PROCEEDINGS OF
NATIONAL TURF FIELD DAYS

OCTOBER 15, 16, 17, 1950

SPONSORED BY

UNITED STATES GOLF ASSOCIATION GREEN SECTION

U. S. DEPT. OF AGRICULTURE, BUREAU OF PLANT INDUSTRY
DIVISION OF FORAGE CROPS AND DISEASES

AND

MID-ATLANTIC ASSOCIATION OF GREENKEEPERS

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WEST POINT LAWN PRODUCTS
West Point, Pa.

Foreward

Ours is the business of helping others to grow Better Turf. We ask nothing for ourselves-- only the opportunity to be of service. All our income is expended in developing service for our Members and Subscribers.

The specialized types of turf demanded in the game of golf have furnished the incentive for learning more about how to grow "perfect" turf under all conditions. In so doing principles and practices have been developed which are useful to every other type of turf. Thus, if the lawnowner follows proven practices, he can have the same type of lawn as the best fairway turf. Likewise if the directors of sports turf followed golf more closely, they would accept the proven principles of growing turf on golf course tees, where punishment is "extreme". The development of superior putting green turf has led to the increased use of similar turf for bowling greens and tennis courts. Other comparable situations exist.

When an organization is non-profit and non-commercial, (neither is it tax-supported) existence sometimes becomes a real problem. Many of our Services are intangible and indirect which don't make good "selling points". There is, however, a growing need for a central authoritative clearing house for turf information which embraces <u>all</u> specialized uses of grass. Golf has led the way to a new era in turf management. Will other turf interests provide continuing support? We can not expect a few loyal USGA member golf clubs to carry the full load.

Fred V. Grau
Director, USGA Green Section

Field Day Hosts

Your hosts for the National Turf Field Days have been the United States Golf Association Green Section cooperating with the USDA, Bureau of Plant Industry. We are located at the USDA's Plant Industry Station, Beltsville, Maryland, on U.S. Route 1, three miles north of the University of Maryland on the Washington-Baltimore Boulevard. Our phone number is Tower 6400.

The staff of the USGA Green Section includes:

Fred V. Grau, Director
Marvin H. Ferguson, Agronomist in Charge of Research
Charles G. Wilson, Agronomist in Charge of Extension
Alexander M. Radko, Research Assistant
James M. Wilfong, Field Assistant
F. H. Williams, Executive Secretary
Anne L. Drennan, Clerk-Typist

The staff of the Division of Forage Crops and Diseases includes:

W. M. Myers, Chief of the Division
Ian Forbes, Jr., Agronomist

Dr. Robert M. Salter is Chief of the Bureau.

Mr. Ray Knight is superintendent in charge of maintenance of the station grounds.

The Plant Industry Station covers about 1,200 acres and is a part of the USDA's 13,000 acre establishment which includes the Research Center where animal studies are conducted. In these 1,200 acres we have about 125 acres of lawn turf to maintain. This is Ray Knight's responsibility under the guidance of the Station Committee of which Dr. Grau is a member representing Turf.

The turf plots are contained in several blocks which cover a total of about five acres. In a general way the responsibility of the breeding of turf grasses is held by the Division of Forage Crops and Diseases while the work of the management and evaluation of turf grasses is the responsibility of the Green Section. Thus the Green Section staff has its own work as well as cooperative work with the Division and with practical turf management on the Station lawns. Other practical work of a cooperative nature is conducted on

golf courses, athletic fields and other turf interests affiliated with the Green Section.

USGA Green Section History

The Green Section was conceived in September 1920 by Mr. E. J. Marshall of Toledo, Ohio. Through the efforts of Hugh Wilson and Alan D. Wilson of Philadelphia and Drs. Piper and Oakley of the U. S. Department of Agriculture, working with Mr. Marshall, the Green Section officially began February 10, 1921. Alan D. Wilson was the first Chairman of the Green Section.

The first publication was the Bulletin of the Green Section of the United States Golf Association. Volume 1, No. 1 carries the date February 10, 1921. The last Bulletin issued was for December 1933, when reduced revenue to the United States Golf Association necessitated curtailment of activities including most of the Green Section staff. Turf Culture was begun with the January 1939 number and expired with the March 1942 number. Timely Turf Topics appeared as an extreme economy measure in May 1940 and was published by the Green Section until March 1948, when it was included in the new USGA Journal as it is today.

During the 30 years of the Green Section existence the following have directed its affairs:

Dr. C. V. Piper
Dr. R. A. Oakley
H. L. Westover
Dr. John Monteith, Jr.
Dr. Fanny-Fern Davis
Dr. Fred V. Grau

Charimen of the Green Section Committee have included:

C. V. Piper
R. A. Oakley
Wynant D. Vanderpool
Ganson Depew
Harold W. Pierce
Frank M. Hardt
Fielding Wallace
James D. Standish, Jr.
Richard S. Tufts

Many students have learned some of the fine points of turf management on the Green Section turf plots. Some of these men are recognized leaders in the field of turf today. The list includes:

John W. Bengtson	Carter M. Harrison
William L. Brown	Gordon H. Jones
Harold Clemens	Joe W. Lentz
John F. Cornman	Alton E. Rabbitt
Arnold S. Dahl	Alexander M. Radko
Robert Darrow	Howard W. Ream
Marvin H. Ferguson	Willis H. Skrdla
Ian Forbes, Jr.	Glenn K. Taylor
Fred V. Grau	Charles G. Wilson
George E. Harrington	T. T. Taylor

F. H. Williams, Executive Secretary, has now been with the Green Section continuously since March, 1922.

O. B. Fitts, now superintendent at Columbia Country Club (with which club he has been affiliated since having left the Green Section in 1928) was also an early member of the Green Section staff, having joined in March 1923.

In 1921, shortly after the first of the year, the Association formed a Green Section. It was to be operated by a national green committee. The committee comprised scientists and about 20 other men from various sections of the country who had a great deal of experience in golf course maintenance and upkeep. The thought prevailed that vast amounts of money were being wasted by many golf clubs in the United States which had no means of procuring proper and accurate information on many problems which they were encountering. It was also thought that if this committee could gather information throughout the country relative to methods that were successful, serve as a clearing house and disseminate this information to the American golf clubs, it would be of general benefit.

A service bureau was established, the purpose of which was to answer questions and to publish a monthly bulletin for the clubs. It was recommended that a copy of this publication be sent to the chairmen of the green committee and one to the greenkeeper of each club. The fee for membership in the Green Section was $15 for both active and allied USGA member clubs and $20 for non-members, including Canadian and foreign. At the end of the first year (December 31, 1921) there were 387 members. The revenue derived from this source did not take care of the Green Section's needs and a liberal contribution was made by the Association to insure continuity of the Green Section work. However, in January, 1927, it was recommended that the Green Section no longer function as a separate corporation, but that the work of the Green Section would be man-

aged by a committee known as the Green Section Committee. It is interesting to report that on November 30, 1926, the USGA Membership was 884 while the Green Section membership had grown to 940 members, comprising both active and allied USGA members and non-members (of which there were 291). The non-membership list included clubs not members of the USGA, Canadian and other foreign clubs. The Green Section currently is supported mainly from membership dues of the Association member clubs.

USGA Green Section Support

Dues from member clubs and gate receipts from tournaments have provided most of the funds upon which the USGA has drawn for Green Section operations. An all-time high of 1450 clubs belonged to the USGA in 1950.

1947 the dues were raised from $30 to $35 a year for an 18-hole club. This change was not sufficient to meet rising costs and Green Section expansion.

In 1946 a Green Section Service Subscriber classification was established to permit other turf interests and firms dealing in turf supplies to help support research work and to share in the benefits of cooperative research. It was set up to include all turf interests as well as all commercial interests. In 1950, $4910 (representing 150 subscriptions) was paid into the Education Fund, which is used for cooperative research. In 1950 the Executive Committee decided to use 30% of this money for administrative purposes.

Contributions have been substantial but, with minor exceptions, all have been earmarked and were sent to the cooperating station for which they were intended. Since August 1, 1945, a total of $49,105.25 has been contributed through the Green Section for cooperative work. Amounts greatly in excess of this figure have gone directly to experiment stations.

Green Section Aims and Purposes

No "blueprint" of Green Section Plans and Purposes has been publicized. It was conceived primarily as a nation-wide turf research and advisory agency to aid member golf clubs with their problems. It has developed into a central authority - a clearing house for matters pertaining to turf - cooperating with state and regional experiment stations. It has been the aim of the Green Section to train future leaders by providing turf research fellowships and, at the same

time, to add to our fund of accurate knowledge. Members of the Green Section staff are available at all times to consult with and to assist member clubs, subscribers, turf groups, and conference groups to carry on their affairs.

Green Section Service

Advisory

Green Section Service embraces a number of advantages through several different types of service.

Correspondence

The Green Section staff is available at all times to anyone interested in turf for consultation through correspondence. Questions for which there is no answer are carefully noted in connection with new research. Identification of specimens long has been a vital Green Section service.

Turf Conferences

The Green Section staff is available for participation in educational turf conferences on the basis of traveling and living expenses.

Special Visits

The Green Section staff is available for special visits to any turf project at the request of anyone interested in turf on the basis of traveling and living expenses plus $50 a day advisory service fee to member clubs and to Green Section Service Subscribers. For non-member clubs and for firms which are not Green Section Subscribers the fee is $100 a day. Many clubs have requested two regular visits a year. Some enterprising firms are taking advantage of Green Section Service and are calling on the Green Section staff for consultation on special problems.

Turf Field Days

Members of the Green Section staff expect no reimbursement for travel and living expenses when they attend state and regional Turf Field Days held in connection with a cooperating experiment station. When travel funds are short, participation sometimes must be curtailed.

The Green Section's National Turf Field Days are designed to interest the greatest number of turf people and to cover the broadest possible range of subjects. Herb Graffis, Editor of Golfdom, said concerning our 1950 National Turf Field Day evening program entitled "Economies in Turf Maintenance", "This is one of those

ideas that Hollywood would describe as terrific and super-colossal. The money that this session alone ought to save for golf clubs would make the USGA dues a great bargain for all member clubs."

The Monday evening session of our 1950 Turf Field Days is reproduced here.

Research

One of the primary functions of the Green Section is to do investigational work on turf problems. These investigations cover a wide range of activities, including the selection and testing of improved strains of grasses, management practices and pest control. Obviously there is much more research work to be done than can be handled by the Green Section staff. Many state experiment stations are now carrying on research work in turf. In many instances the Green Section has provided the stimulus and some financial support by means of state turf advisory committees with which the state experiment stations have inaugurated turf research projects. Many golf course superintendents have felt the need for some practical "on the spot" turf research. When asked to do so, the Green Section has worked with these golf courses. Such cooperation has been very much worthwhile in building up a fund of practical and immediately usable information.

The Green Section now feels that one of its obligations is to maintain an inventory of the turf research projects being carried on and to act in a coordinating role so that each of the cooperating agencies and individuals may be kept continuously abreast of the progress being made.

Turf Research Review was published for the first time in 1950. It is proposed to publish this Review annually. This is the means by which the Green Section will continue to keep research workers informed of progress throughout the United States.

Research Work at Beltsville

The Beltsville Turf Gardens were begun in 1942 when the Green Section moved with the Bureau of Plant Industry from Arlington, Virginia, to Beltsville, Maryland. These are the plots upon which the turf research at Beltsville has been done. The 1950 Field Day program was drawn up with the idea of presenting as many facts of the Green Section's research program as possible.

A brief resume of high lights of the Field Day fol-

lows:

Registration was from 9:00 to 9:30 a.m. (240 registrants). Dr. Fred V. Grau introduced Dr. W. M. Myers, Head of the Division of Forage Crops and Diseases, and Mr. Richard S. Tufts, Secretary of the USGA and Chairman of the Green Section Committee.

U-3 Bermudagrass Triangle. The U-3 bermudagrass triangle was established in July 1947 by sprigging into 1-inch Aerifier holes at 6-inch intervals. A part of this area has been mowed at putting green height (1/4 inch) and the remainder has been mowed at fairway height (1/2 inch). Various cool-season grasses have been overseeded on the bermudagrass in order to develop a year-round turf. Penn State Chewings fescue, Alta fescue, Kentucky bluegrass (common), Merion bluegrass, a bentgrass mixture (equal parts of Highland, Astoria and New Zealand browntop), and a mixture of Kentucky bluegrass, Penn State Chewings fescue and Highland bent were used in overseeding this area. This piece of turf has been outstanding in all the years since its establishment.

Paul Casassa, Director of the Boys Club of Washington, spoke of the successful use of U-3 bermuda on their athletic field in Washington.

Ed. Tabor, the West Shore Country Club, Harrisburg, Pennsylvania, and Roger Peacock, representing the PGA, hit golf shots from the U-3 bermudagrass turf. They were very much pleased with the playing quality of the turf.

W. H. Glover of the Fairfax Country Club lifted some sods of the turf to show the root system. The sods that were removed disappeared in the crowd. We're still searching for them.

New Fairway Plots. A group of plots were established in the fall of 1950 for the purpose of comparing different types of fairway turf, Plots were established to (1) common Zoysia japonica by seeding, (2) the Z-52 strain of Zoysia japonica by seeding, (3) U-3 bermudagrass (sprigged), (4) a mixture of Arlington (C-1) and Dahlgren (C-115) bents (sprigged), and (5) a seed mixture of Kentucky bluegrass 60%, Creeping red fescue 35% and Highland bent 5%. These plots will be managed according to the particular requirements of each. The purpose is merely to demonstrate the type of fairway turf that can be produced by these various grasses.

Bentgrass Selections. More than 200 bentgrass selec-

tions have been screened in the Green Section's introduction nursery. Promising specimens have been procured from various parts of the country and have been grown in plots 3' x 12". This turf is mowed at two heights - 1/4 inch and 1/2 inch. It received no water to supplement the rainfall and no fungicides are applied. Thus many strains are eliminated on the basis of susceptibility to drought and disease. The few strains that do thrive under these conditions are increased for further testing and distribution.

Merion bluegrass plots were much superior to common Kentucky bluegrass plots when the two grasses were grown under the same conditions. Merion has been under test in the Green Section's plantings since 1936.

An area of turf established from seed of Z-52 Zoysia japonica was a point of great interest. Merion bluegrass has been overseeded on a part of this area and the combination looks very good. Golf shots hit from this turf attested to its excellent qualities.

One of the more promising offspring of Z-52, the No. 9 selection, is a vigorous, rapid growing grass. Field Day visitors had an opportunity to see the amount of growth this selection had made in a season after having been planted in the increase nursery by sprigs.

An area of bentgrass which has been maintained as a putting green was inlaid with strips of sod of U-3 bermudagrass, Z-52 zoysia and Zoysia matrella. This area has been treated in this way to provide an indication of the combining ability of these summer growing grasses with bent under putting green conditions.

Maleic Hydrazide on Z-9 Zoysia. Maleic hydrazide has received considerable publicity because it is supposed to stop the growth of plants without injuring them. Visitors at the Field Day saw evidence that some of these claims should be "taken with a grain of salt". The zoysia was practically all killed out in some of the plots. Even at the lightest rates of application there were definite injurious effects.

The remainder of the Z-9 area has been overseeded with Merion bluegrass and is an excellent example of a combination turf.

Z-52 Seed Production Experiments. Experiments on the effects of nutrition upon the seed production of Z-52 have been done in the greenhouse and some very interesting data have been obtained. Field experiments are

now in progress for the purpose of checking further on these results. Nitrogen is apparently a very critical element and results to date indicate that relatively high rates of phosphorus and boron are beneficial to seed production.

Planting Demonstration. Al Radko conducted a planting demonstration with the John Deere Transplantrol. This machine was designed for transplanting tobacco seedlings. With some modification, it may possibly be useful in planting vegetative material of improved grasses in the form of sprigs or plugs of sod.

Combination Plots. These plots mark the beginning of the Green Section's "crusade" on the value of combinations of warm-season and cool-season grasses. Zoysia japonica was established from sprigs in 1946 and strips were overseeded with cool-season grasses following thorough aerifying in the fall of 1947. The turf has improved with each season. These plots are nearly weed-free and they are "alive" and growing the year-round.

Zoysia Breeding Work. This work is primarily the responsibility of the Division of Forage Crops and Diseases. A fundamental study of the genetic make-up of zoysia has been undertaken. Such a study involves a great deal of laboratory work and the crossing of many types of individuals which make up the genus Zoysia. The plants resulting from these crosses are grown in the field for study and evaluation. A more comprehensive discussion of this phase of the work is contained elsewhere in this publication.

Nurse Grasses. A study of several so-called "nurse grasses" has been conducted to determine their effect upon the permanent grasses in the seed mixture. The plots at Beltsville indicate that no benefit has been derived from the addition of these grasses to the seed mixture.

Spring renovation studies using various grasses overseeded after aerifying produced acceptable turf on all plots. The best plots were those on which Highland bent was a component of the seed mixture.

Fescue Strain Trials. These strain trials were conducted in cooperation with the Pennsylvania State College. A few of the fescues that were outstanding at State College and at Beltsville were marked off by

lime lines and special attention was directed to these strains. F-74, F-78 and F-80 were among the better ones. None of these are available for general distribution.

Zoysia Nursery. Many selections, hybrids and introduction of zoysia have been planted in a nursery in combination with Kentucky bluegrass. They will be mowed at three heights and records will be kept on the performance of these plants for turf quality and for combining ability with the cool-season grass.

Ureaform Studies on Bluegrass. Ureaform materials have been studied for several years because they promise to be a source of nitrogen in a slowly available form. These studies were designed to show the relative response of bluegrass to various ureaform products in comparison with other nitrogen-carrying materials.

Crabgrass Control Plots (Chemical). This series of plots is a part of the testing program of the Production Marketing Administration of the U. S. Department of Agriculture. Phenyl mercury acetate products, potassium cyanate and arsenicals were used in these tests. Potassium cyanate provided somewhat better control of crabgrass than did the other materials. All of these materials were rather disappointing in comparison with the control of crabgrass achieved by the use of summer-growing grasses.

It has come to our attention that late-in-the-season applications of PMA has reduced the germination of fall-sown grass seed whereas applications of potassium cyanate have produced only desirable effects.

Cooperative Research at Experiment Stations. The following state experiment stations reported progress in turf research in 1949:

California	Iowa	New York
Connecticut	Kentucky	Oklahoma
Florida	Massachusetts	Oregon
Georgia	Michigan	Pennsylvania
Indiana	Missouri	Rhode Island
	New Jersey	Texas

In 1950 the same experiment stations have continued their work and the beginning of turf research programs were noted in Kansas, Ohio, and Virginia. The Green Section established a research grant at the University of Maryland for the purpose of furthering the study of the nutrition of turf grasses. Turf conferences were also held in 1950 at Pullman, Washington, and at Billings, Montana, but no research is being done at these experiment stations.

The Green Section has had some contact with the turf program in all of these states and in most cases it has contributed directly to the furtherance of the work. Turf Research Review outlines the work of these stations and the extent of Green Section support. Contributions from the Green Section generally have taken the form of research grants and research fellowships. The research fellowships have been especially gratifying. Money used in this way partially pays for an advanced degree in turf and at the same time a fund of basic information is developed upon which better turf practices may be founded. It is money wisely used from which we receive at least double value.

On Sunday evening, October 15, a number of the graduate students in turf and their advisers who were in Washington for the purpose of attending the 1950 National Turf Field Day, met at the Hamilton Hotel to talk about the work that they were doing. While this was a meeting for turf research workers, all those who were interested were invited to attend. Nearly 100 interested listeners made up the audience.

Dr. Grau opened the meeting and introduced Dr. Ferguson, who in turn introduced the graduate students and their advisers. Transcripts of the talks are contained in the following pages.

Neal Wright

Graduate Student
Penn State College

I am working with fescues. As you know, or have observed, there are considerable variations within any species of grass that you have had on your golf course. With that in mind, I started working with 30 selections of creeping red fescue and 22 selections of chewings fescue.

This study is primarily fundamental. A large part of the results are not directly applicable to turf. In other words, it is not a fertility study or anything of that nature. It is a fundamental research study. As I mentioned, I have these 52 selections. Of course, I am studying yield. Along with that I am studying it not only from a broad plot standpoint, but down to the individual head or seed set within an individual head. I am even going further and studying the pollen, determining the developments or stages it goes through in developing pollen and trying to uncover any correlation that I can find that we can use in the future for selection.

The whole idea is to perhaps uncover some methods that will let us take out a lot of the fescue without having to carry them on through the testing program. As you all know, it is rather difficult to determine whether it will make a good turf grass when it is in the high growing stage. It has to be put under the growing conditions of the piece of turf you are going to use it for. The whole idea of this study is to perhaps uncover some means by which we can eliminate a lot of that testing work.

Also, the study includes additional fundamental studies such as chromosome numbers, seed set and, as I indicated, these are all fundamental stages. I am hoping to get some relationship with the turf program. However, my particular thesis will not be that because, as you can well understand, I can't study fundamentals in this stage and also study the grass under turf conditions. It would probably be three or four years from now before that particular seed would be growing in turf.

I am working with Dr. Musser on the entire breeding program. Pennsylvania has been charged primarily with the work with creeping bents and fescues. Our creep-

ing bent program is rather extensive compared to the other fine turf grasses. We are hoping, and we feel that we have some results to take advantage of with seeded bent turf as compared with vegetatively established turf. Of course, we are still in the infancy as far as breeding is concerned in that we are still in the selective stage. We have a long way to go, but I think we are well on the way and have our foot well in it now.

Question: Neal, when do you finish?

Theoretically, in February, I hope.

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Ed Merkel

Graduate Student
Penn State College

As Dr. Ferguson told you, preparations for my project are still in progress. I am just about ready to get the sod on it now. The project has to do with using the Aerifier to break up compacted and thatched conditions, and get the water down into the roots where it is needed. You all know that water is very necessary and, if you have thatched and compacted conditions, the water just runs off.

The only thing I can give you would be a description of the plots. We have six tiers and these are all at a 7% to 10% slope. Each tier is divided into 12 separate plots. The first tier is thatched, the second tier is compacted and that is repeated.

On each of these compacted and thatched plots, half of the first tier of the thatched plots will be thatched and the other won't be. On the compacted plots, half will be compacted and half not. That gives six plots of each. Of those six of each, three of the thatched and three of the non-thatched will be aerified, and the same thing is true of the compacted and non-compacted plots. These are all divided with steel dividers. That is about the only thing I can say now.

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Jack Harper

Graduate Student
Penn State College

I think many of you already know a good bit about the work that Jim Watson did at State, but in case some of you don't know exactly what the set up was, I will go over it briefly.

First of all we had four watering treatments. These treatments we designated as saturated, field capacity, as needed and dry. The saturated plots received water almost constantly. The Hagerstown soil holds about 49% moisture when saturated. However, it did have excellent drainage and because of that, we could only maintain about 37% or 38% moisture content, which would be about 78% saturation. The field capacity plots we tried to maintain at approximately 24% moisture. In the as needed plots water was applied only as we felt it was necessary to keep up a vigorous growth and keep it green throughout the year. On the fourth watering treatment-- the dry plots-- they received only the normal rainfall for the season.

Now superimposed at right angles to these watering treatments, we had a series of five compaction treatments. The first was simply no compaction. It got no wear other than normal mowing and maintenance practices. The second was heavy compaction-- rolled twice a week. This was done using a 40 inch roller which delivered about 60 pounds pressure to the square inch. There is one point I would like to bring out that differed with the work that Jim did. His roller only delivered about 37 pounds per square inch. So on the heavy compaction plots we have materially increased the pressure per square inch.

Then we had the heavy compacted once a week which was rolled with the same roller. Our light compaction plots we had a roller that delivered about 15 pounds pressure to the square inch. As on the heavy, we had one series that got it once a week and one series that got it twice a week.

I think this year was a very poor year for these treatments, particularly the watering. We had plenty of rain throughout the year. As far as the as needed plots were concerned, it was only necessary to water them once and that was in the middle of August. Then they only got a few hours of water. So there was very

little difference that could be seen due to the watering treatments.

Now as a means of evaluating the different plots, we have taken several types of data. First of all,we take population counts of the red fescue, the bluegrass, the bent, poa annua and other types of weeds. From this we can compute such things as the density of the permanent species, the density of our weeds and so on. Incidentally, we also took population counts of the clover and crabgrass.

We are also going to take disease studies and as a means of determining our relative amounts of compaction we have used two instruments. One is the penetrometer. Jim Watson worked out a method that still has plenty of flaws in it, but we hope to work it out better and that is the X-ray spectrometer. Essentially, the X-ray spectrometer takes the fracture pattern of the quartz crystals in the soil and from that we can get our compaction.

This winter I hope to make up quite an extensive series of synthetic soils. We are going to purchase materials such as clay and kaolinite of which we definitely know the mineral composition and mix these in various amounts. The agricultural engineering department is going to try to build us a machine for compaction and we hope from that method to be able to set up a standard to use out on the field.

As far as our results for the year, we have not run a statistical analysis on any of the data yet. However, on the saturated, the field capacity, and as needed plots I think they will be very close to 99% bent. Three years ago they were 70% bent. On the dry plots the fescue has stayed in much better than the bluegrass. There is very little bluegrass left on the plots, but there is about 15% to 20% fescue left on some of the dry plots. I think Dr. Grau will be very happy to know that we are finally starting to get some poa annua. For three years we didn't get any, but it seems to be coming in pretty well now. This past year the crabgrass was much heavier than it has been. We did notice quite a bit of disease on the crabgrass, but very little anywhere else.

As far as the future of these plots is concerned, we hope to start renovation treatments now. Whether they will be started this fall or next year, I can't tell you yet. We are going to analyze some of the data from this past summer and see if they really are in a con-

dition where we should start renovation. How we are going to do this has not been decided. I know for sure that aerifying will be one of the treatments and probably reseeding will be another. I think that is about all I have.

Question: What height are you cutting those plots?

I should say something about maintenance. They are cut at approximately half an inch. During the summer that ran two to three times a week. As far as fertilizing is concerned, we put about 600 pounds to the acre of 7-7-7 in the spring and the fall.

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John Stanford

Graduate Student
Penn State College

I am sure most of you would like to get a good word on Jim Watson. He is doing a good job down in Texas. He is getting started, but we all have to learn to crawl before we learn to walk, and that is his job now.

Now to get into my phase of this. Pennsylvania's Department of Highways in 1947 and probably a long time prior to that had this tremendous problem of getting vegetation on the cuts and fills along the newly established roads. This probably presented a greater problem than I will ever know and most of you who are not directly connected with that phase. I do know that it is a problem and they have tried it from various angles.

One is bringing in topsoil and dumping it on these raw cuts and fills and there you have a condition that is not natural. You also have something unnatural when you cut a road through mountains and hills. We are trying to grow grass and legumes on these raw cuts and fills. When you have a cut through a mountain, the thing may be a 1 to 1 slope and it may be steeper than that. So the problem of Pennsylvania and other states is getting grass to grow on this raw subsoil.

In the work that was set up and sponsored by the Pennsylvania Highway Department with the cooperation of the Pennsylvania State College, we selected a location

in 1947 just out of Port Matilda on Highway 220. On this location we had five species of grass and one legume that we wanted to start in testing. We wanted to know what the grasses and legumes would do on those raw subsoils and what we could expect from them. We really didn't have any documental data on how to handle these conditions.

We seeded orchard grass, Alta fescue, bromegrass, crown vetch, domestic rye and red fescue. Today the red fescue is the best grass. It is holding up beautifully on raw subsoil.

The treatment of the subsoil before seeding was liming, bringing the pH of the soil to around 6.5. Then shortly after that we applied fertilizer at the rate of 60 pounds of nitrogen, 120 pounds of P_2O_5 and 60 pounds of K_2O. I know most of you think that is awfully heavy application of fertilizer. Remember we are starting on the subsoil and we feel we can put in fertilizer at those rates far cheaper than we could haul in sufficient topsoil to put on a location and have it removed with the first bad weather. We wanted it to stay on.

The crown vetch has a light purplish flower on it and is a perennial. This year it had very good cover, but it is somewhat slow in making a good cover. I don't think you could ask for a better cover of any species than we got with this legume this year. On that study along with getting a cover we were interested in knowing what the temperature might be under the species and also what moisture relations are under the species. So we kept close readings on that. The legume will take the soil down to near wilting point far quicker than the grass. Legumes tend to stay in active growing condition longer than the grass after a rain.

Then from there we were interested in getting off-date seeding. By that I mean seeding in the middle of the winter, middle of the summer, spring, fall or whenever a contractor would get through with a job. Every contractor who is laying roads is interested in that problem. We did some off-date seeding and we find that some very interesting things happen. Fortunately, we were able to find a location that had a slope on both sides of the road. The soil type is identically the same.

On the northern and southern exposed slope we used the same species. On this location we started last fall.

We don't have too much data yet, but we can see some good indications. We seeded a mixture of crown vetch, Alta fescue, domestic rye, red fescue, bromegrass and orchard grass on both sides of the road. From the winter seeding, we found that the red fescue and Alta fescue suffer far more than the other species and also on the southern exposed slopes. We have very little information on our fall seeding yet because it has just been seeded about a month now. But all the grasses are holding up on both of the slopes from our spring seeding. Germination is probably a little bit better on the northern exposed slope because it does not get the quick dry out that the southern slope gets.

We also are interested in the comparison of the seed growth and seed production. That is, the comparison of the row production with broadcast production. We find we get a much better yield from row seeding of the various species. I think that probably covers just about all the work that we have on behalf of the road work.

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H. B. Musser

Professor of Agronomy
Penn State College

I don't think I can add very much to what the boys have said about their own projects. I just want to say one word about the comment that Neal made on his so-called fundamental studies.

I don't quite agree with him that it doesn't have very much practical bearing. With the program of research on the fescues that we have under way plus the added fact that practically all of our fescue seed is going to be produced outside of Pennsylvania because we have very little seed production in the East, it becomes increasingly important that many strains that we produce for turf out here in the East have the added characteristic of being good seed producers. There is no use of attempting to develop a strain of grass if we can't have it growing commercially and put it on the market at a nominal price.

There is a tremendous difference in the ability of the various strains of all of our grasses to produce seed. But part of Neal's work is to try to determine the

causes of the differences and I don't think I need to amplify any further for you to get the point that there is a very definite practical hook-up between a fundamental study of that kind and the ultimate turf which we hope you may be growing from some of those strains in the next five or six years.

Outside of that I don't believe I need to say anything further about the work that each of the boys has outlined for you. Those are the projects which they are primarily interested in and on which they will do their required work for their thesis. I can't do anything more in the time that we have available than simply outline the other research projects that we have under way. It is too big a program to do anything more than just outline.

In addition to the work that the boys have mentioned, we have quite an extensive nursery of individual B-27 bluegrass plants purely with the idea of keeping that strain pure. Those are space plants and they have been carefully rogued. In addition to that planting which will be foundation seed stocks, we have a five acre planting being grown by a farmer in the northern part of the state which will be rogued carefully also and which will be a source of good foundation seed for further seed planting to produce certified seed of B-27.

Our fertility work is concerned primarily with two things. The first one is the study of the possible relationship of various rates of potash applications with nitrogen. In other crops there has been a very definite tendency for potash to have a direct effect on disease incidence. We were very much interested in seeing whether it might be tied up in the same way with turf, and so we laid out these experiments on bent cut at putting green height on fescue and Kentucky bluegrass to study various ratios of nitrogen and potash.

The other phase of our fertility work is a study of sources of organic nitrogen and inorganic nitrogen in comparison with the new materials that are on the market, experimentally only-- Urea formaldehyde combinations. We have a rather extensive series of comparisons of different rates on all three of our basic grasses -- Kentucky bluegrass, fescue and bent. Those comparisons are being made both in the Philadelphia area on an established fairway-- the Gulph Mills Country Club fairway outside of Norristown that is composed principally of bentgrass-- and our present studies

at the college where we started from scratch. That is, applications of the various fertilizers were made before seeding and we propose to continue those to the maturity of the grass and probably longer.

During the past season we have had a rather extensive series of comparisons of the materials that have been most widely advertised and used so far for the control of crabgrass. Those tests have been located in the Philadelphia Country Club. Marsh Farnham is superintendent, as you all know. They have consisted of comparisons not only of the materials themselves, but in at least one instance in the case of potassium cyanate, comparisons of various solutions, concentrations and rates of applications.

We are just beginning a study at the college under Dr. Alderfer, who is our Soil Physicist up there, on the utilization of water for bentgrass clipped to putting green height. That has been intensely interesting to me. It is very well to tell somebody to keep the soil at field capacity or keep it at ¼ of the total mass of the soil, but after all what I would like to know is how far below that we can go before we have to reapply water. We are starting a study of that kind and I am personally tremendously interested in it.

In addition to that study there has been a good deal of publicity on various fungicides for seed treatments prior to seeding. There have been some rather elaborate claims made for the effectiveness of those materials in reducing damping off and so forth while your plants are in the seedling stage. Dr. Beach, one of our Plant Pathologists at the college, has been doing some extensive work in studying the effects of a number of these various fungicides for use in field treatments.

Neal mentioned our testing work with the bents and I don't need to elaborate on that any further. That is a long slow process and with the number of strains that are available (we have probably 250 or close to that) and since we should have at least a three year record on every one of them, it becomes a tremendous job. We feel that we can't use any more facilities and labor than is required to test about 50 of them at a time. So that moves rather slowly.

On top of that we have a series of 60 strains and selections of bluegrass, fescue and bent along with commercial types. Those are clipped at three different heights-- about ½ to 3/4 of an inch to simulate fair-

way conditions, about 1¼ for lawns and from 2½ to 3 inches for airfield use. If any of you don't believe that clipping height has tremendous influence at least on commercial bluegrass, you should see those plots.

I think that is about all that I have to say at the present time except this. As most of you know, our research program is under the direct supervision of a research advisory committee of the turf men interested in it. So far those turf interests have been composed largely of greenkeeping superintendents because those are the people who have vitally been interested and have been willing to take the time. No project is established for practical testing work until it has been discussed with that research committee. We have in Pennsylvania local turf associations rather than a state wide association. The research committee is composed of designated representatives from those associations plus the individuals on the staff at the college who are directly interested in a particular field. For example, if Dr. Beach is doing this pathological work, he will be a member of that research committee.

It seems to be working out rather nicely. I think the members on the committee feel that it has been a worth while thing and I know we don't have any trouble when we call a meeting in getting them to come down and talk over those problems with us.

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James Simmons

Graduate Student
Rhode Island State College

Our main problem is poa annua. We have in our area many greens that are mixed bents with poa annua and we would like to find some way of changing over these greens to a pure stand of bent, without going through the cost of complete renovation.

The past winter we had some greenhouse tests where we watched poa annua under different temperatures and water treatments. We also carried on some chemical treatments with this grass aiming at trying to stop it from seeding and at the same time trying to destroy the grass as it germinates. In those tests this past winter, we tested the use of phenyl mercury compounds.

In conjunction with three golf courses this past summer, we carried on a chemical control study and at the same time watched and observed the cultural practices on the greens. We have had the same treatments going on at the different golf courses and we have also studied the cultural practices that these greenkeepers are using.

We have not taken final notes or made any observations that would give us some direct results now. We took some notes last Friday and will again take some this spring to see if we have reduced the percentage of poa annua in the greens and at the same time stimulate and improve the soil conditions in those greens.

That is all I can tell you now.

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Dr. Jesse DeFrance

Rhode Island Experiment Station

The project that we are working on at this time is soil sterilization studies. They have dealt with two phases. One is to put a chemical on the soil that will be permanent. That is, no crop will be grown there. Such places are sand traps, road side shoulders, driveways where you want to eliminate weeds but are not concerned with any vegetation growing there. It is simply to kill all the vegetation. We have tried to use all the chemicals that we thought would be of use, even to the old method of common salt. We used both sprays and dry materials.

The other phase of soil sterilization has been to treat soil or seed beds with chemicals to kill the weeds in the soil prior to planting a crop, preferably grass. Now this year after we have seeded an area we have put on applications of these chemicals at different rates of dry materials and also wet. Then we would plant on those treated areas a week after treatment, two weeks after treatment, three weeks after treatment and four weeks after treatment. Some of you people who were at our field day were quite interested in the results of those studies and we are going to summarize those.

Now we have continued our crabgrass control studies with practically all of the materials that are on the

market. We have been especially interested in the comparison of the wet method of application versus the dry method of application for crabgrass control. We have had several outlying experiments away from the college where we have put on both methods on the same day on heavily infested crabgrass areas.

We are continuing our height of cut studies on fairways and lawn turf. Dr. Musser mentioned that seed treatments with various fungicide materials have the ability of stamping out seedling blight and we find that we have large brownpatch especially on seedling turf where the bentgrasses are used. We treated seed with the chemicals and also planted seeds and then sprayed or dusted the fungicides on the soil after planting. We have had those two methods trying to find out any advantage of those treatments. Previously, I will say that we didn't find any material that was of benefit in seed treatments at least this year. That may be due to the season which we will say was not too good as far as giving us disease was concerned.

We are continuing our studies on velvet bent to try to overcome the sponginess due to an accumulation of undecomposed roots using lime and various compost rates and kinds of compost. We are also going to try to incorporate into that study the use of the Aerifier.

We are also continuing work on the Urea-form fertilizer materials. This year we waited until late June or early July before we put on the materials. I will say it was a lack of good management that caused us to wait that long, but we have some interesting results from putting these materials on in the middle of the season.

Now Dr. Howard is continuing his work on the disease control studies using various new materials and comparing them with some of the older materials that have been used for years. He has had leave this year, but is back now and is especially interested in treatments for snowmold at this time.

Our bentgrass breeding program is continuing. We made five selections this year based on a study of drought tolerance and disease resistance. Last year we had a very dry season and it gave us wonderful opportunity to record notes on those selections of bentgrasses that were resistant to drought.

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Gene Nutter

Graduate Student
Cornell University

I am beginning to believe after listening to these previous speakers that the crabgrass problem is really quite important. I have been spending quite a lot of my time this past summer in the study of crabgrass control and we have had quite an extensive series of plots in the more heavily infested area of New York State.

We have been attempting to study crabgrass control to find some of the answers as to the new materials for control.

We have been interested particularly in potassium cyanate. As you probably know, this is the third season that potassium cyanate has been tested and in the past two seasons, we have had quite a series of tests. We have been interested in trying to find out some of the answers as to gallonage, rate of chemical, number of applications, time of application, stage of control of the crabgrass plants and a number of these things that we need to try to pin down if we are going to be able to get the control of this popular pest. We have been able to go quite a way in getting some conclusions as to rate of gallonage and so forth. As you know, last year was quite a drought season and this year was almost directly opposite. It was a very good year for the growth of grass. The rainfall was good and the moisture was good and the temperatures were fairly tolerant.

We have been partly by public interest and partly by our own curiosity interested in studies of comparative crabgrass herbicides from the materials on the market. Some of the materials in the tests that we have made of these materials are maleic hydrazide, dichloral urea, the various forms of mercuric acetate and dry and liquid forms of potassium cyanate. We have been trying to find out how these materials act in comparison under comparable conditions in the field and to see what possibilities they might have.

We have been also aware from some of our work this summer that there are a number of things we are going to have to do in weed control work if the field is going to grow up. Our weed control work in the country started in 1945 with the advent of 2,4-D. It was not

so much the importance of 2,4-D itself, but it stimulated the interest in weed control developments. It has been an important chemical, but I think by far the most important effect of 2,4-D was that it stimulated the interest in weed control in general. With this interest has come the study and work with these new chemicals. We have noticed discrepancies in the field and we are beginning to realize this and are beginning to look for new basic studies to try to find some of the answers to these discrepancies. We plan to go into some of these effects later on.

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John Cornman

Cornell University

Our work at Cornell is very new in the sense that we have been active in the turf research field for only about three years. When you enter a field of this sort, there are a lot of problems that do not bother old residenters like Burt Musser. He just sits and the money rolls in, I understand.

Such is not the case with us. We, as many agricultural colleges, are prepared to do our duty for the citizens of the state and nothing was done on turf research work there until recently. We got a loud call from the turf men that they wanted some research done. We thought then that we would certainly do our best to do as much as they could promote. Along with what turf work that we have been doing has been a matter of helping the turf men promote their own interest. We certainly have had good backing from them.

They have given us backing in a manner somewhat different from other states in that they have formed a state turf association. We do have four or five local turf associations made up largely of greenkeepers who have been in operation for some time. This state association is designed primarily to focus interest on this research problem. We do not interfere nor do we override any of the local affairs because we feel very strongly much can be done in local meetings.

Each month we put out a bulletin by which we can keep the fellows interested and tell them what is going on. We now have a membership of 350 men in this turf research association. I believe we have more turf in-

terest in our state than in any other state in the country. That is, more installations that require more attention than the average. For example, according to my count, we have over 450 golf courses in this state. I would guess since we have the most people, probably there are more cemeteries, more parks and so on to be taken care of than in most states. So potentially, it might be a big thing. For the last three years we have been trying to work on a few problems with the facilities at our disposal, trying to help the turf men get what they want.

Gene has told you of the crabgrass work. We chose that problem for several reasons. One was that we do not have a turf garden at Ithaca-- several reasons behind that. In the first place it costs a lot of money. It takes money to start and a lot to keep going. With our limited funds, we feel we should spend our time somewhere else. Also, of course, crabgrass is a hot problem and is one that we could do in the field. The crabgrass work has gotten quite a bit of emphasis so far.

Gene didn't tell you, but he has designed a sprayer that takes practically all the work out of making the application and is quite accurate. It has a speedometer on it so that you can judge how fast you are going and know how much you are getting to the acre. This speedometer is an interesting thing. It also registers mileage. It registered 29 miles this year just going over crabgrass plots. I don't think we have all the answers, but we do have a lot of mileage on that thing.

One other project that we are working on particularly is that of the mole-drain. This is a long term project. You have certainly heard of the mole-drain long ago. It comes up in the literature and dies down. I don't know if the mole-drain is going to solve any turf problems or not, but we would like to either prove that it will or kill the thing forever as far as turf work is concerned.

The mole-drain is fundamentally a torpedo-like object like a cigar only bigger, made of steel. This is dragged along underneath the ground. To do that you pass a sharp stiff, thin blade of steel under the ground. All you leave on the surface is a little slit. Gene has put in a number of plots on fairway type of turf and on putting green and we find that water comes gushing out in great quantities.

We were stymied momentarily because of our difficulty

in getting a device that could be adjusted. You can see if you have a fixed carriage like a plow carriage- the Mascaro boys have devised a mole-drain that fits inside the Aerifier carriage. It makes moles, but it has one fundamental difficulty and we have told them about it before. The relationship between the wheels on the surface and the mole underneath is fixed. So if you are going to make the water run down hill, you must make a nice grade and follow it. You must lay these things out accurately otherwise water will lay in there and your little mole hole will collapse and then wouldn't do any good. So our problem has been to get an apparatus that can be adjusted. We think we have one and will put it in operation in the spring.

The English use these moles very effectively. They have very heavy clay soils. They stopped in the research and they feel that it must last ten years to be worthwhile. We figure on a putting green if it would stay one year and if you could do it inconspicuously and have water drain out of that green without tearing it up and putting in tile, you could afford to do it every year. So we have hope of some practical solution there. There are many fundamental problems, of course.

That is as far as we are concerned with turf research. Where we will be five years from now, I don't know. We are getting interest from the turf men in New York state. That is our stage of development at the moment.

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Ralph Engel

Rutgers University

We have been testing a number of materials at Rutgers for three years now. Among these we have had sodium arsenite, the phenyl mercury compounds, potassium cyanate and the Sola materials. The work that we have done on the stadium grounds, as most of you know, is turf that will compare with lawn conditions. As I indicated we had considerable faith in phenyl mercury, potassium cyanate and the Sola materials. We carried sodium arsenite right along with our turf and had a very interesting side line. We started out with a real high rate of sodium arsenite and are cutting it down every year when we put it on the plots. We have

gotten down now so that we are under an ounce per thousand and we seem to like it better that way.

Another thing that we got into in our crabgrass work was the feature of wetting agents. We found some very interesting and beneficial results when the wetting agent was combined with such materials as potassium cyanate, sodium arsenite and so forth.

As most of you know, I inherited about two acres of plowed ground on the college grounds in 1947. We had to put something on there to keep it from washing away so we got busy and planted a large area with bentgrass and the whole triangle to a mixed turf. On the bentgrass area we have our National Fungicide Trials with which some of you are familiar. For those of you who are familiar with the results, I think they are very worthwhile.

We have two other studies on this station's grounds that I am very interested in and those two happen to be on time of fertilization both on creeping bent and on mixed turf. This mixed turf is going pretty much to bentgrass because we are mowing it at 3/4 of an inch. Now you might wonder what I mean by a time of fertilization study. It is nothing more than what a golf course superintendent thinks of as timing a fertilizer treatment. He sort of times it with the weather. We had the idea there that we could possibly show some difference in poa annua development, clover development and such by timing the fertilizer treatments.

So on our bent areas we have it set up in this fashion. We concentrate the fertilizer in the spring and fall. We are feeding the turf heavy in those two seasons. On another group of plots in this test we are concentrating the fertilizer from the middle of May on through to the first of September. Another step is to fertilize right on through the season. I don't have any results to report on this. We are going to keep a close eye on that in regard to poa and clover. On the higher cuts, we are timing our treatments with different seasons of the year. It is a very interesting contrast out there right now. You can pick out plots that look like they are 35% or 40% ryegrass. Right next to it is a plot that looks like 90% bentgrass. It is all a matter of time of fertilization.

I would like to mention our studies in conjunction with turf cultivation. We have a turf cultivation study on the creeping bents and are starting our third

year with that. They involve spring cultivation, fall cultivation, and spring, summer and fall cultivation. Then going on to the triangle where we have a higher cut, we have a turf where we are cultivating at different depths-- deep cultivation, shallow cultivation and disc cultivation. We have the frequency of cultivation study also. In other words, on one plot in that turf we go out and cultivate six times per season, another plot doesn't get any, and another plot gets two cultivations. We have been watching that very closely with regard to weed and turf characteristics.

With regard to crabgrass this season, as far as I was concerned, I can't pick any difference in crabgrass infestation by eye. So we got busy with paring knives and picked the plants out individually and counted them. I haven't analyzed the data, so I can't tell you how the test came out. Also we have the cultivation studies that are taking place out on the old Rutgers golf course. It is a heavier type of soil and from the data that has been collected in the last couple of weeks, it looks as though the conditions may be different out there.

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Charles K. Hallowell

Agricultural Extension Representative
Philadelphia, Pennsylvania

California started their turf plots in rather an ambitious way some two years ago. The College provided space for a turf garden and Dr. V. T. Stoutemyer, Head of the Division of Ornamental Horticulture, was made director of the project. Funds have been collected from golf courses, parks, cemeteries and athletic fields to carry on the turf program. One of the reasons for starting the work in California was because the golf course superintendents said that they had no place to go to get any definite data. Many times they had to take somebody's opinion for the reason to perform certain maintenance practices. So, it is the man who is doing the job of growing turf who is extremely interested in the progress of the plots that are being carried out at the University of California. The turf gardens include bentgrass varieties test plots, fertilizer trials, soil amendment trials, bermudagrass and bent combinations, lawn and fairway grass plots and a recent series of plots to determine the impor-

tance of nitrogen, phosphorus and potash in establishing new seedings.

There was a Field Day at Los Angeles in October, 1949, and a two-day Turf Conference on May 8th and 9th, 1950. Dr. Grau attended this Conference and the first Northern California Conference held at Berkeley on May 16th and 17th.

Representatives of the College of Agriculture, University of California have indicated that if the turf folks would secure private funds to start and carry on the projects until 1951, funds for that work would then be included in the College budget. The more than 400 persons attending the two conferences passed resolutions asking the College for both research and extension work.

There are 34 privately owned golf courses who are members of the Southern California Golf Association and 16 courses in the Public Links Association. Both associations are extremely active organizations and with other turf groups are stimulating to the turf program.

They play golf every day in Southern California and the long growing season intensifies the problems. This long period is ideal for the research worker to secure results.

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Geoffrey Cornish

University of Massachusetts

We have a ten week short course for greenkeepers that starts in January each year. This year we had 68 applicants with 25 vacancies to fill. However, calls to the service may make some difference and by the time we start we may have just 25. We also have a two year course for greenkeepers. That is limited to 15. This year we had 23 applications. We selected the 15, but when we started we had only 9. No fewer than six men had been called into the service from that group. However, we now have it back up to 13.

Just in regard to this research work that we are doing at the University of Massachusetts, I would like to mention one or two things. Two years ago when Dr. Grau was on our campus, he noticed zoysiagrass that was

growing there. This had been planted several years prior to that. I believe Dr. Grau was impressed with the growth that it had made on the lawns on the campus with no particular care. He arranged for a grant and we started research work on the zoysia. Since then we have been spreading quite a bit of it around the state. So our work on that has been quite interesting. For my thesis work I had been working on the growth of clover in turf and that in particular to nitrogen levels. I have now completed the work in so far as my thesis is concerned, but so far as the control of clover in turf is concerned, much more work is required.

We also are working on fertilizer and grub resistance in grass. It is something that ties in very closely with the Beltsville work.

One project that we are going to start this winter is a joint project between ourselves and the Department of Botany. It has to do with chlorosis. We have in the Department of Botany Dr. Jones. He is a plant physiologist and he has worked with chlorosis in a number of different plant orders. This summer we got him interested in chlorosis in velvet bent at the Springfield Country Club. The Springfield Country Club got a grant for us and they are permitting Lawrence Graham the greenkeeper who is a graduate of our school to work on the campus for three months this winter as Dr. Jones lab assistant. Dr. Jones is going to specialize at that time on chlorosis on velvet bent in an attempt to relate it to several chlorotic conditions that are appearing in other orders of plants.

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Bill Daniels

Purdue University

Several of you know that the Agronomy farm at Purdue was sold some time back and they have recently gotten a new and larger farm. On that we have started some rather small grass plots, but it has possibilities of becoming a nice and really intensive study. There we expect to put quite a few of the bentgrasses that Ethan Holt developed as part of his Dr.'s thesis and some of his breeding work under Dr. Payne will be tried out under different fairway and putting conditions. Also we have the opportunity now of having a rather large warm and cool season grass experiment

that is combining some of the zoysia and U-3 with some of the better cool-season grasses. There we do have a chance to see if they will apply to the areas out there that include Indiana, St. Louis and the southern part of Illinois.

On the campus of the Purdue University there has been started a 12,000 square foot area which will be under putting green conditions where we will have a rather large area of C-52 for Dr. Sharvelle to work with on turf fungicides and we are looking forward to the work there in another year.

Also we have several areas where we have U-3 and different grasses planted together under putting green height just to see how they will stand up. If we get a disease infestation of bent without treatment, what will the bermuda do? What will be the relationship in the fall? Does that have any place on tees or on the municipal golf courses for example? I believe that completes my discussion of our work because as you know so much of it is just in the formative stage.

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Earl Staten

Graduate Student
Purdue University

The main part of my thesis work is with zoysiagrass. The test that I am running for my thesis is a winter hardiness test. I have several strains of Zoysia japonica and several strains of Zoysia Matrella. The main reason behind this test is to test differences in the winter hardiness of these different strains to be used in further breeding programs, to try to breed some winter hardiness into zoysia, particularly the matrella.

Also I am doing some planting work with bentgrasses. That briefly just gives you some idea of my work, but it is not too far gone and I have no results to give you now.

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THE ZOYSIA GRASSES BREEDING PROGRAM[1]

Ian Forbes, Jr.[2]

Purpose

You have already heard much about the Zoysia grasses today with respect to past history, and you have seen the turf it makes, so I'll confine my talk to Zoysia breeding. The purpose of the Zoysia breeding program is to develop and evaluate varieties with improved turf characteristics, disease resistance, winter-hardiness and seed production.

The turf characteristics sought include: good seed germination, seedling vigor, rapid stolon production, fairly fine texture (narrow leaves), compatibility with perennial cool season grasses such as Kentucky bluegrass, etc., dense turf forming, longer season of green color, freedom from purple discoloration (anthocyanin pigments), and dark green color.

Disease resistance is all-important in a plant which is required to survive indefinitely without replanting. Although no disastrous diseases have been observed on the Zoysia grasses so far, it would not be wise to presume that this condition will continue once these grasses come into general use. Several fungi are known to attack these grasses to some extent.

Winter-hardiness is vital to the persistence of turf from year to year. Primarily the degree of resistance of a plant to low temperatures and dessication determines its winter-hardiness. It is in this respect that the three species of Zoysia (Zoysia japonica, Zoysia matrella and Zoysia tenuifolia) exhibit their greatest difference.

High seed production is necessary before any of the Zoysia grasses can come into widespread use. Some vegetative plantings have been made throughout the United States, but although these grasses spread by stolons and rhizomes, they spread at a very slow rate

[1] Work done under the auspices of the Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A. in cooperation with the U.S. Golf Association Green Section. Report given at National Turf Field Day, October 16, 1950.

[2] Agronomist, Division of Forage Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, U.S.D.A.

compared to bermudagrass and others commonly propagated vegetatively. To rely on vegetative propagation would restrict the use of these grasses to relatively fewer, smaller and more expensive plantings.

Methods

The methods by which Zoysia varieties, having these improved qualities, may be obtained include: selection of desirable individual plants from enormous populations of seedlings grown from both imported and experimentally bred seed lots; hybridization of desirable individual plants both within the same species and between different species of Zoysia to obtain new, more desirable combinations of characteristics; breeding to stabilize these new combinations and make them permanent in the variety; testing the various varieties produced to determine which are best; and finally to increase the best varieties for release to seed producers who will grow the large quantities of seed needed by the public.

The methods just described are only those required for the actual production of an improved variety of the Zoysia grasses. Before any of those methods can be practiced, much technical work must be done to determine how to apply these methods to the Zoysia grasses. A detailed study must be made of the three species of Zoysia grasses. A detailed study must be made of the three species of Zoysia with respect to chromosomes (the microscopic bodies which carry hereditary characteristics from parent plants to their offspring), hybridization, methods of reproduction, pollination, and inheritance of important characters (which are controlled by genes located on the chromosomes). It is readily seen that it is a long way for Zoysia from the microscope and breeding plots to the family lawnmower.

Exhibits and Experimental Plots

The plots to be shown this morning are:

1. Zoysia selection trials for bluegrass compatibility -- 60 Zoysia selections in duplicate growing in Kentucky bluegrass turf.

2. Zoysia selection trials for seed production-- 6 selections in duplicate plots managed for seed production. (12 plots)

3. Old Zoysia selection nursery which is now managed for seed production-- this nursery contained 7,000 individual plants from which 40 selections have been

made. This 1/4 acre field produced 150 pounds of seed this year.

4. Zoysia selection trials for seed production-- 6 selections replicated six times in a statistical design known as the latin square. (36 plots)

5. Zoysia selection turf trials--These plots are for the comparison of the turf of six Zoysia selections produced from polycross seed in comparison with selfed seed. Each of the twelve different types turf are replicated 6 times to give 72 plots. The statistical design is a split plot randomized block.

6. Zoysia selection clonal nursery-- This nursery contains pure (unmixed) clonal material of 150 selections which is the only source used in cytological work and for the final increase of a selection which has been chosen to be released as a commercial variety. Absolute purity is required for both purposes.

7. Zoysia hybrid selection and breeding nursery-- This nursery consists of 1,600 individual interspecific hybrid plants (F_1, F_2, and BC_1) and foreign introductions. These plants will be evaluated for seed production and turf characters.

8. Zoysia hybrid selection and breeding nursery-- This nursery contains 250 offspring (S_1) of selection 1-52 (Z-52) and 400 hybrids between heavy seeding Zoysia japonica selections and also between heavy seeding selections and 1-52.

Plots and exhibits to be shown this afternoon are:

9. Zoysia selection turf trial and technique study-- This area consists of nine clones each of 100 zoysia selections and interspecific hybrids planted in a Kentucky bluegrass turf. Three heights of cut will be tested to determine the best height or heights for future turf trials. At the same time the 100 selections in the experiment will be evaluated for all characteristics except seed producing ability. Three replications of each different combination of selection and height of cut will be maintained. A randomized block is the statistical design used.

10. Zoysia turf selection nursery-- This nursery consists of 5,000 individual seedlings grown from introduced and domestic seed lots as well as hybrid seedlings (F_1 and F_2), planted in Kentucky bluegrass turf.

These seedlings will be evaluated for all characters except seed production. Here again three heights of cut will be made.

11. Exhibit of the three Zoysia species and their hybrid offspring.

12. Exhibit of photographs of Zoysia breeding work and cytological work.

13. Zoysia pollen under dissection microscope.

Zoysia breeding plots which will not be shown because they are located on the South Farm are isolation plots of heavy seed producing strains consisting of:

14. An isolation plot of pure clonal 9-21 selection.

15. An isolation of selfed seedlings of 9-21 selection

16. A single cross plot of alternate rows of pure clonal material of 9-17 and 9-21 selections.

These plots are isolated from each other and from all other Zoysia by distance, to prevent any possibility of contamination either physical or by cross-pollination with other Zoysia grasses. Seed production and turf produced by seed harvested from these three plots will be compared. The best combination will be chosen and increased for release to seed producers of our first heavy seed producing Zoysia turf variety if it continues to perform satisfactorily. Several years later seed of the variety should be on the market for use by the public.

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Al Radko

U.S.G.A. Green Section

Most of my work at Beltsville to date has been with zoysia. I have been mainly working with Z-52. Of course, established turf of Z-52 to our way of thinking at the present time leaves little to be desired in the way of good turf. So with this in mind we are working with the Z-52 mainly.

Two years ago we put out several seedlings of the Z-52 strain and observed these for characteristics similar

to those vegetatively of Z-52, but in addition we were looking not only for good seed producers but also seed that produces a progeny like that of the parent. We found a few of them. The #1 selection and #9 selection out of Z-52 are very promising. However, the #9 strain is a little bit thicker vegetatively. So until the time comes when Scotty brings us the ideal plant, I think these will fill in for the greenkeepers and to the other people who are interested in these grasses.

We are also working with means of vegetatively planting large areas in short order and working with time of planting in order to bring to the greenkeepers the time of the year best to plant. We are planting plugs of this material the entire year round. Of course, we had a rather nice winter this last season and we don't want to say too much about it now. We will carry it for a few years and we think we will be able to bring you something you can use practically.

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Charlie Wilson

U.S.G.A. Green Section

I am glad that Dr. Ferguson mentioned the value of extension. I think a great many of the people here tonight have gotten the idea that everything must be research. Of course, to begin with we must have research before we come up with anything in the way of new and improved grasses. However, I would like to emphasize the extension aspect of selling these improved grasses. If we dealt with research alone, we would never make known to the public the idea that improved grasses are available. For example, the seed growers must have the public demand before they will go into seed production. We cannot create that demand purely by research.

I would like to say a little about our growing the cool-season grasses in combination with warm-season varieties of zoysia. You have heard a great deal about the work done with zoysia, and I think we could probably classify it in three main categories-- the past, the work that is being done now, and our outlook to the future work that needs to be done with zoysia grass.

In the past it was mainly observational work. Zoysia

that we have observed at Glendale has been there since 1920. One of the most interesting things about it has been the fact that while it has been spreading, it has maintained practically a perfect marriage with creeping red fescue. We have also noticed compatibility on our own Zoysia plots at Beltsville that have been established since 1942 with Kentucky bluegrass. From these earlier observations we realized that by growing a cool-season grass with the zoysia, we could establish a year-round turf.

With that in mind we have plugged zoysia into existing cool-season turf;we have seeded fallow areas to zoysia and later followed up by overseeding with cool-season grasses; we have seeded both at the same time and have had good results in every instance. Plans for the future seem to lie in more of this type of work and more widely scattered tests over the country. We think we have something, but we certainly must get it out to the other experiment stations.

Finally the plan that we have outlined for the future in this combination work will be seeding zoysia into an already existing turf of cool-season grasses.

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Marvin Ferguson

U.S.G.A. Green Section

Our work at Beltsville has been concerned very largely with zoysia. It seems to be one of those grasses that will fill the bill in this particular area. We are just a little far south for good bluegrass and a little too far north for good bermudagrass. So we are trying to work with those grasses and those combinations of grasses that will serve in this area. My own graduate work work at Maryland was with zoysia and the particular phase of it that I studied was nutrition. We feel that we gained quite a little bit from that study. At least we have learned some techniques for studying nutrition in other grasses.

I am not going to go into that story now at all except to tell you that we are going to go ahead studying other grasses. The next one we are going to tackle is Merion bluegrass. We are trying to establish the levels of the nutrient elements that are necessary to be present in the tissue of the grass in order to form

the best or densest turf, the fastest growing turf, and the grass that will do the best job of producing seed. It is quite a job to study the nutrition of any one grass and even after a problem of that kind has been done, there is still a lot of work left. But at least we feel we are on the right track. This nutrition work is one of our main studies now at Beltsville.

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ECONOMIES IN TURF MAINTENANCE THROUGH SEED USAGE

Alton E. Rabbitt, Agronomist
Bureau of Aeronautics
Navy Dept., Washington D. C.

It is a pleasure to have the opportunity to be on the Green Section National Turf Field Day Program. It seems only a few years since I was supervising the planting of and taking notes on the bent and bluegrass variety test plots at the Arlington Experimental Farms.

It is the unamimous opinion of my committee consisting of Dr. Cornman, Dr. DeFrance and Mr. Warren Lafkin that more money is wasted through the improper usage of seed than through any other phase of the establishment and maintenance of turf areas. Many of the failures in turf are due to ignorance of the fundamental principles of good sound turf culture. Failure to combine good planning with good sound agronomic methods usually results in failure to establish the desired cover. Most important among the fundamental principles involved in good turf culture are:

(1) Adequate seedbed preparation

(2) Planting in proper season

(3) Correct choice of grass species

(4) Avoiding too competitive nurse crops

(5) Proper rate of seeding

(6) Adequate fertilizer

I cannot stress the importance of proper seedbed preparation enough. This applies to renovating old turf as well as establishing new turf areas. During the mammoth war airport construction program thousands of acres had to be reseeded because of improper seedbed preparation. The soil should be thoroughly pulverized prior to seeding. In renovation of an old established turf, regardless if it is a tee, fairway, athletic field or lawn, the soil should be thoroughly pulverized. When aerifying is used to prepare a seedbed, it should be used enough times to tear out all of the dead grass and loosen the surface soil completely. It is essential for maximum germination that the seed be firmly pressed into the soil, but barely covered. If the seed is not brought into direct contact with the

soil, the seed will germinate but the seedlings will wither and die.

Timeliness is one of the most important principles to be considered in all seeding operations. In spite of the fact that we have endeavored to teach the public the importance of fall seeding when using northern grass, especially in those sections of the country where competition from crabgrass and annual summer weeds is a major problem, still more northern grass seed is sown in the spring than in the fall. On the other hand, the southern grasses should be planted in the spring or early summer. Seeding out of season usually results in partial or complete failure.

Another principle to consider in the economy of seed usage is the selection of grass species which are best adapted to local soil and climatic conditions and best suited for the intended use of the area. Dr. John Cornman had an excellent article in the July 1950 issue of the New York State Turf Association Bulletin No. 16 on seed mixtures and the use of too competitive nurse grasses.

The seed mixture plots I conducted for the National Capitol Parks, Department of the Interior, in 1939, proved that when more than 10 percent by weight of the quicker growing grasses are used in the mixture, they delay the development of permanent turf. Temporary grasses, such as Italian ryegrass, are heavy feeders and will rob the soil of moisture and fertility which should be used by the permanent grasses. Dr. DeFrance in a field demonstration at Rhode Island showed that there is only a difference of five to seven days between the germination time of bent, redtop, fescue and ryegrass. I do not think it is necessary to use nurse grasses in a mixture when the seeding is done at the proper season of the year unless seeding a slope and then better results can be obtained by eliminating the nurse grasses and applying straw mulch to the area or by sodding. Areas subject to continuous heavy wear should be sodded rather than seeded.

In determining the seed or seed mixture to use, one should also consider the type of maintenance the area is to be given. If it is to be mowed at a height of ½ an inch, one should use bent or some other grass that will tolerate close mowing. However, on areas to be cut at a height of 1 to 1¼ inch, it should be possible to maintain a good stand of bluegrass.

The best demonstration I know of in the economy of

seed usage is the series of plots I conducted for the National Capitol Parks in cooperation with the U.S. Golf Association, Green Section, on the relative importance of various rates of seed and fertilizer in the establishment of permanent turf. These plots proved that good turf could be established on poor soil by seeding with as little as 40 pounds of seed to the acre when adequate fertilizer was used. Many of you saw these plots at the last Green Section field day at Arlington Farms in 1940. These plots told an interesting story in dollars and cents in the relationship between seeding rates and fertility levels, and quality of permanent turf produced.

The soil in the area on which these plots were established was a heavy clay subsoil low in all essential plant food elements and was heavily infested with crab grass, dandelions and other weeds prior to plowing under immediately before seeding. Parallel series of twenty-four 10'x10' plots were established in triplicate in September 1939 and the following spring to determine the significance of time of seeding. The plots were randomized so that no two plots would be adjacent to each other in any series. Kentucky bluegrass seed of high quality was sown at rates of 40,80, 120, 200, 400 and 600 pounds to the acre. A 10-6-4 commercial fertilizer of which 25 percent of the nitrogen was from an organic source was applied to the prepared seedbed at the rate of 400, 800 and 1600 pounds to the acre. At each seeding rate, control plots to which no fertilizer had been added were also established. The plots were rated on density, color, disease and weed population at monthly intervals throughout the growing season.

Within two months it was obvious that fertilizer played an important part in the economy of establishment of a dense stand of turf. The best plots at that time were those receiving seed at the rate of 200, 400 and 600 pounds per acre and fertilizer at the rate of 1600 pounds to the acre. The cost of the seed and fertilizer used was $76, $125 and $173 an acre respectively. In June at the end of nine months, however, all plots receiving fertilizer at the rate of 1600 pounds to the acre were equally superior with the possible exception of those seeded at the rate of 40 pounds to the acre which had more weeds.

At the end of one year the best turf was on the plots seeded at the rate of 40, 80, and 120 pounds to the acre and fertilized with 1600 pounds of 10-6-4 at a cost per acre of $37, $47 and $57 for the seed and

fertilizer. The plots seeded at the rate of 40 pounds to the acre produced good turf but had a higher weed population. However, this is no longer a major factor with 2,4-D available for eradicating the braod leaf weeds.

The heavily seeded plots of 200, 400 and 600 pounds per acre which produced the best turf throughout the first fall, when heavily fertilized, were badly damaged by leafspot in June, and much of the grass was killed. Weeds soon appeared and the final results were not as good as the results from seeding at the lower rates although the cost of seed and fertilizer was much greater.

These plots demonstrated that good permanent turf can be established quickly even on poor soil by seeding in the fall of the year with 80 to 120 pounds of high quality seed when sufficient fertilizer is used. In this experiment, 1600 pounds of a 10-6-4 fertilizer were required. The 200, 400 and 600 pounds of seed per acre without fertilizer produced a thin weedy turf. When these same seeding rates were used accompanied by 1600 pounds of 10-6-4 fertilizer to the acre, the turf was not as good as it was on the plots which had been seeded at the rate of 80 and 120 pounds and fertilized with 1600 pounds of 10-6-4 to the acre.

In other words, better turf was established at the end of one year when 80 and 120 pounds of seed and the same amount of fertilizer were used, and at a cost of $29 and $19 per acre less respectively. The difference of cost is even greater now because seed cost has advanced more in price than fertilizer. Using the current price of Kentucky bluegrass from the Government Federal Supply Schedule, by reducing the seeding rate from 200 pounds to 80 pounds when fertilized with 1600 pounds of 10-6-4, you would get better results and at the same time save $100.80 per acre.

The spring seeded plots demonstrated the importance of seeding permanent northern grasses in the fall of the year. All spring seeded plots, regardless of the rate of seed and fertilizer used, were 95 percent crabgrass by September. In comparison, the fall plots seeded at rates of 80 and 120 pounds and fertilized at the rate of 1600 pounds per acre were practically free from crabgrass. In the heavily crabgrass infested areas such as Washington, St. Louis, Kansas City and Cincinnati, it is almost impossible to establish a permanent stand of grass with spring seeding.

Prior to seeding any area, it is recommended that soil be tested for pH and available phosphoric acid. If the pH is below 6, apply sufficient lime; use a dolomitic limestone if magnesium is low. Seldom is it necessary, however, to use more than 2000 pounds of lime to the acre. Also, sufficient phosphate should be applied to meet the requirements of the grass. The ideal time to incorporate the lime and phosphoric acid into the soil to a depth of two to three inches is at the time of seedbed preparation.

For real economy in seed usage, seed at the proper season with high quality seed of permanent grasses at lower rates combined with ample high nitrogen fertilizer. When bluegrass predominates in the seed mixture, a rate of 80 to 100 pounds to the acre is adequate under most conditions. However, when a significant quantity of bent is used in the mixture the rate should be reduced proportionately due to the small size of the bent seed. When establishing a bent turf 50 to 60 pounds to the acre should be sufficient on average soils. These low rates of seeding must be accompanied by applications of 80 to 100 pounds of nitrogen per acre. On poor soils it would be advantageous to increase the nitrogen application to as much as 160 pounds to the acre. In renovating old thin turf, the above recommended seeding rates should be reduced one-half and not more than 40 pounds of nitrogen should be applied at one time to avoid burning the foliage of the established grass. When organic nitrogen is used, this rate may be increased accordingly.

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LABOR MANAGEMENT

Taylor Boyd, Superintendent
Camargo Country Club
Cincinnati, Ohio

Labor Management today, as everyone knows, doesn't exist-- labor manages us. Seriously, because of the short labor market, which may become shorter, every thing possible should be done to save that most expensive item. Power machinery should be used in every job that will cause a man to do more work than he could by using manually operated tools. Machines that you might want aren't always available and they have to be improvised. John McCoy, Superintendent at the Cincinnati Country Club, has put two Masters fertilizer spreaders together and powered them with an old Worthington Overgreen tractor. With this one man does the work of three.

We use a weeder on the back of our Ford tractor to loosen our sand in traps and remove weeds. One man with this device can do the work of a dozen men. These are examples of what can be done, and there are, of course, many, many more personalized gadgets used by greenkeepers that save labor. Find out about them and use them.

We discovered that the men who mowed the three back sets of greens spent enough time transporting equipment to and from work to mow two extra greens each. We built two small houses in which to store the proper equipment such as power putting green mowers, rakes, power mowers, etc., to service each group of holes. The results were remarkable.

Labor management is actually only cost control. Cost control doesn't actually exist unless there is some easily kept, easily readable record kept. We have a very simple form that gives us the cost of each job per month, six months and per year. This information is all on one sheet so that every board member can see where the money has been spent. As superintendent, I can tell where I am weak, which men aren't doing their share of the work--not by guess but by actual figures. This system was installed here four years ago and has proven most revealing to everyone concerned.

Labor can be induced to produce more work if each man is given certain duties and held responsible for them, shown and told when he either does a good job or a

poor one. Most men have enough pride to want to excel and, if given praise judiciously, will gain pride in the amount and type of work they do.

The greenkeeper must, first and foremost, have a good program and know himself what he is trying to achieve before he can get any support from his men.

GRASSES FOR ECONOMICAL MAINTENANCE

Neal Wright
Graduate Student
Penn State College

It is indeed a pleasure to be a part of this splendid program. However, I must state that I feel a little out of place. As the case goes with the vocational agriculture teacher who, when asked by highly specialized farmers what his job was, replied that he taught farmers how to farm. But to get on with the subject.

The value of considering economics in the production and maintenance of turf has been emphasized by the toastmaster and the speakers to this point. It goes without saying that first-class turf can be obtained and maintained economically. From the topics discussed thus far and those to follow, we are all aware of the interrelationship of all factors affecting directly or indirectly the ultimate production of economically superior turf. This topic, which is grasses for economical maintenance, is a part of the whole program. However, I do not want to underemphasize its importance because the grass that is selected for use often is the difference between good and bad turf. This leads us to the general statement that good economical turf depends largely on the grass selected for the specific use.

In considering the species to select, the individual grass should be evaluated relative to its adaptation to soil, use and climate. As we know, average soil in its original state is highly variable. Areas used for turf are generally far from average. Soils range all the way from subsoil to artificially prepared soil for very specific, special purpose turf. Without going in to the physical and chemical properties of the soil, it can be safely stated with few exceptions that soil is of lesser importance in the selection of grasses. However, do not misinterpret the statement. It is meant that soil is not a limiting factor in selecting between Colonial or creeping bent for putting greens.

There are species that will tolerate soil conditions far from the optimum, but it would be unwise to choose a grass for those conditions and expect to maintain it economically. For good, economical turf the adverse soil conditions should be corrected within reason and not select a grass because it will tolerate a low pH, for example.

A second factor to consider is the use for which the grass is intended. Obviously it would not be economically desirable to attempt to maintain Alta fescue as a putting surface. But if the use is one that demands a grass that must withstand wear and under less favorable natural conditions, then Alta fescue could very satisfactorily be used.

From this point a more careful consideration should be given to the grass species and the proportions of each. Requirements for football fields will differ from those for fairways. It is obvious that those grasses which are able to resist weed invasion and disease organisms and can tolerate heat, drought, insects, winter injury, trampling and adverse soil conditions are going to require less maintenance. It is felt by many that grass combinations must be used in order to obtain turf which will contain a good share of these desirable features. But much is yet to be learned concerning the management of grass combinations particularly a combination of warm and cool-season species.

Climate due to its everpresent direct relationship on determining whether a given grass can be economically maintained, is perhaps the most limiting factor. The fact that climate, particularly temperature, cannot be controlled artificially makes it foremost as a factor to consider. Some climatic conditions can be altered such as moisture. Those grasses that survive under natural conditions over a long period of time must be selected and adapted to the conditions of the area.

There are somewhat under 1100 grasses in the United States of which less than 40 are being used for turf. These grasses can be grouped on the basis of climatic conditions and on the basis of turf of practical importance. It should be kept in mind that there is considerable overlap between the climatic regions. But for more economical maintenance, a grass should be selected that is among the permanent species of the area. To this point an attempt has been made in a general and elementary way to stress the importance of selecting grasses for economical maintenance.

To continue, perhaps some of the characteristics of individual species of grasses should be considered in relation to maintenance. These points will be general for each species and not specific for improved strains that are still in the improvement process. Kentucky bluegrass has reached a stage with the Merion strain which is a definite improvement for economic use. The

grass is heat and drought tolerant, resistant to helminthosporium leafspot, resistant to weed invasion and tolerant to closer mowing than common bluegrass. These factors, along with others, definitely reduce the cost of maintaining desirable turf.

Bluegrass has always been the most widely used grass in the cool, humid regions. Common bluegrass needs liberal amounts of water. It will not stand heavy compaction and should not be clipped less than 1 to 1½ inches. These factors discourage the use of common bluegrass except on lawns and similar areas. Bluegrass in general will not tolerate acidity and liberal supplies of all elements, particularly nitrogen and phosphorus, are required.

The fescues-- chewings and creeping red-- are adapted for general turf use in the cool, humid regions if properly managed. They are highly wear-resistant, due to the heavy bristle-like leaves, highly tolerant to shade and will tolerate dry conditions. They are slow growers, which is an advantage for economy. However, they do not recover from injury very quickly due to the characteristic nor do they compete well with fast growing grasses under intensified management. Moderate fertility levels and a pH of 5.5 to 6 are good practices. Normal commercial fescues are seriously injured with constant close clipping.

The bentgrasses are generally thought of as highly specialized turf and for those areas such as putting greens, the selection will depend largely on the turf quality capabilities of a particular strain. From a maintenance standpoint, disease and disease recovery are very important, as well as the ability to withstand weed invasion.

Colonial bent has a wide range of usefulness, such as lawns, athletic fields, fairways and golf greens. For those less specialized areas it is well to consider the fact that the grass has a rapid growth rate under moist conditions and, on the other hand, will need artificial watering when droughty. In fact, this can be said for any of the bentgrasses. However, I do not want to enter the controversial discussion of bent fairways. There are differences in strains of creeping bent which will help maintain economy, but that material is still to be screened experimentally, making it of no commercial importance today.

Bermudagrass has a wide range of adaptability over the entire southern, warm, humid and irrigated regions

where water supplies are available and is one of the best general all-purpose grasses for that region. It is definitely a warm weather grass and does best under high temperatures and liberal moisture. It will not tolerate poor drainage and high acidity and needs high fertility levels, particularly nitrogen. It can be maintained at a reasonable height of cut with the cost of maintenance increasing with the closer it is clipped. It must be brushed, raked out and top-dressed under close clipping.

Now on the assimilation of the factors to be considered in the selection of a grass for economical maintenance, it is evident that some features of a given grass will considerably increase economy. As an example, Colonial bent is generally considered to be relatively tolerant to disease and requires less top-dressing than creeping bent. These capabilities are a definite advantage for economy. However, Colonial bent is not as saitsfactory under a wide range of conditions and has a slower rate of recovery than creeping bent. This example indicates that in many cases exact economy may not be the most important, nor result in the most desirable turf.

There is no doubt, obviously, that this discussion could have been centered around the selection and isolation of improved strains. Unfortunately, turf grass breeding in general is in its infancy, but from the work under way at the present, there is no reason to doubt that superior turf will be developed,which means that economic maintenance will be improved by the proper use of improved grasses.

I would like to state at this point that it is the unanimous opinion of the committee concerned with this topic that our greatest economy in turf management will come with the introduction of superior grasses, to quote Dr. Glenn Burton of Tifton, Georgia. However, with the exception of Merion bluegrass, Alta fescue and those grasses which must be vegetatively propagated, such as U-3 bermudagrass, new strains at this point are of no commercial importance. The new developments of bermuda, creeping bent, zoysias and fescue, to mention a few, should be watched carefully as they will provide a great advancement in turf quality and maintenance.

However, I want to stress the importance of continued research to develop new strains and methods of management. It can be safely stated that the possibilities of improvement are hardly touched. To exemplify that

point, Merion bluegrass is merely a stepping stone to the isolation of a desirable strain of Kentucky bluegrass. It is a large step just as the results in the new releases of the other species will be. But those specialists who are charged with the breeding programs should not slacken when a more powerful knock-out punch is in sight.

If for no other reason it is hoped that this presentation will arouse an interest in the consideration of the selection of grasses keeping in mind the capabilities and requirements of the grasses so that the highest quality turf can be maintained in the most economical manner.

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ECONOMY IN INSECT CONTROL

Dr. E. N. Cory, Head
Entomology Department
University of Maryland

I am very fortunate in having an excellent committee and I want to take a moment to express my thanks and appreciation to Dr. Kelsheimer of Florida, Dr. Schread of Connecticut (both of whom are members of the committee)and to Dr. Langford of Maryland for their kindness in preparing information for you. That information has been assembled and will be distributed, but I think it would only be fair for me to read a few short excerpts from some of the papers that have been furnished to me by these gentlemen.

The most economical procedure in pest control in my mind is preventive work. That means that you must be constantly vigilant, it means that you must make use of your own state authorities to help you diagnose your difficulties. They will all be glad to help you. The next best thing, in my opinion, is to attend gatherings of this sort where you can get first-hand information. Also your annual meetings and the committee meetings of the greenkeepers associations. The next meeting of the Mid-Atlantic Greenkeepers Association will be January 11 and 12, 1951, at the Lord Baltimore Hotel, Baltimore, and you are all invited. At this point I want to express my appreciation to the West Point Lawn Products, especially Tom,for their kindness in getting out the minutes of the last conference.

The new organic insecticides have brought about new economies in turf management and it is these new economies that we wish to discuss. Insect pests on greens are no longer a problem if silence from greenkeepers means that everything is under control. We still have our pests of the greens and they will be mentioned later. But first, the main problem of the greenkeeper is the care and condition of his fairways. These fairways are the catch-all for all of the insect pests and some other pests that are not insects. The principal pests of the turf or fairways in Florida are given below.

Control Measures

Many insects, both chewing and sucking, may be controlled by the use of 5 percent DDT dust applied at the rate of 30 pounds per acre ground equipment or 40 pounds by airplanes. Hand dusters may be used in small isolated areas and around the clubhouse. If spraying is preferred, use DDT 50 percent wettable powder at the rate of 2 pounds to 100 gallons of water applied at the rate of 100 gallons per acre. DDT is the best control we have for leafhopper. It is also effective against the sod webworm, chinchbug, false chinchbug and slugs.

Perhaps the insecticide most widely used in Florida is Chlordane because of its general effectiveness. Moisture activates this insecticide which makes it different from most of our materials in use today. Air application of Chlordane may remain effective from a month to six weeks. If soils are on the alkaline side, add sulfur to increase the effectiveness of this material. Chlordane may be used as a dust and as spray the same way as described for DDT. Chlordane has a wider range of usefulness in that it controls a greater number of pests than DDT. Its biggest use is in the control of mole-crickets. It is widely used for the control of sod webworm, fall armyworm and for grubs.

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ECONOMY IN WEED CONTROL

Charles K. Hallowell
Agricultural Extension Representative
Philadelphia, Pennsylvania

I wish to take this opportunity to say something to Mr. Tufts that he might pass on to the Green Section. As Fred has told you, I traveled in California and many other sections and saw a good many turf people. All look to the Green Section of the U.S. Golf Association for the source of information about golf course turf.

That was so noticeable in Mexico City. If we wanted to do some good-will work with the Mexicans, I think one of the ways we could do it would be to send some turf ambassadors and help them with their turf problems. O. J. Noer was there and did a splendid piece of work.

It was the same every place I went, whether it was Texas, New Orleans, Arizona, Canada or the West Coast. There is one other source of information that is the spearhead and that is the information that comes out of the greenkeeping superintendents national meeting. When the papers were released from the Boston meeting, they were eagerly read by the turf folks on the West Coast. That was what they had been looking for and it was guidance. The two groups can feel very proud of the work that they are doing for they are rendering a service to so many folks.

I wonder if you realize what the West Point Lawn Products is doing as to distributing turf information. Do you realize that they have perhaps a corner on the information on turf? A young fellow in Texas was asked about where to get information on turf. He said that there was just one place to get it-- send to the West Point Lawn Products. The papers that they have on the different conferences are perhaps the greatest accumulation of data on turf that you can put your hands on in one place.

The committee that was appointed to summarize on weed control, Ralph Engel, Gene Nutter and myself, were united on two things. One was that what we should tell you today on weed control or efficiency in controlling weeds was what you have just heard, and the second thing was that the best way to control weeds was by sound culture practices. In other words,if you have

followed what has been said here by the other speakers, you do not need us because you will be growing grass without any weeds. Our notes have been condensed and are offered to you as guidance whenever it is necessary to remove weeds from turf.

Efficiency in Weed Control

Sound management practices that will produce a dense turf, keeping out most weeds.

Development of a program that will encourage turf to replace removed weeds. This also includes the selection of grasses adaptable for the purpose.

Prior to new seedings thoroughly prepare seedbed so that numerous weeds will germinate and be destroyed and for areas not too large use a chemical for sterilizing or checking a majority of the weed seeds.

Know the weeds in the turf and know when their resistance is low, or when they can be controlled with the least effort.

Decide on a program that will check or control the weed and only temporarily retard the desired grasses. Certainly we do not want to injure good grass. This may be mechanical such as rakes on mowers or dragging turf with fencing or chain harrow in the direction opposite to and before cutting.

If a chemical is to be used, know about its action, for instance whether it works into the soil and through the leaves of the grass plant.

Develop test plots on the golf course where an application of the chemical selected will show approximate results without injury to valuable turf; or be familiar with results secured in the area under similar conditions.

Determine height of cut of turf best for making applications and the soil moisture desirable, also favorable temperature.

Distribute chemical evenly, whether in spray form or dry, which means no missing or overlapping. Burns resulting from faulty applications cause loss of turf that is difficult to replace. I have seen in many places where they applied chemicals and injured good turf. That is not efficient control of weeds if we are going to hurt our good turf.

Using chemical as a spray or dry usually is dependent on the equipment available. 2,4-D and sodium arsenite are materials that are equally effective as a spray or dry. Use only the minimum amount to check the weeds.

Three quarters of a pound of actual 2,4-D per acre in spray form seems sufficient to use on fairways where turf contains bentgrass. Injury is severe when heavy applications are used.

Select the correct chemical in the renovation program the one that will not interfere with seeding if that is necessary, and will check the weeds while the turf is becoming established. Example - sodium arsenite's effect on clover and poa annua- it checks these plants and seeding can be done at the same time the chemical is applied.

Use a herbicide on creek banks and similar areas to reduce the man hours on mowing these areas.

Weed control by chemical means may not be as perfect as desired but chemical control of weeds in tees and approaches is sufficiently practical to eliminate hand weeding. Also, the phenyl mercury compounds are economical for heavily infested crabgrass greens since they do a selective job and save hard labor.

Always compare chemicals on the cost basis. They may do similar work, but the cost differential may be a dominant factor.

Crabgrass control is continually gaining the attention of many folks. The widespread publicity crabgrass control received indicates its popularity but more real facts about the effect of the different chemicals is wanted. The work being done by the Experiment Stations of Rhode Island, Cornell, New Jersey and Pennsylvania are sure to bring forth helpful results. The increased number of chemicals showing possibilities is encouraging.

In determining which chemical to use, golf course men will have to first - determine comparative cost of materials available, second - know the extent of injury to the permanent grasses and the rate at which these good grasses recover from an application of the chemical used, and third - compare the effectiveness of the arsenicals, mercuries, potassium cyanate, dichloral urea and possibly maleic hydrazide. All will want to know how each control the crabgrass, length of time in action, number of treatments necessary and when the

crabgrass is most susceptible to the chemical. The chemicals are here to stay and are one more good tool for good management.

Research at Cooperating Golf Clubs

Much of the work done by the Green Section and by state experiment stations is fundamental research which cannot be applied directly to golf course problems. The gap which often exists between research results and improved maintenance practices is bridged partially by "on-the-spot" research, carried on at golf courses. The Green Section welcomes the opportunity of working with greenkeepers on practical research problems.

Sometimes this final step in the program consists of planting improved strains of grass for testing under play. In other cases it may be the use of a different soil mixture in a green. Whenever greenkeepers begin to use information that has been developed by research they perform the final steps in the research program. Research is not complete until its findings have been proven under practice.

Tuesday, October 17, 1950, was devoted to inspection of two of the courses in the Washington area which are making good use of the results of turf research. They are the proving grounds.

Woodmont Country Club

Inspection of the new Woodmont course under the auspices of the Mid-Atlantic Association of Greenkeepers started the second memorable day of the 1950 meeting. On hand to lead the discussion during the tour of the course were A. J. Tull, architect; Frank Murray, builder; Leopold Freudberg, Green chairman; George Fazio, professional, and Rudy Wills, greenkeeping superintendent.

Mr. Tull was justly proud of the course layout, especially the third nine which consisted of all par 3 holes. We may expect to see a great many more short holes in the future. As life expectancy shoots up and our population age level foretells of a more mature populace, the game of golf will also adjust by eliminating the long grueling haul in favor of the short course.

George Fazio, club professional who was in a 3-way tie for the 1950 Open Championship with Ben Hogan and Lloyd Mangrum, gave a most interesting talk on what the professional golfer desires in a fairway turf. George pointed out that with alarming consistency our top notch golfers come from the south and southwest where firm closely-mowed fairway turf is the rule rather than the exception. He stated that without exception tournament players would rather play off a brown crabgrass fairway mowed closely in preference to a beautiful soft, lush turf that required a high height-of-cut to keep it in condition. Fortunately for all golfers new and improved grasses that can be mowed closely and will still be beautiful are in the offing. Cool-season species such as Merion bluegrass, improved bentgrasses, and creeping red fescues are or soon will be available. Winter-hardy warm-season grasses such as zoysia and U-3 bermuda are also available in limited supply.

The fairways at Woodmont should give the members the desired playing conditions. Through the cooperation of Mr. Freudberg, green chairman, and Dr. Grau, who advised as to seed mixtures, a pioneer development in fairway turfing has been accomplished. Common pasture bluegrass was excluded from the mixture and if we accept the concensus of opinion from those present, it would appear that it shall not be missed. A near-perfect turf of bent and fescue is the result. This can be mowed closely for playability and still present an acceptable appearance.

The greens, many of which had been planted in December of 1949, had come along nicely under the competent care of Rudy Wills. Rudy stolonized his new greens with a mixture of Arlington (C-1) and Congressional (C-19) bents. However, the soil mixture in the greens left much to be desired. The soil, sand and humus were mixed on the green site using a Rototiller. A pronounced layer of humus resulted about 1½ inches below the surface. The Green Section has had reports of similar layering attributed to the use of a Rototiller.

The tour ended on a note of optimism concerning the future for Woodmont and an expressed desire to visit the course again next year.

Fairfax Country Club

Following lunch at the beautiful new clubhouse that good turf built, the party split into two groups for a tour of the course. Charlie Treacy, greenkeeper at Congressional and formerly Bill Glover's right hand man, took charge of one party while Bill Glover, greenkeeper at Fairfax, acted as moderator for the remainder of the group.

Highlight number one was a portion of No. 10 tee that had been stolonized to a mixture of Arlington (C-1) bent and U-3 bermuda in the late summer of 1949. This portion was solid U-3 bermuda that presented excellent playing qualities. The remainder of the tee was practically devoid of a turf cover. Bill feels that U-3 is the answer to a good turf cover on open sunny tees, especially on public courses like Fairfax that receive a tremendous amount of play.

It was immediately obvious that Fairfax had been doing an excellent job of crabgrass control on its fairways. Before the questions as to gallonage, high or low pressure sprays or chemicals used, etc., could be raised, Bill explained that flexible combs had been placed on his fairway mowers in early summer and had been used continuously since that time. Mowing direction had been varied, but not an ounce of chemical had been used all summer. Cultural practices had given nearly perfect control.

The greens were in excellent condition due to good bents (Arlington, Congressional, Collins, Old Orchard, and Toronto), good soil structure and good management. Bill seemed to be the only one dissatisfied with the

condition of his greens. Good judgment includes generous feeding, correct use of water and frequent use of the Aerifier. He continues to improve soil conditions by filling his cup replacements with new soil from his topdressing stockpile. The cost is negligible and he has figures that within four years the greens will be completely changed to a better texture.

Following is a list of the types of vegetative bents used at Fairfax Country Club:

Green	Bent
1	C-27
2	C-52
3	C-1, C-19
4	C-1
5	C-19
6-8	C-1, C-19, C-27
9	C-1, C-27
10	C-50
11	C-15
12-18	C-1, C-19, C-27

Fairfax has tried most of the better known creeping bentgrass selections on their greens. Both Bill and J. S. Connolly, owner of the Fairfax Club, believe that all of them have some merit. From the standpoint of management economy, combining ability, disease and drought tolerance they have favored the mixture of C-1 C-19, and C-27. More recently the two-way mix, C-1 and C-19, has found favor.

Fairfax has its own seed production nursery of Merion bluegrass; an increase nursery of U-3 bermuda, creeping bents and zoysia selections; and a sizable putting green nursery of Arlington and Congressional. In cooperation with the Green Section, Fairfax has also established a fairway planting of zoysia.

As the crowd left to go home, we overheard many favorable comments concerning the 1950 National Turf Field Days. Probably the ones which pleased us most were those expressing the value of overall cooperation and the outstanding results derived therefrom.