healthy mass of live, active roots that had spread into the area surrounding the hole.

Aerifiers are made in different models and sizes. There is the Grasslan model Aerifier, designed for airfields and pastures. It has spoons 1½" in diameter and 6" long. This machine removes approximately 50 tons of soil of average moisture content to the acre.

The next size is the F-G model which is used on golf course fairways and greens, and other large turf areas. It is tractor-pulled and can be equipped with 1", 3/4" and ½" diameter spoons. The next size is the G-L model which is self-propelled and can be equipped with the ½" or 3/4" diameter spoons. This machine is used primarily for golf greens, tees and approaches, large lawn areas, etc., where a tractor-pulled implement is impractical. The next size is the Home-Lawn model Aerifier which is equipped with ½" diameter spoons. It cultivates a path 9" wide and is "people-powered". The smallest aerifying implement is the Aeri-forke which is operated by foot, similar to a garden spading fork. It removes 3 cores of soil each time it is pushed into the ground. The Aeri-forke can be equipped with a core-catching pan so that soil can be removed entirely from a green.

Now let's look into some of the reasons why aerification should be practiced and what its beneficial results are. Many turf areas are thatched and matted. An accumulation of undecayed grass clippings and stems remains on the surface, bands together and forms an impervious

covering over the soil that sheds water like a thatched roof. Turf can be maintained under thatched conditions only with the utmost care and caution. Disease is a problem on these areas. Fertilizer, lime and water applied to the thatched turf areas tend to be held at, or near, the surface.

Areas such as these are a constant worry to the man in charge unless he removes the underlying causes. Aerification and drastic brushing and combing help to overcome the condition.

Another effect of thatch condition or compacted soil is to prevent penetration of water, whether rainfall or artificially applied. I was on a golf course in Portland, Oregon, where they had a traveling sprinkler. The amount of water the sprinkler was throwing should have been adequate. Soil samples taken after the sprinkler had been removed showed that the soil was still dry underneath; low-lying areas and hollows were filled with the runoff water. Dr. Alderfer of the Pennsylvania State College has shown through experiments that as much as 80% of the water applied to an area is lost if the grass is thatched and the soil is compacted. By loosening the soil, we can increase the penetration of water, which will build up the ground water reserves for the future use of the plant.

Another reason for cultivation of some turf areas is poor soil mixtures. Sand layers, muck layers and mixtures of different soil types occur in many of these man-made turf areas such as golf greens and tees. Pockets of these materials dry out faster or stay wetter than the surrounding soil and tend to create trouble spots.

Another reason for cultivation is, even though the soils may be

good from the standpoint of nutritive value, they can become compacted, especially when excessively wet. The sealing effect of the soil particles does not allow for the diffusion of oxygen into the soil. One of the best indications of lack of oxygen in soils is the blue color that is evident when a sample is taken. Oxygen directly affects the iron content of soils. When oxygen is present in the soil, the iron will be in the ferric state and will have a reddish color. When oxygen is deficient in the soil, the iron will change to the ferrous state and can be detected from its blue color.

Hard-wear areas, such as paths leading to golf greens, ends of fairways where tractors must necessarily turn on them, tend to become compacted more than other areas. Where compaction exists, plant roots will not penetrate very deeply but will remain on the surface. Shallow rooted plants cannot survive very long under adverse conditions.

The golfer is about the best machine to uncover shallow-rooted turf. When he knocks out a divot you can be pretty sure that the grass isn't rooted very deeply. A divot cannot be knocked out of deep-rooted turf. The turf can be hacked off but, if the root system is deep enough and healthy enough, the grass plant will re-establish itself.

When I was in Chicago in the fall of 1947, John Darrah, then superintendent of the Olympia Fields Golf Club, used the Aerifier with 1" spoons on his greens. The following spring I was out there again and we noticed that the greens were pock-marked with very green spots. This was pretty good evidence of the effect of air in the soil. Bacterial action started sooner, moisture conditions were better where the soil had been cultivated and the grass had a much

earlier start. It is plain that greens should be aerified enough times to secure uniform results. If the greens had been gone over a few more times, the whole area would have been as green as the spots.

In 1949 I was down to the Lakewood Golf Club at Point Clear, Alabama. Ted Booterbaugh, who is superintendent there, showed me a green that had been over-seeded with rye and had been doing badly. In Milwaukee Ted had had a great deal of experience with aerifying. He did something that had not been previously practiced in the south. He thoroughly aerified the troublesome overseeded green--not just once but six times during a period of three months. He suspected compaction as being the primary cause for the poor growth of the rye, and he was right. At no time was the green taken out of play. The rye did well and carried through and, in the spring, the bermuda responded much faster than the greens that had not been aerified. Ted Booterbaugh maintains that the Aerifier, equipped with the Flexi-press, can be used to good advantage at any time of the year when conditions demand it.

Until turf is deep-rooted, aerification should be practiced with caution. We should always look at our turf area from the user's standpoint. Whether it be cattle, football players or golfers, the users are our first consideration. Everything we do must be geared to their likes and dislikes. Turf areas should be cultivated and gotten into good shape as soon as possible. On small areas, bamboo whipping poles are effective in breaking up soil cores and distributing the soil over the area.

A great economy in golf course maintenance can be effected by the intelligent use of the existing soil rather than the application of top-dressings.

No two greens are alike and the superintendent must use his own judgment in determining the best methods for finishing off an aerification operation. Where soil is poor, a leaf sweeper can be used to gather the soil removed from the green. Where turf is shallow-rooted the soil cores can be melted and redistributed by the gentle application of water. Where soil is hard and of brick-like quality, the soil cores can be allowed to air-dry and then blown off with a high-pressure hose.

Brushing and combing are some of the final steps in the operation. Many superintendents place a man on the green for ten or fifteen minutes to go over it very carefully, lifting small depressions and getting the green in tip-top condition to give the golfer a sporting chance. Light rolling is done where needed.

In 1946 the Philadelphia Municipal Stadium was selected as a proving ground for the Aerifier. Good turf was practically nonexistent. The ground was hard, compacted. Crabgrass was the predominant plant in the area and seemed to thrive under the adverse conditions.

The aerifier was set to cultivate at 4" but, the first time over, it didn't penetrate to more than about $1\frac{1}{2}$". However, after the third or fourth time that the area was aerified during the season, penetration was increased. Today the field can be thoroughly cultivated to full 4" depth without the addition of any weight to the machine.

A good seedbed was prepared, the right grasses were selected for the field, a good fertilization program was established along with aerification, and we have been able to produce good grass and keep it. Charles K. Hallowell, who set up the program, has been more than pleased with the results.

Good turf cannot be produced overnight. It takes a well-planned program, intelligent maintenance and lots of patience. Joe Valentine, Superintendent of the Merion Golf Club in Ardmore, Pa., has a story which illustrates this:

Joe Valentine says that when members come to him and ask him if he will help them to get a good lawn, he asks them three questions: If they answer "yes" to all the questions, success is pretty well assured. The first question is: "Are you willing to spend the money"? If this is answered affirmatively, he proceeds to the second question: "If we set up a good lawn program will you assure me that I will have complete authority over what is to be done and how it is to be done?" If they agree to this, then the last question is: "Are you willing to wait three years for a good lawn?"

Mr. Valentine emphasizes the points that it takes the investment of a little money, it takes the know-how of an experienced man, and it takes a little patience to achieve the results we are after.

BETTER TURF BY BREEDING

Glenn W. Burton

The science of plant breeding that has worked wonders with most of our crop and garden plants can also work wonders with turf grasses. The expensive disease control program so essential for good turf can be forgotten when grasses resistant to disease have been developed. New herbicides like 2-4-D are very effective in controlling many turf weeds but superior strains of grass developed by the plant breeder can solve many of the weed problems at a fraction of the cost of herbicides. The plant breeder can develop turf grasses with better root systems that will grow on soils where the common type will not grow. Given time the plant breeder can help to solve most of the turf problems generally found on the golf course.

Perhaps you would like to know how the plant breeder undertakes to develop superior turf grasses. To begin with he must first know the grass with which he is working. Some grasses are extremely variable and every seed that grows gives rise to a plant that is different from every other one. Most of these differences are very slight but some are so great that anyone can see them. Bermuda grass, bent grass, and Zoysia grass are examples of this type of grasses. Very often much progress can be made with these grasses just by discovering individual plants that are well suited for turf. Most of the good bent grass strains in use today are natural variations that were found doing very well on a green, on somebody's golf course. U-3 and some of the other improved turf Bermudas had their origin in this way. Usually grasses arising in this way have faults that need to be corrected. Continued search through thousands of plants might bring the desired individual.

Generally, however, the process can be greatly hastened by applying the science of plant breeding. Our work with Bermuda grass will illustrate some phases of this procedure.

In 1938 we found a very unusual plant of Bermuda grass growing in some 5,000 spaced plants. It produced no seed heads, had very short leaves and made an unusually dense growth. It looked like the answer to a homeowners prayer--a lawn grass that would need no mowing. When planted in lawns, however, this grass called No. 12 was found to be quite susceptible to disease. Weeds and the more agressive common Bermuda crowded it out. Obviously it needed disease resistance and more vigor. Our pasture breeding program had developed Bermuda selections that had both disease resistance and greater vigor. The science of plant breeding said the quickest way to improve No. 12 was to cross it with the more vigorous, disease resistant selections. Finally in 1942 No. 12 produced seed heads and 100 hybrids were made. These were spaced 8 feet apart in each direction in the spring of 1943. By the fall of 1946 it was apparent that a number of these plants were better than No. 12. In the spring of 1947 twelve of these hybrids and thirty others from the pasture breeding program were planted in the turf plots along with common Bermuda and 50 Bermudas sent in by greenkeepers from some of the best putting greens in the Southeast.

For the past four years these Bermudas have been fertilized and managed exactly alike. During this time they have been rated on 38 different occasions on such things as disease resistance, density, weed resistance, rate of recovery after the transition period, playing quality, and aggressiveness. When all of these ratings were totaled,

Tifton 57 had the best score of any Bermuda in the test. Some of the Bermudas that looked very good the first season made a poor showing a year or two later. Several selections from golf courses have been equal or superior to Tifton 57 at favorable seasons of the year, but during periods of adversity Tifton 57 has been consistently better than these selections.

Although Tifton 57 is much better than common Bermuda and ranks first in over all performance among the many Bermudas we have at Tifton, it is not perfect. It would be better for golf greens if it were softer and finer and it would be easier to handle if it could be established from seed.

Very often excellent turf grasses are very poor seeders or if they do produce seed they will not breed true. Preliminary experiments in Arizona indicate that neither Tifton 57 nor U-3 will seed well when handled like common Bermuda in that area. It is hoped that some method will be found for making these strains produce seed. Vegetative propagation is no great handicap, however, with grasses that spread as rapidly and are as aggressive as Tifton 57.

The logical way to improve the putting qualities of Tifton 57 is to cross it with a grass that makes a better putting surface. Perhaps you are wondering, why not cross it with bent grass? I wish we could, but nature has set up certain barriers that no one has been able to pass. In general things must be rather closely related if they are to be crossed. The horse and the donkey can be crossed but the horse and the cow can not be crossed. Even though they look very much alike bent grass and Bermuda grass are very different, and would be more dif-

ficult to hybridize than cows and horses.

A number of years ago a very fine Bermuda grass that has excellent putting qualities was introduced from Africa. A number of people tried this African Bermuda on golf greens and found it made an excellent putting surface in the spring and late fall but that it died back very badly in the summer. Disease caused a part of this dying back. Two years ago we undertook to combine the excellent putting qualities of African Bermuda with the other good qualities of Tifton 57 by crossing them. A number of hybrids have been made that are finer than Tifton 57. They are not as fine as African Bermuda, however, and do not make as dense a turf as Tifton 57. Whether or not they will be superior to Tifton 57 for putting greens can be ascertained only after several years of thorough testing.

Dr. Fred Grau and his associates, working with the Zoysias in Beltsville, are making progress in developing superior strains of these desirable turf grasses. At Penn State, Professor Burt Musser and his co-workers are isolating superior strains of bent grass. If the plant breeders can develop strains of bent grass that are resistant to disease, particularly large brown patch, all of the South may be able to enjoy year-around putting on perhaps the best of all grasses for putting greens. There is room for improvement, by breeding of every grass now used for turf in the United States. Well supported turf grass breeding programs are bound to pay dividents. Better turf by breeding can be guaranteed.

"BETTER TURF BY DISEASE AND INSECT CONTROL"

By
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Prepared for 1951 Southeastern Turf Conference, Tifton, Ga., May 10-11.

In order to achieve our goal of Better Turf we must hold in check the host of diseases and insects which attack our better grasses. Fortunately for us, Science and Nature working together are removing the major obstacles to progress.

The attack on diseases of grass is three-pronged:

A. Selection and Breeding

Nature constantly is eliminating the weaker individuals permitting only the strong ones to remain. In a dense population of grass plants of heterogeneous nature over a period of time the best individuals tend to predominate (Arlington (C-1) bent) (Dahlgren (C-115) bent).

During epidemics of diseases populations of turf grasses may be wiped out nearly 100% but a few sturdy individual strains may survive. Alertness and quick action may preserve these strains for further increase and for future breeding programs. (Merion bluegrass) U-3 bermuda)

Breeding is the process of artificially or naturally crossing types of individuals with the hope of obtaining superior strains. (Tifton 57 bermuda) (Coastal bermuda).

B. Treatment With Fungicides.

Newer and better fungicides have been developed through research and testing in the laboratory and the field. Few people realize the amount of work that has gone into the development of fungicides. Specific treatments have been derived for many turf

diseases (dollarspot, brownpatch, snowmold, pinkpatch), but the control of others (Pythium, leafspot) elude us and must be approached through development of resistant grasses. Some outstanding chemicals include Calomel, Bichloride of mercury, Tersan, Crag 531, Puraturf 177, Semesan. New chemicals are appearing from time to time and are tested in the National Coordinated Trials now conducted by the USGA Green Section.

C. Management Practices

Certain management practices tend to influence the incidence of diseases. Overwatering, for example, tends to increase brownpatch. Overstimulation with nitrogen makes plants more succulent and more liable to attacks of disease. Formation of a Mat also encourages disease. Poor aeration in the soil is a big factor; drainage is a must; unbalanced feeding, especially a lack of needed elements, will encourage disease. Late fall feeding with N in northern climates induces snowmold - accumulation of organic matter also encourages the disease.

Insects

Not more than five or six years ago we were limited in our choice of insecticides to such things as arsenate of lead, pyrethrum products, nicotine, etc. Today we have such effective agents as Chlordane, DDT, BHC, Parathion, Aldrin, Deildrin, etc. It is highly essential that anyone in charge of turf areas be well informed of the nature of insect attacks and the necessary procedures to combat the attack.

Of first importance is RECOGNITION or IDENTIFICATION. Unless the attack is correctly diagnosed, control measures may be ineffective. Sod webworm produces an effect like dollarspot. Dollarspot control does

nothing to sod webworm and yet I have seen many greens repeatedly treated for dollarspot while sod webworms ruined the turf and the fungicide was declared worthless. Next comes the PLAN and then ACTION! If you are not fully informed as to what to do by all means know WHO to see who can diagnose the insect and prescribe proper control measures. Immediate action is essential in most cases and local recommendations by your state college, your county agent or the extension entomologist should be sought. Insect damage need not be tolerated in this day and age of effective insecticides at reasonable cost. Remember that much of our weed problems result from insect damage.

BETTER TURF BY WEED CONTROL

B. P. Robinson, Turf Specialist
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To the turf producer a weed is a plant out of place, especially if it is aggressive, distracting, or pestiferous. Many plants which the turf producer considers weeds are valuable to other agriculturists. For instance, the highly regarded pests Dallis grass and white clover are extremely valuable to the livestock farmers.

Weeds, generally, are very resistant to the forces of mother nature. They are usually tolerant of drought, extremes of temperature, shade, and low fertility. And, too, their methods of reproduction are very variable and vigorous. Poa annua apparently can produce seed cut at almost any putting green height and various day lengths. Dallis grass produces not only a hard coated seed, but also reproduces each year from a tufted base. Nut grass produces small underground tubers that are capable of somewhat continuous reproduction. Thus, when we discuss the topic weed control in turf, we must consider the diversity manifested by the different plants we classify as weeds and the most practical and economical methods to prevent their invasion and reproduction. Nearly 3,000 species of plants are known to cause trouble as weeds and a large number of these are associated with turf. The spectacular increased interest in growing better turf during the past few years has focused attention upon the class of plants called weeds. Requests for identification of undesirable plants is always followed with, "How can we get rid of it"?

When we consider that weeds grow vigorously where they are not wanted, and survive under adverse conditions, it is seen that the cheapest and usually the best way to reduce weeds in turf is to follow the practices of good turf management as discussed by other members of the program. Drastic reductions in weed population may not immediately follow the beginning of a program of controlled watering, increased fertilization, cultivation, insect and disease control and the use of improved strains of grasses. It is believed, however, that in time an intelligent and steadily maintained program of good grass production will be found to yield all the weed control needed.

One cultural practice which is apparently very helpful in the control of weeds is that of a good fertilization program. We are fortunate that grasses respond very readily to applications of nitrogen provided other nutrient elements are supplied in ample quantities. Timely applications of nitrogen with phosphorus, potash, and calcium will greatly increase the vigor and density of turfed areas thereby decreasing the probability of weed invasion. A vigorous well-turfed area can compete more successfully with germinating weed seedlings than an open poor fertilized sod.

Wherever white clover or Dallis grass are found growing in turfed areas it is an indication that the levels of other nutrients besides nitrogen are high enough for the production of good Bermuda grass turf. Thus, it becomes evident that to decrease the clover population one should use only applications of nitrogen for a period of possibly two or three years. On the other hand, applications of inorganic sources of nitrogen such as ammonium nitrate to produce a burning action on

Bermuda grass turf infested with Dallis grass has proven quite successful. Sodium arsenite in the form of Milarsenite has also been successful. Such a program greatly increases the growth of Bermuda, and thereby necessitates more frequent mowing, and favors the growth characteristic of Bermuda more than that of Dallis grass.

Another type of cultural practice which is often overlooked is the benefit of a good mowing program. Some of the new attachments such as brushes, combs, etc., which are being used have been somewhat successful for the control of different types of turf weeds. The roughs on many golf courses act as a source of weed contamination. For instance, many courses which have troublesome weeds in their fairways may prevent such plants from producing seed in the fairway while allowing seed production to take place at different seasons during the year in the roughs. A good mowing and management program is therefore just as important for the roughs as for the tees, fairways, or putting greens so far as a program of weed control is concerned.

Invasion of many turfed areas by weeds may be checked by the correct applications of water. A good sod, well fertilized and managed can withstand longer periods of drought than newly germinated weed seedlings. A careful program of watering during periods of weed seed germination should decrease weed population.

We have pointed out that certain plants are indicators of soil conditions. Plants such as annual blue grass, clovers, sedges and chickweed appear to thrive in saturated and compact soils. Whenever one experiences an invasion of these species on putting greens and other turfed areas, it is time to start checking on the watering system, soil compaction, and fertilization program.

Trees are seldom thought of as weeds. There are cases, however, where trees may be classified as turf weeds. We refer here to golf courses that are trying to grow Bermuda on putting greens which are heavily shaded by different types of trees. In this case trees are decreasing the vigor of Bermuda grass both indirectly by the production of shade and directly by the growth of roots within the putting green.

Since weed invasion is the result and not the cause of poor turf, the conditions which have promoted their existence should be corrected if a chemical control program is to succeed. Chemical weed control certainly has its place but should be correlated with good systems of management.

A source of weed seed which is seldom controlled is that of top-dressing material. Weed seed can be almost eliminated from top soil by thoroughly mixing 15 pounds of calcium cyanimid per cubic yard and letting the mixture compost for about eight weeks while keeping it moist. Such a program for the production of top soil may be carried out in the open and worked with machinery.

One of the chemicals most widely used for weed control is known commonly as 2,4-D. The general application for most southern broad leafed weeds is from 1 to 1½ pounds of actual acid per acre. The time of application with 2,4-D as well as the other chemicals is apparently very important. For instance, experimental evidence indicates that wild onions can be controlled with applications of the ester form of 2,4-D or the salts if it is applied early in the spring before the plant has time to store plant food reserves in the underground portion

of the plant. If applications are made after this time the wild onion might be burned back to the surface of the ground, but will show new growth within a short time.

Arsenicals are widely used and apparently are one of the cheapest chemicals for weed control on turfed areas. It is almost impossible to use this material without producing some damage to permanent grasses. Used as a spray with a wetting agent 1 to 2 ozs. per 1,000 square feet is a good rate.

Potassium cyanate applied at about 8 pounds per acre is also a good herbicide and compares very favorably with sodium arsenite, however, it apparently does not produce as heavy a burning action as the arsenicals.

Mercury compounds apparently are very successful for the control of such weeds as crabgrass. Because of the cost of these materials, however, their use is almost prohibited on very large areas.

Most of the chemicals used for weed control are most effective on seedling weeds. The use of these materials during the early stages of weed growth along with improved turf management should result in better turf.

PLANNING AND BUDGETING MAINTENANCE OPERATIONS ON A GOLF COURSE

BY CRAWFORD RAINWATER

To me, the assigned subject is an interesting one because for the past several years I have had the opportunity to be a member of a Greens Committee who was faced with an 18-hole course which needed tremendous improvement in upkeep and general playing conditions. Furthermore, these improved conditions had to be brought about on a limited budget.

The purpose of my discussion will be to offer some suggestions as to how you may give your members a better conditioned course at the lowest possible cost.

To begin, let's lay the foundation for management - the Greens Committee and the Greenskeeper. First, we should consider the qualifications of a good Greens Committee:

1. A committee composed of not less than three - appointed or elected in such a manner that not over one new man will come on the committee each year. It takes time for new committee members to become acquainted with the various details and to become sufficiently informed that intelligent decisions can be made.

2. A good cross-section of the golfing membership of your club, both low and high handicap players, should be represented. Remember the average golfer is about a 90 player. You and I are interested in pleasing all types of members and don't overlook the ladies.

3. Each committee member should:

(a) Have previous knowledge and experience in turf culture,

if possible.

(b) Have demonstrated a genuine interest and ability in growing better turf.

(c) Be open-minded.

(d) Be willing to devote sufficient time to the study of problems affecting your course.

Now that we have a Greens Committee, let's consider some of the qualifications of a Greenskeeper:

1. He should be a golfer so that he will understand the players point-of-view.

2. He should have sufficient education to be able to keep records accurately and read up on the latest available information.

3. He must be receptive to new ideas which have been proven by those better qualified than himself.

4. He must be a good organizer and leader of men.

5. He should have initiative and work closely with Greens Committee in formulating policies.

With your Management Group complete, their first responsibility is to analyze as accurately as possible the actual condition of your particular course. This analysis must be unbiased and always from the players point-of-view. Sometimes the use of a Suggestion Box or a letter to the membership asking their views can be quite revealing. At our course, we received several very excellent suggestions, some of which could be carried out with little or no effort. Nevertheless, when a suggestion is carried through you have performed a selling job and the club member who made the suggestion immediately becomes more interested in what you are trying to accomplish.

After you have analyzed your particular situation, you should itemize every condition needing improvement and determine the preference or order in which the items will be accomplished.

Remember, you have a selling job to do and yet you must stay within a specified budget; therefore, you must lay out a well balanced program and estimate costs at the outset. I propose that labor, materials and a planned schedule of maintenance must be laid out on an annual basis. To assist you in such an undertaking, you will be given copies of the charts which I am about to show you.

I - AREAS (See Exhibit 1)

(a) To determine total fertilizer requirements.

(b) To estimate top-dressing requirements.

(c) To estimate seeding requirements for rye grass.

(d) To estimate requirements of fungicides and weed killers.

II - OUTLINE OF WORK (See Exhibit 2)

(a) To insure that every job will be accomplished.

(b) To evenly distribute work load.

(c) To obtain maximum use of labor.

(d) To estimate labor requirements.

SCHEDULE #1

AREAS _____ COUNTRY CLUB

DATE _____

HOLE	TEES	FAIRWAY	GREEN
#1	_____ sq. feet	_____ acres	_____ sq. feet
#2	_____ sq. feet	_____ acres	_____ sq. feet
#3	_____ sq. feet	_____ acres	_____ sq. feet
#4	_____ sq. feet	_____ acres	_____ sq. feet
#5	_____ sq. feet	_____ acres	_____ sq. feet
#6	_____ sq. feet	_____ acres	_____ sq. feet
#7	_____ sq. feet	_____ acres	_____ sq. feet
#8	_____ sq. feet	_____ acres	_____ sq. feet
#9	_____ sq. feet	_____ acres	_____ sq. feet
#10	_____ sq. feet	_____ acres	_____ sq. feet
#11	_____ sq. feet	_____ acres	_____ sq. feet
#12	_____ sq. feet	_____ acres	_____ sq. feet
#13	_____ sq. feet	_____ acres	_____ sq. feet
#14	_____ sq. feet	_____ acres	_____ sq. feet
#15	_____ sq. feet	_____ acres	_____ sq. feet
#16	_____ sq. feet	_____ acres	_____ sq. feet
#17	_____ sq. feet	_____ acres	_____ sq. feet
#18	_____ sq. feet	_____ acres	_____ sq. feet
PRACTICE	_____ sq. feet	_____ acres	_____ sq. feet
TOTALS	_____ sq. feet	_____ acres	_____ sq. feet

N.B. - 43,560 sq. feet equals one acre.

SCHEDULE #2

OUTLINE OF WORK

JANUARY, 1951

Spend as much available time as possible preparing top soil for future use.

Monday - 8 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq.ft. on greens.

Monday - 15 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq.ft. on tees.

Treat rye grass to prevent fungus diseases, at 7 to 10 intervals, if necessary.

FEBRUARY, 1951

Monday - 5 Begin aerifying fairways using 1 inch spoons. Follow immediately with 500 lbs. per acre of 6-8-8. This will probably require 8 to 10 days to complete.

Monday - 19 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq. feet on greens.

Monday - 26 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq. feet on tees.

Treat rye grass to prevent fungus diseases, at 7 to 10 intervals, if necessary.

MARCH, 1951

Monday - 19 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq. feet on greens.

Monday - 26 Apply 1½ to 2 lbs. available nitrogen per 1,000 sq. feet on tees..

APRIL, 1951

Monday - 9 Aerify tees using 1/2 inch diameter spoons.

Monday - 16 Apply 2 lbs. available nitrogen per 1,000 sq. feet greens and aprons.

Monday - 23 Apply 2 lbs. available nitrogen per 1,000 sq. feet on tees.

SCHEDULE #2 (CONT'D)

MAY, 1951

Watch for weeds and spray as soon as they begin to show up. Use light applications for 3 or 4 consecutive weeks.

Monday - 7 Aerify greens on front nine using 1/2 inch spoons. Follow with light top dressing.

Monday - 14 Aerify greens on back nine using 1/2 inch spoons. Follow with light top dressing.

Monday - 21 Apply 2 lbs. available nitrogen per 1,000 sq. feet to greens and aprons.

Monday - 28 Apply 2 lbs. available nitrogen per 1,000 sq. feet to tees.

JUNE, 1951

Monday - 4 Aerify greens on front nine using 1/2 inch spoons. Follow with light top dressing.

Monday - 11 Aerify greens on back nine using 1/2 inch spoons. Follow with light top dressing.

Monday - 18 Apply 2 lbs. available nitrogen per 1,000 sq. feet to greens and aprons. Apply 64 lbs. available nitrogen per acre to fairways.

After completing your "Outline of Work", you are then in position to make a budget. In order that you might have something tangible to take home, I have taken the liberty of including the 1950-51 budget of the Pensacola Country Club. This course has 18 holes on a very sandy soil. Greens are generally cut six days each week. The budget has been successfully used since the fall of 1946 and we believe the course has shown tremendous improvement.

SCHEDULE #3

BUDGET FOR GOLF COURSE 1950-1951

Part time Greenskeeper:			$1,800.00
Labor:			
6 men (45 hrs. @ 65¢)	$9,126.00		
Night Watering (20 hrs. @ 65¢)	676.00		
Caddie Master ($5.00 per wk.)	260.00		10,062.00
Materials:			
Fertilizer:			
Organic Nitrogen (25 T. @ $32.50)	812.50		
0-14-10 (3 T. @ $35.00)	105.00		
32-0-0 (4 T. @ $75.00)	300.00		
6-8-8 (16 T. @ $40.00)	640.00	$1,857.50	
Ryegrass Seed (4,000# @ $12.00)		480.00	
Topsoil:			
Soil (300 yds. @ $2.00)	600.00		
Coarse Sand (150 yds. @ $1.25)	187.50		
Cyanamid (5,600# @ 4.5¢)	252.00		
Peanut Hull Bran (12 T. @ $12.00)	144.00	1,183.50	
Arsenical Weed Killer		200.00	
2-4-D Weed Killer		60.00	
Chlordane		75.00	
Fungicides		300.00	
Hose		125.00	
Sprinklers		30.00	
Miscellaneous Supplies (Flags, Poles, Score Cards, etc.)		180.00	
Gas and Oil		480.00	
Repairs		300.00	
Ice		150.00	5,421.00
Reserve for Contingencies			717.00
	TOTAL		$18,000.00

NOTE: No allowance made in this budget for Capital Expenditures or depreciation. All electricity is paid on one bill and no part is prorated to Golf Course. Water is pumped from private wells by electricity.