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TURF CONFERENCE

R. C. POTTS, CHAIRMAN

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WELCOME

By Ben Lee Boynton
President, Texas Golf Association

I think it is very apropos that during this season, when inaugurations seem to be quite the style, we should rival the President of the United States and the Governor of Texas and have our own inauguration here. This, of course you know, is a joint meeting of the Texas-Oklahoma Turf Associations. The officers of the Texas Turf Association welcome its own membership and are delighted to see so many of you turn out; and those members join with us in welcoming our friends from Oklahoma. I note by reference to the program that they have me down as chairman, and I wish it were possible for me to take all the credit and the congratulations that are due the officers that arranged this program, but I had nothing whatsoever to do with it. My being called chairman is a misnomer. The program was arranged by Dr. Howard Sprague of the Texas Research Foundation and Sid Watson, Secretary of the Texas Turf Association. I am sure that after we get through our two day program, we will be delighted to congratulate them on the work they have done.

I am going to admit, gentlemen, that I do not know a thing about turf. My end of the deal down here in Texas is to try to get us some money on which to operate. That lack of knowledge about turf, of course, is one of the reasons we are having this conference and I imagine that some of you out there also do not know anything about turf; and for that reason we are getting together at meetings such as this to talk about this work.

One of the main problems that confronts the Texas Turf Association (and may also be true of the Oklahoma Association) is the lack of funds with which to carry on research work down at Texas A & M. We know that practically every individual in our state is interested in turf in some form or another -- playgrounds, athletic fields, airports, cemeteries, all of those areas where grass is grown,-- front yards, back yards-- everybody is interested in grass; so, if we can just get those that are interested in grass to back this movement, we will go a long way toward Utopia on the deal. There is an old Pennsylvania Dutch saying about "save at the spigot and run at the bung"; I think that is what is going on in Texas with the expenditure of money and the growing of turf. We know there are thousands and

thousands of dollars spent each year trying to get grass to grow where somebody wants it to grow. These expenditures are on a more or less "hit and miss" basis. They are not being channeled so that any results come from these efforts. That is the reason for the establishment of the Research Department down at Texas A & M, and that is the way Oklahoma will arrange its program. These thousands and thousands of dollars that are being spent annually will be directed in the proper channels and we can save thousands and thousands of dollars. That is the main reason for this work, and we know everybody will be behind us and we will get through this crisis. If we could all dress the part we are playing, we would probably have on buckskin shirts and have a long rifle because we are really pioneers in the field. I hope that the joint meetings that we have each year will lead to a closer working association, a closer comradeship and fellowship between those of us from Texas and those of us from Oklahoma working on our mutual problems.

Now we want to get on with our program; we are a little behind, but certainly congratulations are in order for you men who have come down as far as you have with the kind of weather you are confronted with outside. Dr. Longnecker of the Texas Research Foundation is confined to his home in Dallas, Texas, so he will not be with us this morning to talk to us. Dr. Fred Grau of the U.S.G.A. Green Section has kindly consented to take over the subject Dr. Longnecker was going to talk on, and will talk to us about the Basic Principles of Bentgrass Management.

BASIC PRINCIPLES OF BENTGRASS MANAGEMENT

By Fred V. Grau
Director, U.S.G.A. Green Section

It will be very interesting to see how nearly my ideas of this subject will harmonize with the outline Dr. Longnecker had in mind for this talk. I am very sorry that he did not send an outline up here for me to follow. But, I will do the best I can, but I am just awfully sorry he is not here because he can do such an excellent job on this subject because he has had so much experience with it. Before I go into that I want to congratulate the Oklahoma Turf Association and the Texas Turf Association for this wonderful effort in bringing the two associations together for this joint conference. Both Noer and I have more or less encouraged it, and it is wonderful to see it because you can do so much more working together than you can working individually. Our thinking is going to be more harmonized and we are going to be able to settle down to our basic problems because, afterall, the principles of producing turf in these two great states are not too different. I think we are going a lot further by joining hands in this manner. Again congratulations to all of you. The attendance here certainly indicates the interest in this work. We are with you 100% as we have been from the start and I just hope that our efforts will not be retarded in any way to help you achieve the fine goals that you have set.

Now, on this subject of basic principles of bentgrass management we are going to confine ourselves pretty much to bentgrass greens because that is about all the use there is of bent down here in this area at the present time. It is a very important one because bent provides the kind of putting green that most golfers want. The first basic principle in bentgrass management is manpower-- the right man for the job. The man who wants to grow bentgrass; who will provide himself with the knowledge of how to grow it and seek the information and have the background-- the information, the training to apply that information to the problem at hand. That is the fundamental principle of growing good turf -- manpower. The man on the job is the most important one.

From that we have got to go to the next basic principle and that is the soil. You must have the soil conditions right; otherwise, your efforts are going to be largely wasted. Some of the work that has been done

in the past three years down here, in building new bent greens and renovating old ones, proves the point that if the soil conditions are right your problems are greatly lessened. And the first consideration is sub-drainage. You don't have too much water and there are periods when there is not enough, but there are times when you have got too much. The thing to do is to get that water through the soil and out of the soil in order that there is room for sufficient air to take its place in the soil to promote growth, to have the oxygen there which is necessary for the nicro-organisms, to have the carbon-dioxide for releasing the plant nutrients and deep root growth. You can not get deep root growth unless you have good sub-drainage. There are several ways in which that can be done, and we are not going into detail on any one of those except merely to mention them. In the typical heavy soils that predominate in this area, tile drainage is one of the ways in which to accomplish this good sub-drainage. That tile drainage will not be effective unless there is a layer of two to three inches of highly porous material covering the subgrade so the water can move laterally into the drain tile and out because, if there is an impervious layer over that drain tile, the water is just not going to get into them and the roots are going to stagnate and go to the surface where they can get air. When you have a shallow-rooted turf you don't have a turf that will stand up in this climate.

The next point of importance is internal drainage. Internal drainage is perhaps every bit as important as sub-drainage. Sub-drainage is no good unless you have good internal drainage in the soil so the water can reach those sub-drainage channels and internal drainage in the soil means that the soil has enough coarse particles in it, enough pore space so that the water can move through the soil. That means perhaps more sand, a higher proportion of sand in the soil to provide that good internal drainage. It has been of considerable interest to me to see the gradual change that has taken place in our thinking as to the proportion of sand that is necessary in so artificial a condition as we have in a putting green. You have to admit it is a highly artificial condition. We are mowing the grass every day of the year. We are cutting it down to 3/16 of an inch of its life in order to provide the most perfect playing conditions for the golfers who are paying the bills. That is highly artificial. In order to continue grass growth on that basis we have got to provide as ideal soil conditions as it is possible to do. We are saying now up to 70%

of sand in the top six or eight inches of soil in the putting green to provide adequate internal drainage and aeration. That is terribly high compared with what we have been thinking of in the past. It is terribly high in proportion to what you actually find in putting greens in this area and all over the United States. Very few putting greens in the United States have that proportion of sand in them. We found just one in North Carolina where they had actually 85% of sand of different sizes in the surface six inches of the putting green. And it should be recorded that those are some of the most perfect putting greens in the United States. They have the deepest roots and generally speaking provide some of the finest putting there is. So our thinking has changed on that.

The next item is surface drainage. We have learned a lot about that. We have seen where the architects have left pockets in a green where the water stands because it has got no place to go in any direction except down and, if the internal drainage and the subdrainage is not there, it stagnates and pretty soon the weeds and poa annua and what not comes into that area and gives you a highly unsatisfactory putting green. Surface drainage is highly important, taking the water off the green in two or three or more directions. Certainly we don't want to take it all off on the approach. That is one of the biggest mistakes that has been made in golf course architecture because the approach generally gets too much water anyway and, when you take the runoff from the green, put it on the approach where you have got the maximum concentration of traffic, then you get compaction conditions. Then, where you want some of the most perfect turf on the approach for that delicately controlled chip shot to the pin, you have got the worst conditions that it is possible to have. And so that is another reason for taking that surface water off the green from several directions other than the approach.

I could go into considerable detail about the chemical requirements of the soil. One is the pH, the necessity for having as balanced a condition as possible for nitrogen, phosphorus and potash and all the other elements necessary for growth, but that is a highly technical subject and you can not cover it in the time allotted this morning. But, that is pretty definitely a subject of many articles and discussions and it has to be discussed pretty largely on the basis of what you have under your particular conditions. In this area where you have salts and high evaporation there is a tendency for the pH to run much higher than in

many other sections of the country. Bentgrass will grow well in the range from pH 5.5 to pH 8.5, other conditions being equal. Dr. Reed who was with the U.S. Golf Association in 1931-- when I first came with the U.S.G.A.-- determined that, and those results were published in the bulletin back in 1933, showing the growth of bentgrass at various pH levels. We would like to keep it somewhere in the middle range 6-6.5-7.0 because that represents the pH level where you have the maximum release of plant nutrients, the minimum of tying up the minor or trace elements which are very necessary for plant growth, maximum biological activity, growth of the organisms that release fertilizer and help the grass and that is about all I can say about that at the present time. Now, when you read Noer's stuff you begin to get a very good idea of the balance of phosphorus and potash in relation to nitrogen. Phosphorus and potash are basic, they must be provided in adequate amounts and then the nitrogen must be applied in relation to your conditions and in relation to growth, in relation to the temperature and humidity, and Bob Dunning is going to cover that in excellent detail I assure you, so I shall not cover that any further. We have work going on in other sections of the country where we are studying the relationship of potash to disease and we are finding a very close relationship between the presence of potash and the incidence of disease because we know that if we can grow a healthy plant, healthy in all respects, deep-rooted, we will have a turf that is much more resistant to the attacks of disease than if we have a shallow-rooted, weak plant which is highly susceptible to disease and injury.

Now, let's leave the soil because my time is limited-- I don't want to cut into these other speakers-- so let's consider grass. We have got the soil right, we have everything in there that we need. We have subdrainage, internal drainage and surface drainage. We have got the phosphorus and the potash there. We are providing nitrogen in adequate amounts. Now, let's consider the grass. You have got a choice here, a considerable latitude of choice in the grass that you are going to put on that green. You have seed; you can plant seed on that green and develop turf. On that green you can plant stolons of selected types of grass and have a different type of putting green. Probably one of the most popular of the grasses in this area is Seaside bent because it is a creeping bent because it contains a highly different number of strains of grass, some of which are poorly adapted, many of which are well adapted to your climate, to

your soils and to other things. Seaside bent will continue to be highly useful, particularly in the more arid regions where diseases are not the problem that they are in the more humid regions. The amount of seed to use-- well, we have found that three to four-- a maximum of five pounds per thousand square feet is ample for, where everything is taken care of right, you can use less seed and actually get better results than if you use too much. One of the mistakes that has been made in the past is using too much seed where in the tender seedling plants are so highly competitive with each other that they are all so weak that it takes you longer to get a good turf than if you had started with a smaller amount of seed so that each individual plant was stronger. We know that creeping bent is going to cover it in a relatively short time anyway.

We don't hold a brief for the Colonial bents for putting greens in this area. It is very, very difficult to make a putting turf out of Astoria bent or out of Highland bent. We have got a lot to learn about that and so we are depending much more on the Seaside bent because of its creeping characteristics. Among the creeping bents that are propagated only by stolons a number of them are in Oklahoma. Alex Repin will probably tell you more about it. The Arlington bent (C-1) seems to be standing up very well. It is probably one of the more popular of the putting green grasses all over the United States today and, if I get a chance later on at this conference to show you some pictures, I will show you where in areas where disease is prevalent we have had Arlington bent without any disease treatment whatsoever for some years and it still does not have a blemish on it. Now, it has gotten the disease at one time or another, but the disease was not serious and the grass was strong enough to recover from the disease attack. So you did not have any permanent injury, but some of the other standard grasses like Washington along side of it, under the same conditions, has been completely ruined. So the choice of the grass will go a long way toward determining whether or not you are going to have success in your venture on bent greens.

C-19, Congressional bent is one of the better bents and it is usually used in combination with the Arlington bent. C-1 and C-19 together make a better putting green than either one alone because they complement each other. C-19, Congressional bent, is greener, starts growing earlier in the spring, holds its color later in the fall and through the winter,

but the Arlington bent is much more heat tolerant, drought tolerant, deep-rooted, which we have determined by experiments, and it holds up through the summer better so the two complement each other very nicely.

Some putting greens are built of C-1, C-19 and C-27 all three mixed. But, of the three the C-27 is the weakest cover and I am not ready to say as yet that they are a better combination than just C-1 and C-19 for this area. I would prefer just the C-1 and C-19 down here. There are other grasses, C-15, Toronto bent, is making beautiful putting greens in the Chicago district, but it is highly susceptible to dollar-spot and requires very close attention in order to keep that disease under control. C-7, Cohansey bent, from Pine Valley is another excellent, fast growing grass, but it again is highly susceptible to dollar-spot and must be kept under control by careful fungicidal treatments. But, it has high heat tolerance and so it is steadily moving south as far as bent is going and is becoming a more popular grass.

Many of the disappointments in bent greens in the past have been graininess, a matted turf, sponginess and all of that. Well, that comes under the head of management. And here the man in charge of the work is the important factor because the management of that grass is under his direction. We can point out to you any number of examples where you have perfect soil conditions, perfect grass and yet the management has resulted in a very unsatisfactory green. So the management is perhaps more important than anything else I have said because in the first place if your watering program is out of kilter-- too much water put on it, applied at the wrong time -- you are going to ruin an otherwise perfect set-up. Water management is perhaps the most important of the many other factors of management and we are stressing today, minimum water rather than maximum water. More good bentgrass has been ruined by applying too much water than by applying too little. We are learning that by proper drainage, by proper cultivation-- and you are probably going to hear a lot of this talk about aerifying at this conference because it is happening all over the country-- by keeping our soils open and porous so we can get water down into the soil quickly we can cut our water consumption in half by growing the proper type of grass and deep root systems. So minimum quantities of water until you get an accumulation of salts on the surface; then, it is going to take a heavy drenching of water to wash those salts out of that soil and away in the drainage water. That is going to be necessary

once in awhile. We can not give you much detail on that, but we are sure it is going to be necessary.

Fertilization. Your fertilizer program is extremely important because it has got to be geared according to your play, according to your season, according to the kind of grass you have and it takes a skilled man to do the right kind of a job in fertilizer management and I think Bob is going to cover that so I will not go into detail except just more or less to set up the principles which we have touched on.

Insect control. When we go into a new thing as bent in an area where not a great deal of bent has been grown before, the insects in that area that attack bentgrass are going to ruin you overnight unless you are prepared to recognize the beginnings of that injury and take immediate steps to control that insect. I have seen new bent greens completely wiped out by an attack of an insect when they thought it was something else and did not have any idea that it was an insect doing the job. And we have new tools-- remarkable tools--in order to control our insect pests. DDT, Chlordane, benzene-hexachloride and, at New York at the entomology meetings a few weeks ago, I heard them talking about a new one-- Compound 118. Compound 118 seems to be ten times as effective as Chlordane and Chlordane has been more effective than DDT so we are just taking great big strides in this insecticide field and we won't have to do the basic research on that; that is being done some place else. What you must be interested in down here is the applied research in these new insecticides in order to be able to control the outbreak of any insect.

Disease-- I have already covered disease to a certain extent. Where you are going into bentgrasses for the first time you have got to be prepared to control outbreaks of disease and here is where we can bring you 25-30 years experience in controlling disease on bentgrasses because the diseases are much the same all over the United States and the control is the same. The application of the principles of control you have to determine on the basis of your climatic and soil conditions. We have got three principle fungicides for disease control. One is mercury. Mercury is still in the picture and is most effective in the coolest part of the year, early spring and late fall. The mercury in the soil seems to make the other fungicides more effective which has been brought out already at some of the turf conferences that have taken place before this one. Another fungicide which has

been developed only within the last few years is the cadmium fungicide. There are two of them-- 531 or F-531 and Puratized 177 cadmium fungicides which are specifically for dollarspot control. Don't try to use the cadmium for brownpatch control because it won't work. You will be disappointed; you will say it is no good, but it is not intended for brownpatch control. It is for dollarspot. Then, Tersan is still pretty much the standard fungicide for hot weather disease which is brownpatch. Tersan is safe to use in the hot weather because it does the least damage, but there again Bob is going to cover that and I shall not take it up any further.

I think probably I have covered the basic principles of bentgrass management as well as I can in this limited time, and with absolutely no notes.

MODERN EQUIPMENT FOR TURF MAINTENANCE

By O. J. Noer
Agronomist, Milwaukee Sewerage Commission

I cannot help but feel that this is a mechanical age. This is true on the golf course as well as in everything else. We are being forced to mechanize as much as possible and to do as much of the work that way as can be done. I have no doubt that down in Oklahoma and Texas the situation may be very much like it is in Chicago and New York, Milwaukee and elsewhere. Wages are high and, within the last couple of years, men have been hard to get. Certainly it has not been possible to recruit help in May, and lay them off in November. You had to take roustabout labor as a consequence. Most of our boys thought labor problems were solved when the war ended, but it has been worse since the war than ever before. As a result there has been a trend towards mechanization.

Of course, one thing that has happened is that very few golf courses in the north mow greens by hand any more. Clubs have been forced to go to power putting green mowers. The man who runs the course may have a yen to mow by hand, thinking that the work is better done that way and that it is less difficult to maintain turf under those conditions. I don't believe it is going to be possible-- at least it is not in our area-- to get workmen to use hand mowers on greens. Be that as it may, and even though you may not like power mowers, I think that we are going to have to solve the problem of using them.

During the past couple of years of travel around the country-- particularly in the north-- I have been impressed by the shallow rooted turf, especially on bent grass greens. It is more or less universal. We have been asked time after time what can be done with the feeding or watering program to produce deeper rooted turf. It is a good question, but I believe there is something more fundamental at stake than that. I know soil compaction is on the increase not only as a result of the equipment we use, but also from the heavy player traffic. If they are to blame, it is up to us to find ways to overcome soil compaction.

In speaking of mowing equipment on the greens, many of you talk about height of cut. You say I am cutting at a quarter inch or I am cutting at 3/16 or at 5/16 and so on and so forth. I don't believe that the setting

of the mower on a hard floor has any particular bearing upon the height at which you actually cut the green. Obviously if the mower is set at 3/16 of an inch, you are going to cut closer than if it is set to cut at half an inch, but the fact that it is set at 3/16 doesn't necessarily mean that the green is being cut at 3/16 inch above the ground. If there is a mat of turf on the surface of half or three-quarters of an inch thickness, then you are cutting not at 3/16 of an inch but actually at 3/16 inch plus the thickness of the mat. Usually the grass down in the mat serves no useful function. It is brown in color, and as a consequence leaves do not perform their normal life functions. The dead grass is a possible menace from the maintenance point of view. It harbors disease organisms, and that kind of situation prevents penetration of water etc. So from the standpoint of cut, please bear the above in mind. Personally I don't think high cutting on bent greens advisable. There may be times-- that is, temporarily-- when it is necessary to raise the height of cut slightly over a brief period. But to cut at 3/8 of an inch or higher as some men think best is actually detrimental because it develops a surface mat. Troubles resulting from it may be even worse than anything resulting from close cutting.

Last June Fred Grau couldn't go out to the west coast so he asked Marvin Ferguson to pinch hit for him. We were in Portland during the flood stage of the Columbia river. A number of the courses were under fifteen or sixteen feet of water. I kid Fred about being Alta fescue Grau, and I guess he and Ferguson kid me about being matted grass and dry spot Noer. Now, while in Portland Fergie looked at me and said, "Well, O.J., where are you going to find any dry spots under sixteen feet of water?" Several days later we went to eastern Oregon and stopped at the nine hole course at La Grande. When we went out on the greens -- Mr. Reynolds, the Chairman, was there along with the greenkeeper. He said, "We have some disease on these greens, but we don't know what it is. None of the fungicides seem to stop it." I looked at the greens, and saw localized dry spots although we were standing with an umbrella over our heads. Just to see what would happen, I told Mr. Reynolds, "The greens are dry." He looked at me as though he had made a mistake, wasting his time coming out to look at the greens with such a fool. He said, "Do you see it is raining?" And I said, "Yes, but the greens are still dry." He replied, "It has been raining like this for a week. We have had the wettest fall and the wettest spring in twenty years and then you come out here and tell me

that our greens are dry." So I took my knife and cut out a plug where the grass was still green and showed him that it was bone dry underneath. He was amazed. Then I told him that the heavy surface mat of grass was the cause. They used grass to shingle their greens instead of wood shingles. "Well," he said, "We have been trying to get a good mat on there so the greens would hold the ball." They accomplished that purpose but in doing so got into even more serious trouble as I mentioned a moment ago.

Now, a few words about soil compaction. I believe we are coming into a time when something must be done about aeration of the surface soil-- even though we are quite careful to get the medium sandy loam that Bob Dunning talked about a few minutes ago-- because of the traffic both by man and power equipment. Bob Irwin and others of you were here in the days when I first came to Oklahoma and Texas. You were using forks then, some with hollow tines, some with solid tines. It was customary to do some forking on the bent greens in the southwest one or more times each year. Then, we came into the era of drilling with the Terferator, the machine which has a series of drills operated with a motor and eccentric. It drilled holes five or six or seven inches deep. The job was perfectly satisfactory but slow. And after that, came the Mascaro F-G Aerifier. It was, I believe, at first designed more for fairway use than it was for greens, but with the half-inch--and even with the inch spoons- it is doing a fine job on many greens so far as cultivation of the soil is concerned. Unless the soil contains enough air the roots are going to stay near the top. I don't care what you do about fertilization or water practice or anything else; roots are going to go down in the soil only when the soil is adequately supplied with air to furnish oxygen which they need to survive and live. Grass roots breathe just as you and I do and unless they get oxygen they are going to stay up near the surface where it can be obtained. Last evening Shorty Hornbuckle and I kidded about the last time I was at Odessa and saw the announcement of the Tournament advertising the finest fairways and the lousiest greens in the state of Texas. I understand since then the water system has been installed and they now have good fairway turf as well as greens. As we discussed aeration by drilling or by the Aerifier, Shorty said this, "I'll have to see that Aerifier used before it is going to go on my greens because I think it is probably going to take two or three months for the holes to repair themselves." So I told him, "Well, if that is true, which I doubt, you can use it and

still advertise the best fairways and the lousiest greens in the state of Texas." Yet, I know there is virtue in the Aerifier. I have some pictures that I intend to throw on the screen, but since time is fleeting, I think we had better dispense with them now and show them later in the meeting provided time permits. They deal with the problems of equipment and maintenance.

Just a word about fairways. In the north on some of our creeping bent fairways where there is a heavy mat of turf we have been running into a little trouble in the last year or two particularly if fairways are not cut short enough. Then a mat forms on the surface and water does not go down through it. Localized dry spots develop, and in hot weather grass starts to wilt, then it turns brown and there are bad patches on the fairways. So we are resorting to renovation to thin the turf. The Aerifier is doing an admirable job on the fairways at Milwaukee Country Club and on many other courses as well. Some disc and others use a rotary hoe. Renovation is important in the south also. Those of you who develop good bermuda fairways and get the desirable type of turf density which can be obtained with bermuda, sooner or later you are going to be confronted with the same problem of treating the bermuda a bit rough at times in order to prevent matting and localized drying. The water used on fairways will be far more effective if the turf and soil are in condition to take water.

When greens develop localized dry spots there is often confusion about the type of equipment to use. We have the spiker and when I speak of a spiker I like to think of a tool that makes a hole anywhere from a half an inch to an inch and a half deep. There are a number of spikers on the market; there is the McClain, the Graham, the Wolfrom and so on. These machines have discs with sharp teeth which prick small holes. If the green is bad with localized dry spots due to dry soil underneath, the spiker is not going to do much good. You have got to make holes four or five inches deep and of sufficient diameter to provide a big enough reservoir to hold sufficient water to seep through and moisten the soil. That is the only way to effectively restore soil moisture. I think some of the boys in the Detroit area use spikers every ten days to two weeks. Then there is some justification for its use. In other words, when the tendency is for soil to be hard and for the surface to crust regular use of the spiker during the season increases water absorption. The spiker is used for prevention rather

than for cure. When dry spots develop, deep forking is the answer.

Until I came into this area two years ago I had not seen localized drying from tree roots. On my last trip in August I found that even in the south you have the same problem of tree roots in the greens that we have in the north. You will have trouble during hot weather unless something is done about the roots. A series of pictures appeared in Golfdom showing the root pruner which Jim Haines of Denver Country Club made, and attached to the power lift on his tractor. It does a good job and will snap roots down to a depth of 16-18 inches.

Another tool which should be of value, particularly to those of you who have trouble with salt in greens is the mole drain which Linkogel devised and used on the greens at Westwood in Saint Louis. I understand the Mascaro boys are going to make it. It is a very useful tool. It makes a hole about an inch in diameter. The drain line can be made from three to eleven inches below the surface. The mole drain is especially desirable where the surface soil is heavy. I think I had better stop and not take the time, Mr. Chairman, to show the pictures. If at the end of the hour, or sometime later in the day, the group wishes to see them I will be glad to show them.

Question: Is the accumulation of that mat the only thing that causes localized dry spots?

Dr. Noer: No, there are a number of things that will cause localized dry spots. A matted turf is one of the worst faults. Improper watering is another cause. I can recall some years ago being in New England where the Lord has always been good to them so far as rainfall distribution is concerned. He gives them rains when they are needed so watering has not been as important a problem as it is in an area like Kansas City or Cincinnati. I noticed localized dry spots where the grass was thinning out, it was wilting and turning brown along the edges of the closely mowed putting surface. When the greens were watered no attention was paid to the aprons or the slopes. The water was applied only to the closely clipped putting surface. On sloping banks water evaporates from the side and the top of the slope, or in two directions. The dry soil in the banks tends to pull water out of the greens and develop dry spots along the odge. In areas where watering is quite a problem it is important to keep the banks and the aprons around the green suffi-

ciently moist so water is not going to be pulled away from the green proper. So dry spots can come from faulty watering. Another factor which you don't get in this part of the country is extreme acidity of the soil. When soils become strongly acid the colloidal clay tends to exist as individual particles or in what the chemist says is the deflocculated state. The soil is made more clayey and more impervious to water. Applied water does not go into the soil as well as if it were nearer pH 6 or 6.5 as Dr. Grau mentioned a minute ago. But I would say those are the principal reasons for localized dry spots.

Question: How about if the pH is too high?

Dr. Noer: When reaction is pH 8 or 8.5 on the alkaline side then there is a tendency for deflocculation of the clay. We don't think about that in the north but it is not uncommon down here. I don't want to take too much time because you have other speakers. I do not want to steal their time. Alex is going to do a much better job than any of us have up to now so we want to give him plenty of time to talk.

Question: O. J., I would like to ask you one question on the spiker. Is it used in conjunction with top-dressing?

Dr. Noer: The question was asked about using a spiker similar to the McClain or the Wilder-Strong disc spiker before or after top-dressing in order to work it in. Some greenkeepers spike first, because they believe the top-dressing makes better contact with the soil. In my opinion there is virtue in the practice.

FERTILIZING AND TOP-DRESSING BENT GREENS

By Alex Repin
Superintendent, Tulsa Country Club

The main consideration on the golf course is the greens. To produce superior turf you need good soil structure, water, fertilizer and also good equipment. Every turf grower should know the soil conditions because soil is mother of the plant. Neutralizing soil acidity or alkalinity is the most important factor you deal with. Before seeding or planting on the golf course, analyze the soil for pH. If you are planting an airfield, park area, cemetery, recreation field or farm pasture, also analyze the soil. It doesn't matter where you are-- north, south, east or west-- plant life is almost the same. It is, like human life, born of nature and requires oxygen to breathe, food and water to live on. Study Mother Nature and try to follow her activities, and for proper care use your own judgment and common sense to lead you to success.

Good physical soil conditions produce vigorous turf, but the majority of golf courses aren't built on soil of good structure, and the man who cares for such a course faces quite a few problems. Turf life can be injured by many factors such as:

1. Soil of poor physical condition.
2. Compacted soil.
3. Heavy matting of turf.
4. Fungus disease organism.
5. Drought injury.
6. Over-watering.
7. Over-fertilizing.
8. Heavy top-dressing.
9. Chemical burns.
10. Weather conditions.
11. Mowing at the improper time.
12. Improperly cared for putting green mowers.

And there are many more factors to be on the alert for.

Aerating soil helps to eliminate turf diseases, and improves water penetration. Roots strike deeper and the plant grows more vigorously. Soil aeration is improved by hollow-tine forking or plug ejector, aerifying and spiking. Good soil of pH 6 to 7 should be used for top-dressing. If you have no compost pile, use a good top-dressing mixture. Good loam soil 35%

to 40%, coarse sand 30% to 35%, good decomposed manure or cultivated peat 25% to 30%; all items by volume and proportions varied according to your judgment. To each screened yard of top-dressing material mix hydrated lime from 5 to 10 pounds or more, Milorganite 40 to 50 pounds, commercial fertilizer (your own selection) 30 pounds. This top-dressing should be prepared from three to six months before using and should be kept under a roof or inside a building. Fertilizer and lime make heat in the soil which kills the crabgrass and weed seeds. Before top-dressing greens, remove excessive surface thatch and heavy matting. Use Delmonte rake or brush attached to a power mower, and aerate before top-dressing. It is essential for success of better turf and fewer turf diseases.

For top-dressing 5,000 square feet of green use one to one and a half yards of top-dressing material. In the hot weather reduce the amount to half. Work the top-dressing into the grass with a mat, brush or any other suitable tool. Water it slowly; do not flood the greens or area you are top-dressing. Water will carry particles of soil and fertilizer in the openings made by aerifying. The plant absorbs food gradually through the season. Top-dressing will give a good putting surface, even and uniform; no streaks or ribbons should show from over-lapping spreader. The top-dressing stimulates new growth, improves plant life, heals injury, helps to decay dead roots and dead spongy vegetation and over-comes matted turf.

In top-dressing material, sand separates particles of soil and peat and keeps them from becoming layers. It also helps to prevent compaction. Peat and manure are organic matter and absorb water and hold moisture and build bacteria in the soil which act as a part of the plant life. Brown peat takes longer to decompose and remains in the soil for some time. Cultivated peat and manure decompose easily and leach away slowly. For good putting surface greens should be top-dressed 3 or 4 times through the season and fertilize the greens when they are in need of it, mixing two different fertilizers; it gives better plant food. Commercial fertilizer acts faster and leaches away in a short time. Organic fertilizer (Milorganite) acts slow and lasts longer and helps to build bacteria in the soil which protect the plant from disease infection. Apply Milorganite with an addition of muriate of potash at least twice a month. A light application of 3 to 5 pounds mixture to 1000 square feet of turf should be used. This eliminates dollarspot and gives the plant a chance to grow vigorously and densely. Heavy fer-

tilizing stimulates rapid growth for a short time, makes grass tender and easily bruised and, in unfavorable weather, small or large brown patches can be easily developed, which gives added worry.

In hot weather plants do not grow much but require a little food just the same. Always fertilize light and often, but only when needed. Between fertilizing or top-dressing, light applications of sulfate of ammonia or nitrate of soda ($\frac{1}{4}$ to $\frac{1}{2}$ pounds) and the same amount of muriate of potash per 1000 square feet in liquid form is helpful, but do not overdo it. After rain and in humid weather when algae appears, application of hydrated lime-- $\frac{1}{2}$ pound to 1000 square feet-- in liquid form is helpful. Iron sulfate -- $\frac{1}{4}$ to $\frac{1}{2}$ pound to 1000 square feet-- in liquid form is also halpful. Fall fertilizing should be early enough so the plant uses up the nitrogen and hardens by nature before frost sets in. For winter season try to keep greens more on the dry side, especially in heavy soil. When greens are wet, snow and frost develop low temperature turf disease-- snowmold.

Watering greens is a very important factor on the golf course, especially in hot and humid weather. Watering late at night gives more satisfaction to the players and good condition for maintenance. Morning watering on a heavy played course is not satisfactory for the players and maintenance. Wet greens mark from foot prints and ball injury and the soil becomes more compacted.

The construction and location of the greens is another important factor, as the movement of air and sunlight play the biggest part in plant life. Greens or other turf areas require so much water. Do not over water or flood. Give enough water so the plant can survive at least 24 hours. Water can always be added if not enough, but cannot be taken out if there is too much. We must satisfy the players rather than ourselves. It is our work, our second home, where we make our living for our families and ourselves. Work more effectively, study your profession, search for better plants or seed. There are more than 1000 varieties of grasses to choose from. Plant a big nursery for emergencies. Re-turf two or three greens every year with a good nursery sod and improve the soil structure before you lay the sod. The old sod can be used for approaches around the green. Make a program for turf maintenance and golf course improvement, eliminating hand work as much as possible. It will reduce maintenance costs for years to come. Be active in your organization,

try to attend all meetings, short courses, conventions and do not hide the secrets of your experience. Confer more often with your organization friends, turf experts and college professors for further scientific information. Turf society was not created in one day; it took many years to develop the turf profession and will take a lifetime to improve upon the quality. The biggest contribution ever made was given, and still is given, by the college professors and turf experts. Scientific research is aiding to develop fine turf, not only for sports, but also for parks, cemeteries, airfields and farm pastures.

Research is stronger today and will continue more so through the years to come. These scientists deserve hearty credit from every turf grower in our beautiful country. The knowledge which they give us is of inestimable value.

The greenkeeping profession has an inspiring history of a century of greenkeeping practice. We dedicate ourselves as professional turf growers and sustain our qualities by cooperation through this fine organization.

If you want to be a good professional turf grower, study the plant life, grasses, trees, shrubs and flowers. It is your profession. Don't try to be a jack-of-all-trades by being a mechanic, a carpenter, brick layer etc. Just try to be a good greenkeeper.

I consider it an honor to be a member of this fine organization where it is a privilege to have friends whose loyalty does not change in the fast moving world of today. I appreciate the value of your friendship and I do believe that every turf grower in the country should belong to such a valuable organization. I am proud of my profession, the strong organization and keen minds that have built it and are building for the generations to come.

RELATIONSHIP BETWEEN GREENKEEPER AND PROFESSIONAL

By Joe Dahlman
Past President, Oklahoma P.G.A.

This is kind of a touchy subject. I knew about that when Bob asked me to talk on it. I don't know why he asked me to do it unless it is due to the fact that he and I have talked about it over a great number of years. I want to direct most of my remarks here to the greenkeepers and I hope, boys, that you won't take any offense because I want to get right to the root of it. But, when I do it I am doing it with the thought of giving you some constructive criticism, not trying to antagonize you or make you feel cheap in any way at all. But, it is just things that I have observed and seen through my years as a professional. One thing I am just a little bit puzzled about is Bob said that all the speeches had to be written. I never wrote a speech in my life, but I have got one here, but I am going to do more talking than I am reading.

Now, this subject of relationships between pro and greenkeeper I think is very, very important. To me there is only one word that enters into the picture and that is harmony. If you don't have harmony, boys, you are not going to get along. Now, at some of the clubs it is the custom for the pro to be over the greenkeeper. In other words, being in charge of the course with the greenkeeper under him. I have had that proposition put to me for years and years. Personally, I don't see a thing wrong with it. Later on, as I go on down through here, you will see some of the faults of it and you will see a lot of the benefits. In a lot of cases I think it is the best thing that could happen for the greenkeeper simply because he has a pro in there acting as a buffer between the chairman of the green committee and, not necessarily him, but the members themselves for they will come to him with all their cries and woes for one thing, and another, he gets a chance to smooth them over. Now, I know that in my own case that at different times I have had an opportunity of saving a greenkeeper's job which I have been very happy to do. It was not the greenkeeper's fault that he lost some greens and right away they started talking about, "We have got to get a new greenkeeper." They were ready to let him go right then. Well, I got them together and tried to show them that in the majority of cases it was not the fault of the greenkeeper at all. It was just climatic conditions-- things he had no control over, but they

did not understand that: they had to be told. I think in a lot of cases where things like that have come up they never even talked to the greenkeeper or said a thing to him because I was there to stop them before it ever got that far, for in most of those instances, I did not even say a thing to the greenkeeper. And the reason I did not say anything about it was that I knew it was not right. Why should I go in and tell him that he is just about to lose his job and I stepped in and saved it, trying to throw glory on myself which I was not entitled to. Then, at the same time if you go in there you are going to tear down his efficiency and not only that, but his initiative and he is eventually going to take that attitude-- "What the hell, I do the best I can; I work day and night and they are not satisfied so the best thing for me to do is just forget it or just don't do any more than I have to do to draw my pay." And I think that is the wrong attitude, but you can get that attitude if you were to go in there and keep telling him about every little gripe that comes in. You get that every day so I just forget it.

Now, I have been talking a good bit about myself, but at the same time I think that not only takes care of me, but I will say about 95% of the pros who really take an interest in the greenkeeper and respect him as a man and try to work with him. So I don't think there is any trouble in working under the pro if he is allright. Of course, you are going to run into exceptions; I will cover that a little later on. Now, I think the greenkeepers have done an awful lot to raise their standards, that is to help themselves to raise their standards of wages and living. I remember the time not too many years ago where particular greenkeepers got $125.00 to $150.00 a month. But, he was not a greenkeeper, just the same as pros. Some of them put a bag of clubs over their shoulder and call themselves pros. He is not any more a pro than he is the man in the moon. He has just got a good golf game. But as I say I remember there where they helped themselves. I remember when you would go out on a course to see the greenkeeper and you would have to ask which one he was because he was just as dirty as any of the laborers. And he looked as if he belonged to the House of David because he never shaved except Sunday morning. That is going away now. I don't mean that they should wear a tuxedo or anything like that when they are working, but at the same time there is no reason or excuse for a man not being neat. In other words, if the chairman of the green committee has got a visiting fireman and he wants to come out and brag about

your greens and bring this man out on the course and wanted to introduce you to him, you should not appear dirty and everything or he does not feel very happy about introducing this plutocrat whoever it might be. At the same time you look at the same boy's checks that they are drawing today and they are going to draw in the future and you are going to find that on the first and the 16th that they are up anywheres from $50.00 to $100.00 a pay day, and the majority have done it themselves so it means that they are building themselves up.

Now, here is another thing that Lee has been working for. He figures that your average club-- I mean your good club-- has a big investment there and they value it from a quarter of a million to a million and a half dollars, and I think I am being conservative when I say that. They give a greenkeeper anywhere from ten to twenty-five or thirty-five or forty thousand dollars a year to spend. Now, if you stop to consider that these same men who are businessmen had a business down town, would they go out and pick up some man on the street and give him $150.00 a month to spend twenty-five, thirty or forty thousand dollars a year of their money. Then, put them in charge of a plant that is worth at least a quarter of a million dollars. I don't believe they would. And, boys, you have a chance in there and I would say within the next few years. The trend is upwards to where a good greenkeeper at a good club-- I know there are some clubs now that are doing it-- they pay $500.00 to $600.00 a month. But like I say just a few years ago you could get pretty near anyone for $150.00, but, boys, remember do not expect to sit around to get that. You have got to get out and you have got to attend these meetings and as Alex said talk to your college professors and your scientists, anybody you can get a chance to talk to and they will give you a lot of information. Another thing, I think the average greenkeeper has to learn to do is to talk. By that I mean you don't have to use perfect English or anything like that, but don't choke up. Good gracious, if you have something to say, man, don't get up there and gulp and stutter and mess around like some kid with his fingers in his mouth. Speak free and easy, that is the main thing. And get your point over. That is also advice for the pros as far as that goes. And I guess the greenkeepers have a few things that they could pick on the pros about. No use getting hell from one unless you get it from both and that is what I am figuring on getting when this thing is over.

Well, now, I think we will run across a pro who has to be a big shot, or at least, think that he is in his own estimation. And he has a greenkeeper working under him, but he treats him as if the greenkeeper was only a lackey or a kid or something. Now, that is not my idea of harmony or cooperation at all. When you get connected with him there is nothing you can do to please him. I would say that as a rule this man is not always too expert in his own profession, let alone his knowledge of greenkeeping. But he tries to make himself a big shot by worrying the greenkeeper to death, telling him this and that and the other thing simply because he is afraid for his own job, and he is trying to make a showing for himself and try to make people think how much he knows and how smart he is. But don't hit him over the head with a shovel, just kind of sit back and let nature take its course. The chances are that he won't be there too long because the board of directors is going to get wise to him and if you know your job you don't have to worry about it. But if you don't, then he has got the axe on you.

Then we have the case of the greenkeeper who is on his own. Now, of course, I have heard for years that that is what the majority of the greenkeepers would like. I would not blame them as far as that goes. But, I do think it has its drawbacks because if the pro has nothing to do with it at all, every grievance is going to fall directly on the greenkeeper. Now, there is no reason why a greenkeeper can not have entire charge of a course if he knows his business-- fine. But I think one of the reasons that a lot of these clubs like to have a pro in charge of the course is because the pro plays golf and the greenkeeper doesn't. There are a lot of little things that show up on a course; they need that the greenkeeper play golf and get in some of these places and see just exactly what it is the members are griping about. If he doesn't play golf then he doesn't know exactly what is going on unless the pro or someone tells him all the little things that are insignificant, that you think would not amount to much, but still they do.

Now, like one particular job (I have told the boys about this before) but one particular job I had, many players came in just raising the devil every day and every day because the pins were either on top of a bump or in a corner. Now, I asked him one day what he thought about putting the pin in the middle of the green, especially for Saturdays and Sundays to speed up the play. And his answer to me was, "Joe, I have been greenkeeper for thirty years and in that thirty

years players have never used the center of my greens and, by God, they are not going to." Well, is that harmony? I was not trying to run the course, I was merely trying to make a suggestion but I did not try to make any more. But to me that man was not a greenkeeper, never was a greenkeeper, never would be a greenkeeper. To me he was just a selfish rascal working for himself. He was spending the club's money, using labor, building greens, taking care of them and all the greens were ever used for was just a place where the ball went to the corner of the green and then went into the damn sand trap. And I just cannot see it. My idea on a case like that is why doesn't he just concrete the center of the greens and just play on the edges-- put some bunkers in the middle of the green, put a fishpond in there or anything; the center of the green is no good if you are not getting any use from it. Now, you take at our place on Saturdays and Sundays we run anywhere from 150-300 players a day. Well, when you have got the pin stuck in the corner these players are getting in the trap and you have got too many people around and if you make it easy for them like on Saturday use the front center, then at noon move it back a little bit, Sunday move it back a little bit more in the morning and back again in the afternoon. In other words, change it twice a day to keep the greens from getting tramped up. Now, that is kind of getting off the subject a little bit, but it all enters into this stuff. You know when you put the pin in the center of the green, you give these fellows a chance to score a little better. Now, don't think that Bill Jones and the rest of these boys don't like to get their names in the paper.

Then next you have the small clubs where they can only afford one man. The question you ask is this, "Should the man be a pro or a greenkeeper?" Well, now that is entirely up to the club because we will take two clubs for instance, we will say that they have got 200 members at each club. One club is interested in greens; they want to get out there and walk around so they want the course in shape so they hire a greenkeeper and I think that is the smart thing to do. Now, on the other hand, you have got the club that would rather have a pro and let him have charge of the course and on the course just a man as foreman. Allright, now that pro would have to have a knowledge of greenkeeping because that man he is picking off the course to act as foreman does not have too much knowledge of it or he would not be in that position. So the pro goes out every morning and designates some work, assigns him this and that and then he goes out to see

how things are coming along. Now, that club wants a man that can stick around the club and the shop during the day. So that is just one of those things.

I just talked with a friend and if they go through with an idea that he has in mind, they are really going to have a sorry set-up. I don't know if he told you about it. They are going to put the club manager in charge of the pro and in charge of the golf course with the pro under the manager and the greenkeeper under the manager. He is going to tell them what to do. He is going to tell them how much money they can spend. He is going to hire and fire the men on the course. Now, that certainly is going to be the most godawful set-up that one man ever told another about because I know that this club manager doesn't know bent from bermuda. But, he is going to run the golf course. I know that I can tell you what I think is the reason for this and that is that they had one of those so-called big shot pros who has worried the poor greenkeeper to death until they can not even get a decent greenkeeper or even go out and talk to anybody about taking the job. I know they talked to two or three good greenkeepers, met them on the street or called them on the phone and they would not even go out to see about the job because this pro would just make life so miserable for them that it is not worthwhile.

Then, you have the greenkeeper or pro who is working directly for the owner of the course. Now, that really should be a pretty easy set-up, unless the owner is a nasty little screwball, because he is interested in making money. The country clubs are a non-profit organization; they are not particularly interested in trying to make money; they are trying to save and stay within the limits of their dues, but on these privately owned courses the person who owns them is really trying to make some money. Well, if you want to get some fertilizer, you can go to him and ask him and tell him what you need it for and the chances are that he will go ahead and get it. Well, that makes it easy and all the way down the line, anything you want. The only time that you are going to be out of harmony there is when you cross him. Now, when the harmony is gone you are out of a job because he is not going to keep you if he cannot get along with you. He does not have about ten or twelve other directors or 300 members that are going to say that he is all wrong and the greenkeeper is right. He just says I am getting me a new man and that is all.

You say that you have got your problems there. We have got a difficult problem of our own and that is our fiscal year. Our fiscal year ends June 30th. By the time the first of April rolls around we have not any money. Now, if you think that is not something to work with. We have to try to anticipate our needs back in September or October. What we are going to need in the spring in the way of fertilizer, sand and all that stuff and order it and get it because later if we don't the money is spent for something else. Then here comes the winter and you have got a different picture entirely. You have got to anticipate and get everything that you need, but you cannot do that. When you run across a proposition like that, that is something that is hard to handle. Now, I believe that this pretty well covers everything but I still cannot see where the pros and the greenkeepers cannot get along. They are both-- I will have to say here-- they are both getting over the lousy, petty jealousies that they used to have a few years ago. And I know that some of you old timers can remember that. I can remember when greenkeepers thought that they had discovered something and they would not give that deep, dark secret information out to anybody. Well, you simply could not have got together a gathering like this 15 years ago to discuss turf problems and this and that and the other thing. I say no, and I know because I have gone through all that. And the pros are just as bad as the greenkeepers. But they are not like that now; they have all opened up. So there is no reason why they cannot get along; they are working for the same people; they put up with many of the same problems and there is no reason why they can't work together in harmony.

FERTILIZER PROGRAM FOR ATHLETIC FIELDS

By Professor A. W. Crain
Texas A and M College

Some two dozen colored slides were used to illustrate several points about fertilizing and managing turfs on athletic fields. The remarks cover bermudagrass improvement and elimination of weeds.

Soil Conditions and Shape of the Field-- Most football, baseball and other athletic fields in the Texas and Oklahoma section are natural areas that have been developed as a matter of necessity rather than planned and prepared areas. Usually this involves the use of subsoil or other waste soil from building excavations or landscape work. This dirt -- not properly called soil, has been used to fill in and develop the infield of the diamond or the oval contour of the gridiron. As these pictures indicate, good surface drainage may be impaired by heavy machinery or the ruts of tracks left by trucks hauling soil for top-dressing. On a new field or one completely renovated by plowing, it is a good practice to even and smooth the field by top-dressing with soil after the turf becomes established. An uneven surface was shown to limit the development of a good smooth turf. This is due to poor drainage or excessive water or fertilizer on parts of a field. (Slides were shown which illustrated the above features.)

Soil Analysis and Fertilizer Requirement-- The best basis on which to begin a fertilizer program is soil analysis to determine available calcium, nitrogen, phosphorus and potash. Surely no turf exists that does not need nitrogen. The pH of the soil should be between 6 and 7. The amount of organic matter is highly important for good vigorous growth of turf grasses. The amounts and kinds of fertilizer-- including organic materials-- to be used will largely be determined by the chemical analysis of the soil. Other factors are the condition of the turf and the amount of water available.

Mowing and Watering influence the amount of fertilizer to be used-- or watering and mowing determine the amount of fertilizer, they all work together. Watering should not be too frequent but plenty to keep the soil moist. This means heavy applications of water in preference to light frequent applications. Mowing bermudagrass at one to one and a half inches during

fall and spring and two inches during the summer is most favorable. There are many fundamental reasons for this which will not be elaborated here. The mower must have sliding adjustments in preference to adjustments that will lower the blade a half or an inch at a time. Turf for the infield of a baseball diamond during the playing season will need closer clipping, consequently more water and fertilizer.

Weed Growth-- Turf men will vary in their estimates due to varied conditions, but no doubt fully 80% to 90% of the weed problems on athletic as well as other turf is due to lack of plant food and proper soil conditions-- topography, texture, drainage and others which influence plant growth. Thus, when we make the environment right for good plant growth, bermudagrass will crowd out other plants-- weeds.

Good Turf and Public Health--This is one point which I want to discuss briefly before developing a fertilizing program. The others discussed relate to the effectiveness of fertilizer and points which must be considered in getting a good turf. This point of public health-- health of the athletes using the turf and the enjoyment of the spectators is a result of good turf.

I have been unable to obtain figures, (I doubt that they exist but would be happy to have some) to illustrate my point, but athletic directors and coaches have given general statements. Being as unhuman as possible and considering only the dollars and cents involved, they say that the expense of a good turf is much less than the added cost of doctor bills. Dollars may pay for setting a broken leg or arm, salve may help to soothe the irritating effect of bruises and scratches resulting from hard-caked poorly turfed fields. But money can't replace the boy or his spirit or the fighting spirit of a team. Boys do not tumble or wrestle on cement, they use a heavy mat. A good mat of healthy turf is as much a cushion and much more beautiful and pleasant.

Yearlong Fertilizer Program-- Having briefly discussed fertilizing and some unmeasurable values of having a good turf, let's now briefly outline a general fertilizing program. Each field presents special problems; still we can proceed with generalities. Let's take an average football field. It has not been fertilized in recent years, crabgrass is abundant, fair stand of bermudagrass. Following the last football game we will completely renovate the field and apply a ton of

5-10-5 or some similar complete fertilizer. This must be somehow worked into the soil. Grade the field and even the surface and slope to the general contour needed. The last evening and smoothing operations are with the slope-- up and down, not on the level. In the late winter use a top-dressing to spread by hand to even up the low spots. Use a mixture of 50% loam, 25% coarse sand and 25% organic matter. This organic matter may be well rotted barnyard manure, or cured city sewage or other such material. Then about the time the bermudagrass begins to grow seed, add 50 pounds of high quality hulled bermuda seed. Apply nitrogen fertilizer using about 60 pounds of nitrogen. This would be a ton of cottonseed meal or a ton of Milorganite or 600 pounds of ammonium sulfate or 400 pounds of ammonium nitrate. Repeat this fertilizer application in the late spring.

Following this application, raise the mower to 2-2½ inches. Beginning the middle of August, lower the mower ¼-inch each time you mow. By the first practice game it will be back to the proper height.

Even without experimental proof, doesn't it seem logical to apply a third or half of one of the spring fertilizers early in September if the field can be watered?

Now what the turf plants can tell you. If burclover or white clover is abundant, do not use a complete fertilizer; use only a heavy application of a nitrogen fertilizer. Clovers don't like this.

The time to fight crabgrass is now in the summer but late fall and early spring-- use plenty of good plant food-- fertilizer.

An application of quick acting fertilizer (ammonium sulfate or ammonium nitrate) applied on dallis grass during the summer will kill the grass. When moisture becomes available the bermuda will use the nitrogen and soon cover the bare space where the dallis grass existed.

I hope this brief summary has been interesting and that it may prove useful. Better turf means better sports and sportsmen.

FERTILIZING BERMUDA TURF

By O. J. Noer, Agronomist
Milwaukee Sewerage Commission

When I first came to the South, I was told that bermuda would grow anywhere out in the open. The implication was that it did not need any feeding. After the preceding talk I can see that that view no longer prevails. What I propose to do this morning is to outline briefly what seem to me the basic principles underlying the fertilization of bermuda turf.

The first thing that must be considered is the matter of soil reaction. Bermuda grows over a very wide range of reaction; I have seen it existing on very acid soils and also doing very well on alkaline soil. However, those of you who have athletic fields and happen to have acid soil can testify to the fact that bermuda responds to lime. The first pictures that I ever took of bermuda-- and that was long before Kodachromes were in existence-- was on the football field at Rice Institute at Houston. The bermuda alongside the lime lines was green and looked healthier, whereas out beyond it was brown and suffering from several weeks of dry weather. We must remember the fact that if the soil is too acid, bermuda needs lime. It shows up principally in its ability to better withstand drought and other adverse conditions.

Then, comes response to fertilizer, normally nitrogen, phosphorus and potassium--those are the three elements generally considered from the fertilizer standpoint. Professor Crain stressed the especial importance of nitrogen. There is no question about that. Of course, bermuda must have all the other necessary elements as well. However, with respect to phosphorus it resembles the fescues and the bents in the North, rather than grasses like Kentucky bluegrass. Bermuda can exist and grow fairly well on a low level of phosphorus, whereas the bluegrasses must have a high level of phosphorus in the soil. Either bermuda does not need as much phosphorus, or it is more aggressive in its feeding powers for phosphoric acid. If the soil is low in available phosphorus, probably a third to a half as much phosphoric acid as nitrogen will suffice even on greens where clippings are taken off.

A couple of years ago I had a letter from a contractor in Tennessee-- he was doing some work for TVA. He told me that payment was being held up due to the fact

that he did not have a stand of bermuda on the shoulders alongside the road. The area had been sprigged with bermudagrass the year before, but the bermuda did not make a satisfactory covering. We asked him to send us some soil samples, which he did. We found a soil reaction of about 4.5-- pH 4.5 and according to the Truog method there was no more than about a trace or about 15-20 pounds of available phosphorus to the acre. We suggested that he apply between one and two tons of lime, put on 500 pounds of 20% superphosphate which is 100 pounds of actual P_2O_5, and then enough nitrogen, or about 3000 pounds of Milorganite per acre. With the lime, phosphoric acid and nitrogen we were sure he could get a turf. That was done in the spring. I did not hear from him so in December I wrote and asked him how he got along and he replied, "Well, I have been paid my $28,000 which was held back, which should answer your question." This was one case of those exceptions when lime and phosphorus were important along with the nitrogen. So for that reason I think it is well to check the soil for reaction and phosphorus, particularly in east Texas; I don't imagine you have any acid soils in west Texas, but in regions where rainfall exceeds 25 inches per year it is a good thing to find out what the situation is with respect to reaction and be guided accordingly.

Some time ago-- it was mentioned yesterday-- I had a letter from down in Texas about scale on bermuda. The boys in Florida were troubled that way. I wrote them about what the latest information was and got no reply so, as I told some of you yesterday, when I was in Florida about three weeks ago I talked with Baker and he told me about the work that Bair was doing over at the Everglades Station and also what the local situation was. Insecticide treatments have not been too successful in Florida. However, the trouble was mostly on the Coquina rock soils which are very alkaline because of the high content of calcium carbonate. They finally concluded the problem was largely nutritional or one of getting a more healthy and better bermuda. With them iron sulfate did a lot towards keeping the bermuda in reasonably satisfactory playing condition on the golf course. I recall one of our men who had athlete's foot very bad, his toes were raw; his hands were bad. At times he supervised the mixing of sodium arsenite to make Milarsenite and was blaming the sodium arsenite as being responsible for his troubles. My wife happened to have been trained as a nurse. One time when he was out at the house she said, "Si, it seems to me that instead of trying to find some salve or some dope that will hold the athlete's

foot under control, you should go to a man who knows his business and get at the root of the trouble and find out what really is wrong." He went to a skin man for an examination and was told, "I don't know what the trouble is, but it looks to me like a goiter problem, that you need iodine." He was given a metabolism test, and told to take iodine. It was not more than a few weeks before his trouble with athlete's foot disappeared. Today he does not putter around and look for palliatives to keep the fungus under control, which it actually is. This example shows the importance of getting to the root of the thing rather than trying to treat symptoms.

Most of you are interested in golf course turf. You have heard something about athletic fields and I imagine you will hear something about renovating old sod-- bermuda sod-- by the next speaker. So far as golf greens are concerned the way to have a good bermuda green is to feed enough nitrogen to keep the grass vegetative and leafy. It was all I could do to keep from injecting myself into the picture when Professor Crain was showing slides because several of them showed so very strikingly the thing which seems to me is so important. In an early one you saw the effect of nitrogen on the bermuda--how much more leafy it was and much finer textured. That is the point I want to make and stress. Phosphorus and potash should be kept at a minimum during the summer because one of the big problems is to prevent stemminess and stiff leaves. The bermuda wants to produce seed. In other words, every plant so long as it is vegetative tends to stay softer and more succulent. Then as it approaches maturity it becomes stiff and stubbly. Your problem is largely one of trying to keep the grass vegetative throughout the season. Bill Perry is here from Memphis. The greens at his course are always good throughout the season. I believe they receive approximately three pounds of nitrogen per thousand square feet per month. Over a season that would be equivalent to 20 or 25 pounds of nitrogen, somewhere in that category per season, or a total of 800 to 1000 pounds actual nitrogen per acre. Some of the rates mentioned by Professor Crain seem excessive at first, but they are not too heavy afterall.

A northern grass is used on bermuda greens for winter play. Ryegrass is used mostly. Nitrogen feeding of the bermuda should stop a month or six weeks before the winter grass is to be seeded so that the bermuda will harden off and not continue vigorous growth at seeding time. It is harder to get rye to take hold

and make a stand of turf if bermuda offers too much competition. Furthermore, damping off is aggravated by too much nitrogen. Loss of ryegrass immediately after seeding is apt to occur when the level of nitrogen is high. Those who have the best results year after year are the fellows who stop or materially reduce the amount of nitrogen about six weeks before seeding time. Then, they renovate the bermuda to thin it out. As I said yesterday if the bermuda is thick or heavily matted the winter grass seed cannot make contact with the soil below. Then you are going to lose a lot of grass and some of you will blame damping off when actually it is because of too heavy a mat of grass. About a week or ten days before seeding, the greens should get a good dose of superphosphate and potash. We like to see anywhere from 10-20 pounds per thousand square feet of superphosphate and from 10-15 pounds of 60% muriate of potash, applied at the time. These two elements, more than anything else, can cause stiffening of plant structures which is extremely important because ryegrass seedlings are very soft and tender. Withhold nitrogen until about two or three weeks after seeding and then begin to use it. Ryegrass is not quite as heavy a feeder for nitrogen as bermuda, but it will take a lot more nitrogen than many of you suspect. If you follow the plan described above and avoid using too much organic matter in the top-dressing used at the time of seeding, I know you will have much less trouble.

Some of the things said by Professor Crain about athletic fields apply just as well to fairways. There is a great deal of similarity. When bermuda is thin you don't have to worry too much about sprigging provided there is some grass present. A dense turf can be developed by feeding alone. In my opinion the thing to do is to check soil reaction, and soil content of available phosphorus and potash. Take care of them first, and then it is a matter of nitrogen. I have said-- but am just a piker apparently-- that anywhere from 100-250 pounds of actual nitrogen per acre should be applied. Enough nitrogen must be applied to get turf density, after that is attained it is a matter of using enough to keep it that way. Some southern clubs are afraid of crabgrass and clover. Some who tried watering had a bad infestation of either or both. It was not altogether the fault of the water. Fairways can be watered; that has been demonstrated by John Price at Southern Hills, by Memphis and at other places. Where a high level of fertility is maintained so the bermuda is dense and heavy crabgrass, clover and other weeds are not a big problem. Actually it is

a simpler problem to have good turf with bermuda than it is in the north with bluegrass, fescue or bent.

Soil tests are no better than the samples which are collected. One can show almost anything within certain limits by the way samples are collected. Agricultural or farm lands are plowed, disced and cultivated so samples are collected to the depth of the plow layer. It is a representative soil sample and the tests reflect the soil situation with respect to levels of phosphorus and potash. It is not the case on the grasslands. Once the turf is laid down it may stay there for 20 or 30 or 40 years. I know some golf courses where fairways have been in existence for 40 years or more. The soil has not been disturbed. As a consequence any phosphorus or potash applied in fertilizer tend to concentrate near the surface. We find both these elements more plentiful in the first inch. They gradually decrease and may be quite low at a four inch depth. In our soil testing we experienced trouble at the start because there seemed to be no consistency in the tests. A club would send in samples this year; we would tell them to put on some phosphate and to put on some lime. In the fall we would get a new batch of samples, and the soil would show less phosphorus and maybe greater acidity than it did in the spring. We were in a dilemma and at a loss as to what to tell them. They would say, "We put on a lot of phosphorus as you said and then the darn tests show even less, so where are we going?" And as a consequence we sampled the first inch, the second inch, the third inch, the fourth inch separately and ran tests on them. We found phosphorus and potash high near the surface and both decreased with depth. That is why we insist that samples be drawn at a uniform depth, and use samples drawn to a uniform depth of two inches. When that is done we get results which are consistent one year to the next. Then it is often possible to spot things that you fellows have done even though you don't tell us; whereas with the old method that was never possible.

A good sampling tool to my way of thinking is a broken golf shaft because then it is not necessary to pick extremely large samples in order to get a fair composite sample representative of the area being sampled. Eight or ten plugs from a green is enough. Eight or ten plugs from an area on the fairway, where the soil is uniform and topography is uniform, usually gives a fairly representative soil sample. The sampling tool can be made from a discarded steel golf shaft. It looks like the one illustrated. The steel shaft tapers

Soil Sampling Tool

so we suggest taking a hacksaw and cutting the end off square. Then, take out a section shaped as illustrated using an emery wheel. The lip should be approximately 3/16 of an inch. The cutout section should be three or four inches long and it should be taken down to the center of the shaft, so it is easy to slip the plug out. A score card pencil can be used to push the plug back through the lip and then by turning the shaft over the plug will fall out. A mark should be filed two inches from the bottom. Paper bags which you can get from the grocery store make good containers. A soft lead pencil should be used to mark them.

There are a good many inexpensive kits for soil reaction tests. They are based upon coloremetric methods so that you can make the tests yourself. Personally, I would not advise you to run phosphorus, potash, calcium, magnesium, manganese and so on by yourself. These tests should be made by someone who is trained to do the work. I believe there is such a service in Texas under Dr. Fudge and a similar service in Oklahoma as well. So you can send samples to your experiment station or others who do that type of work. I guess that is all I have to say.

Comment: There is one thing that I would like to bring in at this point on fertilizing bermudagrass that we have learned from fertilizing our pastures and that is those pictures you saw awhile ago where we applied 40 pounds of nitrogen. Thirty days after we applied the nitrogen, the bermudagrass had used up all the available nitrogen as indicated by the soil tests and by plant tests. So it will be necessary, I believe and most of our fellows do, to make rather frequent applications of nitrogen to some of our sandy soils, particularly in Texas. Within sixty days after we had applied 120 pounds of nitrogen to the acre we could find no nitrates in there for six inches; it was gone, just passed out of the picture. So that calls for frequent application. Dr. Noer, do you agree with

that?

Dr. Noer: Absolutely. And I am glad you brought that up because I would like to inject something else on soil testing. Personally, I never put much reliance in soil tests for nitrogen on grassland because if grass is growing well it takes up most or all of the available soil nitrogen unless there has been a very heavy application of soluble material such as sodium nitrate or ammonium nitrate. One can judge need for nitrogen by the behavior of the grass. Afterall, nitrogen is the sales promotion engineer of the fertilizer industry. If the fertilizer contains nitrogen you are going to say that it is a good one because the grass turns greener and grows better. The other elements are important also, if they are deficient. They have got to be present in ample quantity in order for the nitrogen to really do a job. Some years ago there was trouble with bent greens in the north, a man in Baltimore told me, "I have got the secret of maintaining this bent. I maintain the nitrogen in my greens at 60 parts per million." And he said, "Look at this green, it has 300 parts per million." "Well," I said, "Bob, did you stop to think that you have lost the grass and have nothing to take up nitrogen so as the soil organisms develop nitrates they accumulate in the soil." So the nitrogen tests on turf are the least reliable. What we need is to learn more about tissue tests. They may give us the clue to the nitrogen story for grass.

OKLAHOMA TURF PROJECT

By William C. Elder
Oklahoma A and M College

Since the turf project under the supervision of the Oklahoma A. and M. College Agronomy Department was started less than a year ago, only a short progress report can be made at this date. However, an outline of the project and methods of procedure can be given.

This study started at the Oklahoma Experiment Station in 1948 and was organized in close cooperation with the Oklahoma Turf Association. Many of the objectives are suggestions that were received from this organization. This is the first turf project started in Oklahoma. All of the research work on this subject now available has come through study of grasses for pasture. Of course, much turf information is available from practical experiences of home and landscape gardeners and many others. However, a critical evaluation should be given to many of the turf practices now being used in Oklahoma. There is a great need for better adapted species and strains of grasses for the many special turf studies found in the state. More information is needed for maintenance of turf in all parts of the state, especially is this true for some particular cases. It would be desirable to give recommendations for turf establishment and maintenance with the same degree of accuracy that can be given for pastures in Oklahoma.

The first objective of this project was to make an evaluation of the species and strains of grasses now available for turf. A turf nursery has been established on the Experiment Station and it now has twenty-four different grasses with some in combination established. Other turf grasses will be added to this nursery as they become available.

This nursery is fertilized and clipped at different heights to check the reaction of many plants under the different management practices. If any one grass shows up in this nursery for a particular turf use, it will be moved to the other sections of the state to check its adaptation.

The second objective is maintenance of bermudagrass and buffalo grass under turf conditions. These two grasses were already established on the experiment station and plots were laid out and fertilized with

ammonium nitrate at rates equivalent to 0, 50, 100 and 200 pounds of nitrogen per acre. These plots are clipped at 1/2 inch, 1 inch and 2 inches. The objective is to find the proper amount of fertilizer to apply to these two grasses and the height to clip. This study will require several years as the root system will have to be studied for reserves after the second year.

The third objective is a selection of buffalo and bermudagrass strains for turf. These two grasses are now being used in the state without regard to different strains within the species. However, we find that there is a great variation many times within the same area where these grasses are found growing. Several of the selections of bermudagrass have been isolated and will be checked for their ability as lawn and turf selections. In our extensive buffalo nurseries planted this year, it was very noticeable that some male plants were producing a much better color of forage than others which is desirable for turf planting. It was also found that the mating of one male and one female buffalo plant produced a much finer leaf, another very outstanding feature for our turf selection.

The fourth objective in this project was weed control. Since much work has already been completed on this subject, especially for the use of 2,4-D on grasses, most of the time will be spent on bermudagrass control. Bermudagrass is our best lawn grass but it also quickly becomes a pest when it spreads from our lawns or our highways to our fields, gardens and flower beds or from our fairways to our golf putting greens. Several chemicals are being used to check the growth of this plant. One or two already look promising for eradication. If a convenient way is found to keep this grass in its place, it will be of great help to our turf information.

Other objectives will be added to this project as the ones we have now take less time, as the demand for particular problems require more information, and as more personnel and finances become available.

A STUDY OF THE PHYSICAL PROPERTIES OF GOLF GREENS IN OKLAHOMA

By William L. Garmen
Oklahoma A and M College

The physical properties and the mechanical composition of the golf green has long been recognized as one of the important factors in growing and maintaining healthy and vigorous turf. Too often the standard procedure of the greenkeeper has been one of "trial and error", with the old Army philosophy of "do something right or wrong". Unfortunately, this situation still exists because enough of our soil scientists have not been called upon to study these specific problems. The maintenance of turf on a golf green is indeed a difficult problem. There are few other circumstances in which soil is required to withstand such heavy usage under severe treatment of daily compaction with all variations of moisture conditions and still produce vigorous plant growth. The greenkeeper who can maintain vigorous and healthy grass under such adverse conditions deserves much credit. The important thing that he needs is more technical assistance in doing his job. Many important problems in soil physics have been studied and reported upon, but most of these have been in relation to field soils and to crop production. More of this information should be specifically applied to green construction and maintenance.

Dr. H. J. Harper, Soil Scientist at the Oklahoma A. and M. College, was one of the first to recognize the need for a study of green construction and maintenance. About 20 years ago, he suggested to the personnel of the Indian Hills Club at Tulsa, Oklahoma, that they spike or fork their greens to increase porosity and percolation of water during high rainfall seasons. He also suggested that more favorable top-dress mixtures could be worked into the spiked holes. Since this first experiment in spiking, the hollow tine spike has been developed and is considered standard equipment for green maintenance over the United States today. About a year ago it was decided that basic information was needed concerning the mechanical composition of the greens at the different golf courses in Oklahoma. During August of 1948 porosity measurements were made and soil samples were collected for laboratory analysis from both good and poor greens at ten golf courses in the state.

The results of the analyses from this preliminary survey have furnished valuable information for the solution of some of the most important green problems. These results are shown in Table I.

One of the first observations is the apparent similarity in mechanical composition of the surface four inches of both good and poor greens on the same golf course. The data further show that the percentages of sand, silt and clay in the greens of all the golf courses sampled were very closely related. Even though the amount of clay in the different greens varied from 1 to 10 percent, most of the samples varied only slightly from the average which was 5 percent. The average silt and sand percentages were 20 percent and 75 percent, respectively.

At the 1948 meeting of the Soil Science Society of America, Dr. Fred Grau reported the results of mechanical composition studies at the Saratoga laboratories. This report indicated that greens should contain 10-15 percent clay, 25-35 percent silt, 50-65 percent sand and 3-6 percent gravel. You will note that the above mentioned clay content is considerably higher than that found in Oklahoma greens. For several years we have recommended a clay content of 8 percent, since this amount is considered to be more favorable for Oklahoma climatic conditions where high seasonal rainfall requires a soil mixture of relatively high porosity.

Until more extensive investigation has been completed, we consider a soil mixture of 8 percent clay, 20-25 percent silt and 65-70 percent of sand and gravel to be a favorable combination for this climatic region. Since the clay is the fraction of the soil which holds substances like potash in reserve, nutrient deficiencies may occur unless the clay content is held to an 8 percent level or unless frequent applications of balanced fertilizers are applied. It is more economical to maintain favorable soil composition than to make frequent soil amendments.

The results of the survey demonstrate at least two good reasons why there has been a trend in Oklahoma toward coarser textured top-dress mixtures which are low in clay content. First of all it has been deemed necessary to increase the infiltration rate of water since it has been apparent that many greens have absorbed water slowly-- especially during the spring months when rainfall is excessive.

Secondly, the soil used in the top-dress mixtures has not been of favorable composition. Table II shows the mechanical analysis of a typical soil used for top-dress mixtures in Oklahoma. This soil contains less than half enough clay to be considered satisfactory for making a top-dressing mixture with a 1-1-1 ratio of soil, sand, and peat. It is suggested that a creek or river bottom loam or silt loam soil, which contains 20 to 27 percent of clay, 45 to 65 percent of silt and 25 to 35 percent of sand, be selected for use in the top-dressing mixture; if 30 to 40 percent of this soil is used, the mix will contain about 8 percent of clay.

The infiltration measurements which were made on the greens show that the rate of water penetration varied considerably from one green to the next, even though the mechanical composition of the surface four inch layers was almost identical. The infiltration tests (Table I) at the Oakes Country Club at Tulsa are specific examples. On the high side of Number 11 green, the infiltration rate was 1.14 inches per hour. On the low side of the same green the rate dropped to 0.66 inch per hour, and on Number 3 green (almost same composition of sand, silt and clay), the rate was only o.34 inch per hour.

These tests show that the composition of the sub-surface layers of soil are restricting downward water movement; that position on the green and topographical location of different greens, all, are factors affecting water penetration. The sub-surface layers (below 3 to 6 inches) of most of our greens are composed of soil materials of relatively low porosity. Where greens are located at the base of long slopes or at the base of escarpments, underground water movement together with capillary rise under the green reduces infiltration. When water penetrates to a slowly permeable layer in the soil profile, it begins to move laterally down-slope. On undulating greens where there is a sharp reduction in slope, water will accumulate to the saturation point during the rainy season.

It is my opinion that the most important job in the development of better greens in Oklahoma is to provide or develop better drainage conditions in the sub-surface layers, usually at 6 to 18 inch depths. The profile analysis of the number 3 green at the Southern Hills Country Club, Tulsa, Oklahoma, (Table III) illustrates the condition which exists on many golf courses. Note that the surface layer is of favorable composition; the 6-12 and 12-24 inch layers, however, contain 21 to 28 percent clay, 38-48 percent silt and

35 to 40 percent of sand (mostly fine and very fine). The color of these sub-surface layers was yellow and grey mottled, indicating low porosity and poor aeration. Because of this poor physical structure this green developed an excess of salinity which reached toxic proportions-- the turf was badly damaged this fall.

The first consideration in developing better greens is to decide upon a practical and economical way of improving the physical structure of the sub-surface layers. When this is done the rate of water infiltration will reach a more satisfactory level, aeration and gaseous exchange will be improved, roots of the grass will penetrate deeper, and a more desirable turf which requires less maintenance will be developed.

There are several procedures which may be used to do this job. A procedure developed for one green may need modification for another. Suggested techniques would include tiling, spiking with hollow tines to at least 12 inches in depth, drilling cores 2 inches or more in diameter at 1 to 2 foot spacing to a depth of 2 to 3 feet and filling with gravel - gypsum mixtures, and on greens which are very difficult to maintain, complete reconstruction may be advisable.

Where new greens are to be constructed, a more careful selection of materials for the sub-grade should be made. A few more hours or a few more dollars spent at the time of construction in better design technique will return large dividends in future maintenance savings.

One would readily agree that extensive research is needed to carry on the program suggested above. We need more information on the infiltration rates of the various soil materials; the resistance of these materials to compaction under heavy play; and their ability to hold a reserve and yet furnish a readily available supply of water and nutrients for plant development.

When this has been done, we will have solved a few of the many problems that deserve our attention.

INSECT AND DISEASE CONTROL OF SOUTHERN GRASSES

By Fred V. Grau
Director, U.S.G.A. Green Section

I don't know who put me on the program because I know less about the southern grasses than most of you. But, since bentgrass has moved this far south, we will consider for the moment that bent is a southern grass. At least it is the one that will require the most attention.

What are your insects on bent greens? I heard a number of you talking about cutworms eating you out of house and home and that you couldn't control them. Sod webworms, chinch bugs, mole crickets and ants are others. Well, fortunately through research, Chlordane, one of the new insecticides, will control every one of those insects on greens, without damage to bentgrass. It is used at the rate of 4-8 ounces of 50% wettable Chlordane to a thousand square feet. With ants plenty of water must be used following the application to get it down into the holes. With the other insects it doesn't seem to require quite so much water. Those applications of Chlordane have been marvelously effective pretty well all over the country. It is one of the new insecticides that is really giving relief. I don't say that pyrethrum, rotenone, benzene hexachloride and DDT and those things are out of the picture, but Chlordane seems to take the place of a number of them and do a better job at equal or lower cost.

Earthworms-- the standard treatment is still arsenate of lead, 5-10 pounds to a thousand square feet when necessary. Arsenate of lead does other things besides controlling earthworms -- it helps to keep down crabgrass. The standard treatment for crabgrass and chickweed and poa annua on many bent greens in the country is arsenate of lead. If you use enough arsenate of lead, you don't have poa annua, you don't have chickweed, you don't have crabgrass. That makes it pretty easy. Of course, arsenate of lead is rather expensive, but still, on those highly specialized areas, the cost is justified.

You are fortunate that as yet you don't have the tropical earthworm. The tropical earthworm is giving the boys a lot of trouble along the eastern seaboard. They pole and sweep the greens 5 to 10 times a day to keep them playable. In hot, muggy weather the greens are continually covered with wormcasts; they cannot be

kept down and, in sweeping and continually poling, they injure the grass until they hardly have any grass left. A research project has been set up at the Connecticut Experiment Station at New Haven to study the habits of the tropical earthworms and to try to devise a means of controlling it. They get fat on arsenate of lead; they get fat on Chlordane and DDT and benzene hexachloride. You have to kill the grass and you still don't get the worms. We hope to get relief soon.

Army worms have given a considerable amount of trouble in a number of parts of the south. I don't remember the exact details of the army worm control program but your entomologists will know. I know that DDT has given some results, so have arsenate of lead and benzene hexachloride. The only thing about benzene hex around the golf course is that musty odor that hangs on for days and days and it is rather objectionable to the players.

I am not going to try to cover the insect problems thoroughly because that is an entomologist's job, and I am not one. On disease I think that has been fairly well covered at one time or another during this conference. I want to reiterate what Dr. Garman has just said on drainage and aeration-- on growing healthier plants and on growing those grasses which are naturally more resistant to disease in order to reduce the frequency and the number of disease treatments that may be necessary. I want to emphasize also minimum use of water and still maintain playable greens.

Dollarspot-- we did not say much about feeding, but there again, a great many greenkeepers over the country have practically eliminated dollarspot from their bentgrass greens by adequate feeding program. In fact, many of them say, "When I get dollarspot, I feed it out of the greens." And they make very little use of the commonly accepted dollarspot fungicides. Brownpatch is another animal entirely; it thrives in hot, muggy weather and requires different treatment. We mentioned Tersan yesterday but hydrated lime also comes into the picture because many times with heavy rain, high temperatures when you spray fungicides you are simply increasing your difficulties because you are adding more water and there is where hydrated lime comes into the picture. A light application, maybe 2, 3 or 4 pounds to a thousand square feet-- maybe even a little bit heavier-- checks the brownpatch, gives the grass a new lease on life and you don't have more water to add to your troubles.

There are a number of diseases for which there are no fungicides. Leafspot is one. Leafspot is a disease that gets inside the plant and no fungicide can reach it. There is where breeding and selection come into the picture-- resistant grasses, naturally resistant to those diseases. Common bermudagrass at Tifton, Georgia, was nearly 100% diseased last fall with leafspot, and other diseases, whereas the new selected strains were virtually free of those diseases and maintained a beautiful green color late into the fall.

The damping off problem has not been licked, but there again, we don't understand everything about it, but moisture and temperature and high nitrogen enter into the picture and increase the difficulties of damping off. That problem is being studied by Dr. Stoddard at the University of Florida at the Belleglade Station. They had very severe trouble with it last fall where they seeded rye into the bermuda, and some of them lost two and three seedings of rye from damping off. It is a serious problem where they have high temperatures and high humidity. They are getting some relief through seed treatments, but as yet it is not an established fact where we can make a recommendation and say, "This will control damping off." We have not reached that point yet.

That uses up my five minutes. Do you have any questions on something I might have missed? Any particular insect? Any particular disease?

Comment: You mentioned army worms-- arsenate of lead is one of the best cures I have found.

Dr. Grau: How do you apply it?

Comment: Four pounds per thousand square feet.

Dr. Grau: Four pounds per thousand square feet. Spray or dry?

Comment: As a spray.

Dr. Grau: As a spray. Left on the leaves?

Comment: I leave it on the leaves.

Dr. Grau: So when they eat the leaf they will take it into their stomachs. Any more questions?