PROCEEDINGS

of

1961 TURF CONFERENCE

Sponsored by the

and

PURDUE UNIVERSITY

LAFAYETTE, INDIANA

March 6 to 8, 1961

PROCEEDINGS OF THE

1961

MIDWEST REGIONAL TURF CONFERENCE

The 45 articles included in these Proceedings are condensations of talks by speakers before sections and divisions of the 1961 M.R.T.F. Conference. We appreciated the willingness of the speakers to participate and prepare material for your reading. See Table of Contents next page. Proceedings of each annual Conference since 1948 have been prepared. A limited number of 1959 and 1960 Proceedings are available at price below.

A copy of these Proceedings were mailed to:

1. The 600 attending the 1961 Midwest Regional Turf Conference.
2. One person of each Member Organization within the Midwest Regional Turf Foundation not represented at the Conference.
3. List of those in educational activities.

Additional copies are available at $ 1.00 each from:

W. H. Daniel, Exec.-Secy.,
Midwest Regional Turf Foundation
Department of Agronomy, Purdue University
Lafayette, Indiana.

Attendance divided by interest as judged by registration card		Distribution by States	
Golf Courses	320	Illinois	188
Turf Materials and supplies	133	Ohio	133
Sod Nurseries & Landscape	51	Indiana	124
Parks (most have golf courses)	24	Michigan	47
Industrial Grounds	17	Wisconsin	22
School Grounds	11	Missouri	21
Cemeteries	9	Kentucky	20
Non-profit & Educational	35	Outside Midwest	21
		Purdue	24
Total	600	Total	600

TABLE OF CONTENTS

		Page
President's Report	R. V. Mitchell	3
Executive-Secretary's Report	W. H. Daniel	4
You and Education	D. C. Pfendler	5
My Graduate Program	C. W. Lobenstein	7
Sharing Turf Information		
A Golf Course Superintendent's Experience	Mal McLaren	9
A Salesman's Experiences	Jess Taggart	11
Answering the County Agent's Phone	Fred K. Buscher	13
Grasses and Their Utilization		
The Transition Period	J. MacGregor	15
Fairways 1940 to 1960	F. V. Grau	18
My Views on Today's Fairway Problems	Colin Smith	22
" " " " "	A. Linkogel	23
Seedhead Prevention on Bentgrass Nursery	A. Linkogel	25
Turfgrass Mixtures - Influence of Mowing & Nitrogen	R. R. Davis	27
An Evaluation of Varieties of Kentucky Bluegrasses	W. H. Daniel	30
Utilizing Zoysia	Donald Likes	34
Public Relations and Zoysia	M. M. Parsons, Jr.	37
Starting & Maintaining Bermuda	E. Schneider	38
Progress in Bent Maintenance, 3rd year	Paul W. Neff	40
Disease Observation and Control		
Selective Disease Control on Fairways for the 60's	R. Williams	41
Fundamentals of Turfgrass Disase Control	Houston Couch	43
Turf Diseases & Their Recognition	M. P. Britton	46
Recognition of Diseases	M. P. Britton	48
Our Turf Disease Control Program	George Reynolds	49
Turf Management and Fertilization		
Turf Management vs. Turf Renovation	Ted Smith	50-A
Machinery & Techniques for Streamlined Operations	J. H. Latham	53
Nitrogen Studies on Plant Tissue	James B. Beard	56
Nitrogen Losses	Mel Hansen	59
Basics about Fertilization	A. J. Ohlrogge	60
Fertilizing for Growth Control	W. W. Milne	62
A Turf Fertilizer & Care Program	Bob Kelley	63
Aids in Understanding Nitrogen Nutrition	W. H. Daniel	65
Summary of Crabgrass Prevention	W. H. Daniel	67
Let's Look at Turfgrass	O.J. Noer	68
Our Turf and Landscape Program	R. Duke	71
Using Flowers - Planters	J. McCoy	73
Beautifying the grounds with flower beds	Paul Voykin	75
Wildlife and Golf	A. G. Brotzman	76
Sod Promotion	Ben Warren	78
Labor and Its Supervision (abstracts)		
A Report of U.S.G.A. Meeting	J. L. Holmes	81
Efficient Use of Men and Equipment	R. Williams	84
The Golf Course Worker	Al Radko	85
How to keep a Well-trained Crew	Chet Mendenhall	86
The Role of G. C. Chairman	Rear Adm. J. Phillips	86
Standardized Accounting Systems	M. M. Ferguson	87
The Evaluation of Calcined Clay Aggregates for Putting Green Rootzones	R. Montgomery	88

PRESIDENT'S REPORT

Robert Mitchell, President, M.R.T.F. 1960-61
Supt. Sunset Country Club, St.Louis, Mo.

The Midwest Regional Turf Conference has grown to be one of the finest of its kind in the country. Since the first meeting with less than 30 men present back in the 30's, it has grown to the 601 that were present at the 1960 Conference. In just the past 10 years it has more than doubled in attendance. Actual membership in Midwest Regional Turf Foundation has steadily risen as well and totaled 341 in 1960. Of this number 64%, or 219, are golf courses, and the remaining 36%, or 122, consist of industry, individuals, cemeteries, parks, landscapers, etc. However, the attendance figures and the percentages do not correspond to those attending the Conference. Of the 601 attending, 51% represented golf courses and 49% represented all other fields. An alarming fact to be considered also is that out of the 601 attending the Conference last year only about one-half of them were members. When we consider these figures it seems as though we need to:

1. Encourage our neighbors to join the Midwest Regional Turf Foundation.
2. Encourage them to attend the Conference and reap the full benefits from their memberships, and
3. Encourage the people attending the Conference who are not members to join.

The total monies collected in dues from the 341 members pays only approximately one-third of the total turf program at Purdue. The remaining two-thirds comes from industry in the form of grants and the State of Indiana and Purdue University in the form of taxes and facilities.

With the cost of everything increasing at a rapid rate and our dues remaining the same for many years, it behooves us to talk to our neighbors. Tell him of the value of research and the knowledge gained from being a member in an effort to increase our membership. In the Midwest area, it has been estimated that we have more than 2000 potential members. In 1960 we had 341, or approximately 17% of this number. I am sure that Dr. Daniel has helped this situation a lot recently by having written a letter to all clubs in this Midwest area, telling them of our function and purposes. The ice is broken, so to speak, with this letter, and perhaps just a word or two from us would gain another member. Let's try it!!!

Before closing I wish to repeat what every retiring President of the MRTF says, which is to try to thank Dr. Daniel and his staff for their work and leadership in the operation of the Foundation and Conference. I'm serious when I say that with Bill's enthusiasm in the role of Executive-Secretary that we as members can be assured of a continued fight against our problems, and can look forward to an easier task in our professions. Gentlemen, it has been a pleasure to serve you as President, and I look forward in every way possible to helping the Midwest Regional Turf Foundation.

\- - -

EXECUTIVE SECRETARY'S REPORT
March 7, 1961

Perhaps a brief recall of the relations and functions of M.R.T.F. would be in order. In 1945 a non-profit research oriented Foundation was established by charter, with By-Laws and officers. With only minor modifications in By-Laws in 1952, the wisdom of the early formulators still guide us today.

By Memorandum of Agreement the Foundation was housed and so integrated in the Department of Agronomy of Purdue University that their identify has become synonymous. As a result, for fifteen years efficient aggressive work accomplishment has been the only target, for no other problems have arisen.

Let's examine its working components. Mrs. House, a wonder secretary, handles billing, receipts and records of memberships. We had 341 in 1960, out of some 2,000 potential, and they provided almost $ 10,000.00 in funds. Of this perhaps 10% covers all costs. It is easy to maintain, but needs expanding.

All funds received become University funds and are used with administration approval in purchasing, etc., at discount. In our turf program, the biggest expense is personnel, which has three components:

1. Staff for continuing work.
2. Graduate and undergraduate assistance and training.
3. Fringe benefits related to above.

The student training program has been a strong point and had top priority. You see it in numbers - 5 Ph.D.'s, 8 Master's, 27 Bachelor degrees. But, more important we are pleased to have the performance of these men in our broad turf picture of today. And, more are coming, for we had 5 graduates and 15 undergraduates in training this year.

As you will notice from the Annual Report, leaflet No. 25, January 1961, we also receive grants and materials of considerable value - actually in excess of memberships.

M.R.T.F. is serving a second function in providing a strong active turf research and information function. The evidence of this is what new sales people, who start contacting turf interests, say about what you ask them; namely, "What does Purdue, Midwest Turf, or Bill Daniel say about your product's performance?" We must keep this outgoing, aggressive attitude which channels and encourages correct information. Frankly, I am convinced that it is not enough for an Experiment Station to be against something. It must be <u>for</u> something if its full weight and character is to be counted. For example, in leaflet No. 11, fourth revision on Controlling Crabgrass. We expect to distribute 10,000 of these, and more important, we try to make it clear enough that the reader has enough specific information that he can pick up the phone and order a product which is wanted.

You, as turf managers, are encompassed in this second point. You have not attempted to expect us to give extensive individual counsel. However, we do our best in the time available. You do compliment us repeatedly by coming to Conferences and Field Days so that current progress is maintained.

Our 25th Conference will be in 1962. Please mark your calendar early and bring lots of friends. Meanwhile, the total program of turf research and education as M.R.T.F. at Purdue has been a challenge that has made work with you a pleasure.

\- \- \-

YOU AND EDUCATION

D. C. Pfendler, Assistant Dean,
School of Agriculture, Purdue University

The University is glad to welcome you to the campus. Many industries, large and small, turn to this and other universities for help in solving practical problems. In turn, the practical problems of industry give point and direction to much of our so-called pure as well as applied research. The inter-relation between turf and University is clear.

You are interested in turf for sport, turf for beauty and industrial uses. The golfers, the football players, the airlines and homeowners each need highly specialized turfs. You must serve the needs of these users of turf with workable answers. And, good answers are usually hard to come by when they involve complex biological systems. Highly specific knowledges from several disciplines are involved. Soil structure, climate, irrigation, varieties, fertility practices, control of diseases, insects and weeds are segments of the problem. Because well-organized bodies of knowledge have developed in places like Purdue, we can help you and you can help us by uncovering specific problems.

Anyone who works with biological systems soon learns that apparently minor changes may have far-reaching consequences. I hope you will pardon a personal experience. After a good lawn was established, damage from moles took place. The lawn was sprayed with a combination of lindane, chlordane and DDT, with the idea of removing the food supply of the moles. The treatment seemed effective, the moles disappeared. Unfortunately, the olive backed thrushes, robins, summer tanagers, and brown thrashers also soon disappeared. Were they affected by eating earthworms that had accumulated toxic levels of some of the chemicals used in control? When the chemicals were applied I certainly had no notion I was trading thrushes and robins for starlings and English sparrows.

Education is a complex problem also. A small change here or there may result in far-reaching changes in unexpected places.

We have been in a great ferment concerning the educational procedures and even educational objectives in recent years. The Russian success in outer space and in atomic matters have shocked us out of our complacency. All levels of American education are subject to scrutiny. Grade and secondary systems are being examined, upgraded and reorganized. University programs are also being given critical attention.

A great emphasis has been generated in science. In certain quarters it is virtually worshipped. And, science is important. Our survival as a nation depends upon the efficiency of our science. Yet, most of us

know that the long-run survival of man depends upon breakthroughs in understanding and tolerance and charity. In our haste to reconstruct the educational plant of today and the immediate tomorrow, we must take time to be sure that all human values are being considered and protected.

The first great right that must be protected is the right of the individual to determine his own educational goals. Commissions that decide what kind and how much education may be available for the individual result in much wreckage. Germany had such a system and her society goose-stepped over the precipice.

The second great right is the student's right to quality in the educational process. This is a fundamental problem probing deep into our national conscience. Our teachers and preachers have historically been underpaid and poorly cared for in their old age. The teacher is the key to our survival. More dedicated people must be attracted to the profession. Their training must be better. Their professional status must be made more secure.

There are other important rights, but these two key areas are to be protected: first, the individual right of free choice of objective, and second, the right to expect excellence on the part of teachers and system. Far too many universities today are answering the problem of more students by raising their entrance standards, and raising their flunk-out rate simultaneously. Trade and vocational schools will probably emerge in greater force to take up this training gap.

There is a great deal that each of you can do as leaders in your own community. High school programs with depth and rigor should be encouraged. High school teachers and administrators who best know what should be done and want to do it frequently have no real backing from the community. Do your part to make scholarly activity in high school and grade school not only respectable, but "the thing." Help put scholarship on the equality with basketball. Undue emphasis on social activities, too free use of autos, lack of respect for scholars and scholarly activities are mostly reflections of the community spirit which the school system itself cannot overcome.

In reworking our curriculum in Agriculture, we approached the wisest men we knew in the several fields of Agriculture and of allied industries. Their answers had a striking similarity. Your professional training is excellent. There must be definite pluses. More skills in communication in understanding people and how to handle them. More knowledge of business, money management and accounting principles.

The rapidly changing times put unusual emphasis on fundamentals. Our faculty beefed up basic science in mathematics, physics, chemistry and biology. The communications and business requirements were about doubled. Applied courses in Agriculture were reduced. These changes have met with approval by employers and the total enrolment in Agriculture at Purdue is edging up, which is counter to national trends.

As compared to former generations, today's youth faces a future of infinitely greater challenge and perplexity. Our survival as a free people, the survival of the race itself depends upon the answers they will generate. You, as business and community leaders, must help set up the right environment.

MY GRADUATE TRAINING PROGRAM

C. W. Lobenstein, Ph. D. Student
Purdue University

In the 1959 Midwest Turf Conference Proceedings appears a very interesting talk by Mr. Earl Yesberger entitled "Using a Golf Course." In it he quotes several challenging proverbs. One of these, I think, very aptly describes the principal value of a graduate study program. The proverb goes something like this, "If I supply you with a thought, you may remember it - you may not; but, if I can encourage you to think a thought for yourself I have indeed added to your stature."

Twenty-one years ago when I completed studies for my B.S. degree, I thought there had been a tremendous amount of material to learn in chemistry, plant physiology and the like. Now it seems that we must learn three and four-fold that amount with all that has been discovered and proven in the past two decades. That is why I like the proverb in Mr. Yesberger's talk - if we can develop through our graduate study an attitude of mind that is more self-sufficient, the fear of the unknown is reduced.

The purpose of the Graduate School incorporates primary objecfives:

1. To provide advanced professional training of qualified students.

2. To promote knowledge through research.

These objectives are created to provide for society, individuals trained not only with a broad scientific background, but also with specific knowledge, skills and professional qualities. We must satisfy the requirements of a broad scientific base because more and more, pushing back the frontiers of ignorance involves inter-relations of several fields of knowledge. On the other hand, it becomes increasingly difficult for one man to be equally proficient in several areas of science; therefore, specialization also becomes a necessity.

Graduate students are actually enrolled in the Graduate School, a distinct division of the Univers ity, and not in the respective professional divisions, such as Agriculture, Engineering, etc., as the case may be. The first step to graduate study, of course, is admission into Graduate School. This is determined by demonstration of ability to study and to learn, (in short, by past college records), by evaluation of one's potential as a graduate student by former teachers, and by the openings available in the department of one's choice. One doesn't just walk in the door and announce, "I'm here and ready to start."

A committee, headed by the staff member to whom the student is directly responsible, Dr. Daniel in our case, supervises the individual student's study and research program until he has, in its judgment, fully satisfied the general requirements of the Graduate School, the requirement of basic scientific knowledge, and professional ability in the respective fields of study involved. A graduate program involves far more than attending classes and attaining satisfactory grades. For example, all must demonstrate reasonable proficiency in English grammar. All doctorate candidates must be able to read and translate two foreign languages, or at least one language, plus statistics, or mathematical calculus.

Ph.D. candidates must also pass special examinations over the general scope of their scientific knowledge before being permitted to present their research projects and dissertations for approval. These are the "prelims" in graduate student parlance. The last river to cross is passing an oral examination on all work, including the thesis report.

Dr. Daniel has frequently pointed out that "We think with facts." As an example of this principle, our graduate program and our research depend largely on the reliability of the facts we accumulate and use. For this then, our graduate program must first begin with the most "facts" that we can accumulate from:

1. Formal class work.
2. Extended reading of the literature.
3. Practical contacts and experiences of others.
4. Seminars, bull sessions.
5. Previous studies and alert observations.

Here there is no cut-and-dried standard pattern; each man's case is a little different according to his background, interests, and future plans. Bill LeCroy may concentrate on plant anatomy and morphology; Jim Beard digs into all the deep mysteries of biochemistry and cellular physiology; my interests will be concentrated on the natural growing environment of plants, ecology, soils, applied physiology. But, even with our varied interests, many of our study programs overlap in several areas. Thus, we attack the first requirement, a broad scientific background of knowledge.

Fulfilling the second requirement becomes a test of being adequatly able to put these facts to constructive use - How well can we diagnose a problem, reason with our factual tools, and endeavor the solution in a research program of our own? Usually a graduate research problem is selected by one of these ways:

1. We arrive with it already in mind.
2. It may come as a result of study and accumulation of facts.
3. It may be suggested by wiser,more experienced minds than ours.

Thus, from several intriguing possibilities we may select an apparently easy, tough, or even tougher problem and take off through the weeds with it. Sometimes the very toughest problem is the most appealing simply from the aspect of challenge. One has to weigh challenge against practical considerations of time available.

Here at Purdue, a graduate student is required to complete twenty-four semester hours of course work and a research thesis for a Master's Degree, or forty-eight semester hours, plus a research dissertation, for a Ph.D. Degree. Approximately one-half of the courses taken are directly related to one's major field of interest; the remainder are divided among two or three fields of minor study. For our work in turf, these may be soil fertility, biochemistry, plant pathology, statistics, microbiology, plant breeding, etc. On the average it will require 1 - 5 years for a Master's, and three for a Ph.D. Degree if the maximum permissible course load is taken.

To summarize then, a graduate problem involves:

1. Formal course studies.
2. Development of a research project.
3. Satisfying requirements for a total sum of scientific knowledge.
4. Passing special examinations on our research and professional capacity.
5. Writing an acceptable thesis of our research project.
6. Sweat, study and not "goofing off."

As far as my own research project is concerned, we have been doing a lot of culling since last September and had to regretfully lay aside a couple of extremely challenging ideas. Bill Daniel challenged me one day to write down my ideas of the specifications for an ideal bluegrass plant. From this have developed many ideas. Basically, we intend to take a closer look at bluegrasses, their morphology, growth habits, and regulative physiology in an attempt to more concretely define those characteristics which enable them to perform under today's turf management.

Some of the factors we are considering are: broader, shorter leaves; shorter leaf sheath and closer spacing between leaves; wider leaf angle; longer rhizome length; shade tolerance; and photosynthetic efficiency of the different strains. As measurable differences are found, then we would hope to consider physiological factors affecting them. Only a little of this is in the literature, and most of that is not related to conditions of turf management.

Possibly this problem involves asking such questions as - Do we need to try to modify the type of bluegrass we are using? Do we perhaps need even different types for different conditions? Can we find a set of standards that in the long-run may provide more accurate evaluation of newly developed strains? This may eventually lead to more adequate bluegrasses which can tolerate stress conditions.

Sometimes as I try to keep up with the pace of the keener, more alert minds of my fellow graduate students, I wonder "Why in the name of Poa annua did I get into this business at age 44," but, it seems to be a normal thing in Graduate School to feel overwhelmed, frustrated, rushed, and confused. Sincerely it is a challenging and most satisfying experience. I personally am buoyed up at times by another proverb that I have borrowed from Mr. Yesberger's talk, "The men who attempt to do something and fail are still infinitely better off than those who try to do nothing - and succeed."

\- \- \-

SHARING TURF INFORMATION

"A Golf Course Superintendent's Experiences"
Malcolm McLaren, Supt., Oakwood Golf Clur
Warrensville Heights, Ohio

When Bill Daniel asked me to appear on this program I agreed very readily, without much thought as to the subject he had in mind. Later, I got to thinking of the subject, "Sharing Turf Information." You will have to admit he came up with something new.

The first thing that came to my mind was the early days of our Superintendents' Association, when we had to beat down the foolish thought that everyone had the secret of turf maintenance, and it was ours to have and to hold and share with no one. They would tell about visiting another golf course and asking the one in charge, "What kind of fertilizer are you using?" His reply would be, "Do not use any kind of fertilizer." Yet, you had seen a big pile of empty fertilizer bags back of the barn. The same would apply to fungicides, boxes of Bordeau mixture, and bichloride of mercury on the shelf, but he didn't have to treat for any brown patch. One of the greatest things responsible for the growth of membership in the G.C.S.A. was the fact that a few members were willing to appear on programs such as this, and share their experiences with others.

When a member of your club asks about a problem with his lawn, take the time to give him the best answer available. Sure, you are giving away free advice, but on the other hand, he thinks you are a real expert on turf problems and will tell others what he thinks of you. Who knows, maybe some day he will become an officer of your club, may even be your greens chairman, and you will be glad to have him in your corner.

Most clubs have their own news bulletin, and a few words each month about lawn care will be appreciated by all your members. Garden clubs and garden centers are begging for information on turfgrass problems. You do not have to prepare long speeches for this. Show a few slides, and tell them the basic rules to follow for a good lawn. Then start a question and answer period. The only word of caution I can give you is to be sure you understand the question and know what type of lawn they are talking about. You will find out that most garden clubs have big ideas and very small treasury balances. But here again, you are building up your reputation in the eyes of the public by sharing turf information, and believe me, getting an education yourself.

In 1957 several of us thought that there was a need for a Turfgrass Association in this district. We sent to the Pennsylvania Turfgrass Council for a booklet on "Organizing and Conducting a Turfgrass Association." After much study and discussion, the Western Reserve Turfgrass Association was formed.

The program for educational meetings is to have four meetings a year. The times selected were: February, June, August and October. These were also co-sponsored by the County Extension Service. Today we have about 175 members in this Association. These members consist of all types of turfgrass maintenance men, such as landscape contractors, superintendents of airports, churches, schools, cemeteries, parks, hospitals, indsutry, and even some golf course superintendents.

The educational meetings are well attended. Subjects covered are selected by a committee, including the County Agent. The following are some of the items covered in the past:

General Turfgrass Problems.
Growing & Harvesting Grasses for Lawn Seed.
Tree Care for Grounds Maintenance Workers.
Common Turfgrass Diseases and Winter Turf Damage.
Winter Plant Damage.
Weed Identification and Control.
Color Slides and Talk on Equipment.
Equipment and Supply Demonstration.

Snow Mold and Snow Removal.
Demonstration & Methods of Planting and Pruning Trees & Shrubs.
Ohio Turfgrass Research Results.

As you will notice, we are covering all phases of maintenance problems. As the meetings progressed, the speakers have gone into more detail and added new subjects such as, Disease Identification, Drainage, and the Care and Repair of Machinery. Speakers are selected from the membership of the Association, from the Ohio State University and Experiment Station. A few others have come from out of the state and are nationally known turf experts.

They say from little acorns grow big trees. So it is with little turfgrass associations. Others have been formed throughout the state, and at the present time there is in the making an Ohio State Turfgrass Council. The activities of this Council will be supported entirely by grants and gifts from individuals, organizations and industries interested in the advancement of research and technical education in the turfgrass field.

About three years ago Fred Buscher, our County Agent, came to me with the idea of organizing a school for garden supply dealers. About ten of us got together and all agreed that here is where some education would be a real benefit to the homeowner. The first school was set up for one night a week and five weeks in a row. About eighty attended each session, some coming as far as 100 miles. Each winter this program has been repeated. Today they have their own association and last month completed one of their most successful clinics.

Huge sums of money are spent each year in the establishment and maintenance of turfgrass areas. Much of it is wasted, or not used to best advantage because of a general lack of understanding. By sharing turf information many people in this district benefit, not only the members of these associations, but the hundreds of people whom they serve. They are just as proud of their turf as you and I, and they have a right to be.

This has not been a one-man operation, but a team effort by several men. I will not mention their names, but they are the fellows sitting out front here with the big smiles on their faces, because they enjoy helping others.

\- - -

A SALESMAN'S EXPERIENCES

Jesse F. Taggart, Technical Service Representative
Industrial and Biochemicals Department
E. I. du Pont de Nemours and Company
Wilmington, Delaware

It is always a pleasure to attend the Midwest Turf Conference, and I certainly appreciate this opportunity of sharing some of my experiences as a salesman calling on golf superintendents and others interested in fine turf.

There is no question that the imaginary picture of a salesman has changed in the last fifty years. We formerly thought of a salesman as a fast-talking individual who would sell a big bill of goods and be gone, probably not to be seen again in that section. However, the salesman of today is an entirely different fellow. He lives in your community and lives a life similar to yours in most respects. It may differ somewhat in that his office, much of the time, is in his briefcase and car. His place in industry is very similar to yours. The salesman supplies products, know-how, and service. You supply the knowledge and the ability to use his products and assistance in your business.

Selling in the turf field is quite different from selling in some other fields -- such as building supplies, or furniture, or any field where you do not encounter the variables we have when working with Mother Nature. Every manufacturer would like to think of his product as being a complete answer, but so often we have found that results with the same product can vary greatly under different conditions. Unfortunately, there is always the possibility that too much will be expected of a product, or that it will be used improperly. It is amazing how often product labels are misread -- if they are read at all.

We called on a golf course once and the superintendent told us how poor 2,4-D was for broadleaf weeds. This was rather surprising as we have seen excellent results with 2,4-D when used properly. In this case, the growing conditions for the plants were favorable for 2,4-D action, so we asked what rates he had used. We were told that he had used one quart per acre, but it took two applications to get an effective kill, although all the other superintendents he had consulted used one quart and got excellent results.

When we checked the label it stated that the product contained less than two pounds acid equivalent per gallon. The effective rates for 2,4-D are one pound acid equivalent per acre, and this man was using only a half pound and complaining that the product was poor. He thought he was getting a good buy, but he was buying by the gallon with no consideration of the acid equivalent, or concentration, he was purchasing.

On another call we made, the man complained that the fungicide he was using was not effective. This was just after he had aerified his greens and the holes were not healing. The grass around the holes gave the appearance of dollarspot, and the superintendent was using a good fungicide for dollarspot control. It was amazing the way the aerifier holes closed over after an application of a good insecticide. When we explained the problem was cutworms and not dollarspot, the superintendent was quite relieved.

On the other hand, we called at a golf course during a very trying period when disease in many areas had been a problem. This course was in beautiful condition. In checking with the superintendent we found he was following a program similar to another man in the area, except that he was spiking his greens regularly. The greens had excellent turf, good color, held the ball well on chip shots, and putted true. With this light spiking he was able to get more efficient use of water during dry periods, and his greens would dry out more rapidly during periods of excess moisture. We believe this to be an excellent cultural practice, and have strongly recommended it as we share ideas in our travels.

We also have learned from superintendents that small amounts of iron used regularly have produced stronger, more disease resistant turf, and the addition of lime in small amounts each year has been helpful even when pH tests showed adequate lime. This is certainly a two-way street - as we learn improved methods from one superintendent, we try to encourage these practices with others. Salesmen are carriers of information.

In addition, I am certain we will all agree that these turf meetings, both in the formal sessions and the informal gatherings, have been helpful to salesmen and superintendents. Whenever ideas are exchanged, new product information and practices are learned.

Today a salesman is thoroughly interviewed by many people before he is hired, and then trained in the use of his products before he is sent out to make sales calls. As he makes calls, he progressively gains in knowledge of products and practices. I believe my place as a salesman representing a manufacturer is to supply you with information about our products and how they can best be used in your program to fill your needs and solve your problems. I learn something on every call and try to fit that knowledge to future problems that may arise.

\- - -

ANSWERING THE COUNTY AGENT'S PHONE

Fred K. Buscher, Cuyahoga County Agricultural Agent
506 The Arcade, Cleveland 14, Ohio

A letter received from Bill Daniel informed me that Mal McLaren agreed I would participate on the program to briefly describe how a County Agent shares his turf information by answering the telephone. This was a most appropriate title since we spend a considerable mount of time answering the phone. You have the same problem I'm sure, but the calls are directly related to your business. County Agent calls cover a wide range of subject and do not always relate to agriculture.

The telephone is a serious occupational hazard of County Agent work. There is a constant interruption to the daily routine of work. Our small office in Cleveland had 8,600 calls last year. If you assume the average call takes only three minutes, this number of calls would occupy one person for about eleven, 40 hour weeks.

You may or may not know your County Agent, or the operation of the Cooperative Extension Service. It is the off-campus educational arm of your state's Land Grant College of Agriculture and the U. S. Department of Agriculture. Extension is the link between research at the Agricultural Experiment Station, resident teaching staff of the University, and the public. Federal, State, and County government cooperate to finance the Extension Service under federal and state laws.

Extension helps to disseminate and interpret research results made available by the Experiment Station, the state Land Grant College, and the U. S. Department of Agriculture. Other sources of information, such as the Midwest Regional Turf Conference, are included. Basically, Extension con-

ducts an educational program by assisting in the practical application of this information. In our County it would be with nurserymen, greenhouse vegetable and flower growers, garden supply dealers, and grounds maintenance specialists, to name a few. The large urban population of Cuyahoga County receive considerable turf information by telephone, bulletins and leaflets.

Cuyahoga County has a population of 1,700,000. Our agriculture is Horticulture; 92% of the agricultural income is derived from greenhouse vegetables, flowers, nurseries, and related Horticultural business. Cuyahoga ranks in the middle of Ohio's 88 counties for total agricultural income, this on 11% of our available land area. The greenhouse vegetable center of the United States is located in the Cleveland area where over 400 acres of tomatoes and lettuce are grown under glass. Examples of new Extension programs are for grounds maintenance specialists and garden supply dealers. Sharing turf information with those who come in contact with others is a primary objective.

Sharing turf information over the telephone can be handled more efficiently by remembering four facts:

1. When a caller asks for information, he expects an answer from the expert. Since you have a phone number, information and help is expected.

2. If the caller begins with a problem or question, he is uneasy and concerned. Put him at ease that he called the right place.

3. Ambiguous questions require carefully worded questions to find the real problem.

4. Terminate the conversation by a "thank you for calling" in regard to the questions you answered. You can close by asking for name and address to mail a bulletin, leaflet or letter.

Six general questions make up bulk of our turf telephone calls.

1. Soil testing. There is magic connected with soil analysis; that all problems can be solved. We find the pH, lime requirement, and questionnaire answers most questions.

2. Crabgrass and Weeds. There is a difference between weeds and crabgrass with home gardeners. Broadleaf weeds calls come in May and June. Crabgrass calls come in August and September. This may indicate our educational efforts in weed control, pre and post-emergence, need to be evaluated.

3. Dead Spots and brown areas. These ambiguous questions are difficult to answer. Thatch, mat buildup and invasion of bent into bluegrass lawns cause most trouble.

4. What seed should I plant? Few grass seed mixtures offered for sale agree with recommendations of the Experiment Station and College of Agriculture. New York has discovered the same situation in a recent survey.

5. Fertilizer. Callers seldom admit they apply the recommended amounts. Most home turf problems of weeds, crabgrass, insects, shade and drouth would be reduced with additional fertilizer.

6. Weed grasses. There is an increase of calls for a control of the coarse broadleaf weed grasses in fine turf. Usually a person conscientious of turf maintenance has most trouble. As lawn becomes established so do weed grasses of tall fescue, velvet grass, etc. Chemical control recommendations are difficult to make over the phone.

There is no uniform method of how to handle, or answer the telephone problem in County Agent offices. Some west coast areas do not encourage home garden questions. East coast urban populated counties advertise to contact their County Extension Office. Where county staffs are small, the telephone is a serious,constant interruption. Good public relations must be evaluated in the telephone problem.

The fact that turf information is available from a County Agent's Office, in addition to the broad field of agriculture and plant growing, should be made aware to turf specialists. You can help yourself and your Agent by inviting and including him in your programs, meetings and Conferences. Good turf is desired by all. You and your County Agent can help share this information with others.

\- - -

THE TRANSITION PERIOD

J. MacGregor, Kahn Brothers Company
Chicago, Ill.

Thie title, I believe, is appropriate to that era of the early twenties. Fairways then, to say the least, were little better than pastures. Some golf clubs before the twenties had seeded the fairway areas with fescues, or bluegrass. No effort was made to fertilize; in fact, fertilizer manufacturers had neven been approached about producing a balanced fertilizer for golf course turf. When you come to think of it, why would anyone want to fertilize fairways when there wasn't enough equipment to mow the grass as it was?

Some clubs were graduating from the horse-drawn mowers to tractor-drawn. Most of the clubs at that time were using horses, one-horse single unit mowers to three-gang mowers for team hitch. There were two types of gang mowers. One type was the side wheel drive, and the other the roller-type drive.

1920 was the year, I believe, when these units really got going in five-gang units. A tractor was also developed to pull the gangs. This tractor had large drive wheels about 4 ft. in diameter with a bull-gear attached to the rear axles. You could hear those gears grind a couple of blocks away. The speed was not over 5 miles an hour, but with the new combination of tractor and five-gangs the fairways could be mowed in about three days. The rough on many of our present day courses is better than the fairways of the early twenties.

The remainder of this talk will be my experiences in this changing picture of growing and developing fairway turf.

I came to the Chicago Golf Club, Wheaton, Illinois in the year of 1921 to help with the reconstruction of the golf course. The reconstruction was being done while keeping nine holes in play, after deciding on the line of play for the nine holes to be used during this period. The new layout was completely different from the original. Holes 1 to 9 followed the outside line of the property, and 10 to 18 were inside the first 9 holes, using approximately 100 of the 200 acres. Incidentally, Chicago Golf is, as far as I know, the only course that plays from left to right. The reason for this unorthodox line of play was because the architect was a terrific slicer. He was Charlie McDonald, and a charter member of the Club.

Re-designing of the golf course made it necessary to relocate the fairways, so it was a matter of preparation and construction of the finest fairways in the Middle West. Carloads of stock yard manure were spread on the fairway areas, then plowed under to a depth of 10 inches, using a two-bottom plow, tractor drawn. The construction was finished by the end of 1922. I forgot to mention that while the fairways were being prepared, tiling and the installation of the first fairway watering system were being installed, using 6 inch cast-iron pipe as a loop and branching to 4 inch cast-iron, with caulked joints. All of the ditching was done by hand, 4 ft. deep, or below frost. At that time with the enlargement of the lake, pumps, pump house, water tank with capacity of 50,000 gals., the cost was $ 60,000. In the year 1923 problems arose. These problems were weeds, mostly dandelions and plantains. Because of the heavy applications of manure these weeds really were big and healthy.

I had been corresponding with Springfield about means of destroying these weeds. After debating the recommendations given, we decided to use Copperus (iron sulphate). Recommendations were 1½ lbs. to 1 gal. of water. We bought the material and a 200 gal. power sprayer. We had to use a three-horse team to pull the sprayer around as there was no tractor available at that time. Of course, this was an experiment,and we found that wherever the wheels of the sprayer had gone we got real kill of the foliage, whereas between the width of the wheels very little damage was done.

We then purchased a chain drag to pull behind the sprayer. This was the answer, so continued this practice, and tried to make our treatments two weeks apart, or as soon as the weeds had attained 2" in height. This we were now able to do as the Fordson Tractor was available. All of this spraying was being done in the rough.

After trying the operation on the fairways, it was found that bruising of the fine grasses did considerable damage to the turf. We then decided to use oil cans, soldering a sharp spike along the spout, using gasoline in the cans, and by spiking the heart of the dandelion, or plantain, the gasoline penetrated in the wound. This was the method used on the fairways. Two men did nothing else from April 1 to September 30. They operated between lines 3 ft. apart. Each man coverved two fairways a year (on their knees). If one or more men had an hour or more after finishing some other job, he was put on dandelions.

Grass was growing so fast because of the manure used, we had to purchase a Parker Sweeper to remove the cut grass. As time went on, better mowing equipment and tractors were developed so fairways could be mowed in two days with a five-gang.

Fairway watering was an exasperating experience. The fairways were from 150 to 160 ft. wide. The water hydrants were placed in the rough near the fairway, 150 ft. apart. The only sprinklers capable of throwing enough water were mounted on a four-wheeled carrier. Each sprinkler would throw 90 gals. per minute. However, our pump could deliver only 450 gals. a minute. While trying to keep grass sprinkled on 19 new greens, three of these fairway sprinklers were all that could be used. It took nine hours to water one fairway, so we had a good water system, but no practical method of distribution. As time went on, we used reducers from two to one inch, and a 1 inch hose. Sprinklers were being made whereby one could use 16 or more at one time, and by running 24 hours a day, the fairways could be watered in four and one-half days.

After four years the effects of heavy applications of stock-yard manure were wearing off. The chairman of the Greens Committee contacted Mr. Swift, who was a member of the Club, to find out whether or not they produced a fertilizer suitable for fairway use. As a result of this contact, two chemists from Swift's Fertilizer Department came out to the Club. One of them was Dr. Siems,who later talked at several of our meetings. Knowing the demands made on the soil in growing fairway turf, it was my opinion that because of the frequent mowing, nitrogen could be used abundantly, phosphates would be drawn on for root growth, and so the demands of the plant would not be so great, potash would not be used as much as the other two elements. I suggested a formula of 12-6-4, and Swifts produced this fertilizer, which proved to be an excellent mixture.

We then proceeded to use the 12-6-4 at the rate of 300 lbs. per acre twice a year. This practice was followed for years, and produced the finest fairways anyone had ever seen. As the result of continued killing of dandelions and plantains, and fertilization, we had comparatively weed-free turf cut at 1.25 inches. The turf was so dense a ball could be played with a wood club anywhere. We did it the hard way, but no other method was available. Our Club was awarded the Walker Cup Matches in 1928. The Tournament brings the best British and American amateurs together.

I believe we had an innovation. It may have been done before, but not to my knowledge. With the cooperation of the Worthington representative, we equipped two tractors with headlights and spotlights on the rear, showing the seven gangs of mowers for night mowing. We mowed the fairways every night during the matches. Those Enlishmen thought they were "seeing things." While they were eating dinner, the lights would be heading straight for them, then they would disappear as the units turned around. One day this will be standard practice.

Fairway bunkers had to be mown with sickles and scythes. Mowers had not yet been developed to accomplish this, so it took about three weeks to complete the job. So - you can bet for two weeks these bunkers were real hazards.

During the thirties the picture changed rapidly. Sprinkling systems were being installed on many golf courses. Better and more efficient sprinklers were being produced, and more up-to-date and larger gangs of mowing units were being used. Tractors with more horsepower and better traction made it easier to maneuver and pull the seven gangs so that fairways could be mown three times a week, making conditions more favorable for the players. Arsenicals were being used by some. In some cases, where good judgment was used, fair results were obtained. Milarsenite was produced by the Milwaukee Sewage Commission, then discontinued.

Research was going on during those years, and the golf clubs are indebted to the U.S.G.A. The U.S.G.A. has been fortunate, since inaugurating the Green Section, in having very outstanding men on research. We can go way back to find such men as Drs. Piper, Oakley and Carrier, followed by Dr. John Montieth, whose ability as a scientist was outstanding, and then Fred Grau, who worked untiringly for better turf.

Many more important happenings may not have been covered. However, I am sure many of the practices will be interesting to our young men here today. You can expect further changes in your work period.

\- - -

FAIRWAYS -- 1940 to 1960

Fred V. Grau, Consulting Agronomist, Hercules Powder Co.,
College Park, Maryland

Mr. Chairman, ladies and gentlemen, a year ago I had a date with a surgeon and the surgeon had a scalpel. He used it with great effectiveness. I can tell you quite frankly I am very glad to be here. It is a pleasure to be on this program with John MacGregor, who discussed fairways before 1940.

In 1935 I became the first extension agronomist in turf in the United States at the Pennsylvania State University. One of my first recollections in visiting golf courses was that many clubs reseeded their fairways each spring with Kentucky bluegrass seed, using a wheelbarrow seeder. They had no money so they used no fertilizer. Quite naturally the grass seed that was sown had little chance of germinating and developing turf. Obviously it was not grass seed that was needed, but more ample fertilization.

The most common vegetation on fairways was weeds and clover. With fairways cut at an inch and a half or higher, the ball often could be lost in the fairway. Fortunately the work in weed control in turf that I had begun in Nebraska in 1927 and had continued at the University in Maryland in 1931 was beginning to be used. Sodium arsenite had been proved to be effective against fairway weeds because we must remember this was long before the day of 2,4-D. I well remember stretching strings across the fairways at the Kahkwa Club in Erie, Pennsylvania, where the men used weed canes filled with a mixture of complete fertilizer, sodium chlorate and sodium arsenite. It worked. The weeds were destroyed, but, of course, recurred. At that time many fairways were good red fescue. Just as soon as these were watered and fertilized, the fescue began to disappear, and *Poa annua* and weeds took their place.

1935 marked the beginning of the use of lead arsenate and sand on fairways for the control of grubs. Also in Philadelphia, some of the first weed control treatments on fairways were made at Springhaven by the late Tommy Daugherty, who sprayed sodium arsenite regularly on his fairways. Many experiments were run at the Philadelphia C. C., using dry formulations of sodium arsenite and fertilizer. In one case the grand mixture of sodium arsenite, fertilizer and seed was used with good results.

How well, too, we remember the fertilizer tests at the old Bannockburn Club conducted by the Green Section, where the worst plots nearly always were those that had the most fertilizer. The difficulty lay in the fact that the well-fertilized plots grew the fastest, but the plots were not mowed until the unfertilized parts of the fairway needed mowing. By that time the fertilized plots were several inches high, and in the heat of the summer when the mower whacked off the grass, nothing returned but crabgrass and goosegrass.

It was in 1941 that the Exp. Stations of Michigan, Ohio and Indiana entered into a "gentlemen's agreement" with fertilizer manufacturers to produce 10-6-4 for turf. It has persisted to this day, but there have been significant changes. Also about 1941 some 60 fairway tests were begun all over the U.S. in 10 x 30 ft. plots, varying nitrogen, phosphorus, potash, lime, organic and inorganic nitrogen. The only inorganic nitrogen came from natural organics of which there were 19 sources. At this same time there were only three bermudagrasses - U-1, U-2 and in the Arlington plots U-3. Here we learned also that the least seed and the most fertilizer gave the best results in bluegrass seedings.

In November 1941 Zoysia was discussed in Timely Turf Topics and some had survived the severe winters and grown well in Boston. The comment was that it had "interesting possibilities." Came the war! Fertilizer programs were discouraged; water was reduced; fairway mowers were set higher. In August 1942 nearly everyone from the Green Section, many Experiment Station personnel and superintendents entered the war effort. In that month the decree came out that there was to be no more inorganic nitrogen for turf. "All-organic fertilizers" may be sold without restriction. Victory gardens were the rage, and I guess more ill-assorted vegetables were raised that never were eaten than ever before in history. In 1943 Dr. K. G. Clark at Beltsville was given the task of working with urea and formaldehyde to try to produce a material of good fertilizer value, high in nitrogen content that would supplement the short supply of natural organics. In September 1943 chemical nitrogen again became available.

In August 1944 Zoysia matrella received a depreciating release, indicating it to be a very poor fairway grass. In November 1944, one of the great break-throughs in the turfgrass world came about and that was the release of 2,4-D for the control of broadleaf weeds, and today it still remains the best.

In August 1945 I became Director of the U.S.G.A. Green Section. The practically neglected plots at Beltsville were evaluated and we began working on Zoysia, U-3 bermuda and B-27, now Merion bluegrass. It may come as a surprise to many that B-27 very nearly did not get elected to become the improved bluegrass. A sister bluegrass, B-44, was selected and watched until a severe attack of leafspot took it out. Merion was released and has remained as the standard of the improved bluegrasses.

One of the truly significant things in turf occurred in 1946 when the American Socity of Agronomy recognized turfgrass as a legitimate agronomic enterprise. It was my great honor and privilege for the eight years that the Turfgrass Committee was in existence to be chairman of that committee

A campaign of closer fairway mowing raised protests because it was said that "if we mow our fairways closer we will lose our bluegrass."

Admittedly a great deal of bluegrass was lost, but no grass is sacred if it cannot stand close mowing without injury. The upshot was that a great many bluegrass fairways were converted to bent and to other grasses so that golfers could have the course again. In Texas close cutting of fairways improve shot performance on the green. In Chicago bent in bluegrass was fluffy - until cut close as bent should be.

Another instance was at the Memphis Country Club prior to the U.S.G.A. Amateur. The fairways were thin, weedy, full of clover, hard and practically unplayable. The cure turned out to be repeated treatments of sodium arsenite, generous applications of fertilizer, and by the time of the tournament the fairways were about as beautiful bermuda as anyone could find. The fertilizer can be credited most of all with turning the trick.

In these days a great deal of opposition was voiced to fairway watering. With starvation the rule rather than the exception, watering brought weeds and more weeds. Many of us still believe that if more fairways were better fertilized there would be much less need for fairway irrigation. In 1947 the first U.S.G.A. Green Section fellowship was established at Penn State, Jim Watson's thesis was "Fairway Irrigation and Compaction."

In 1947 in T. T. T. there appeared an article "Turf on Fairways," and I quote:

> "Turf on Fairways should be firm to provide a 'short roll' for the ball, resilient to facilitate walking, and of maximum density to hold the ball up so that it does not sink down into the grass. Long blades of grass which partially hide the ball destroy the player's confidence and tend to affect the shot. Thin, open turf requires closer cutting than dense, firm turf, to produce the desired lie, which is provided by choice of adapted species, generous balanced feeding, minimum irrigation, and mechanical treatments to promote deep penetration of moisture, nutrients, and roots, and to avoid 'fluffiness,' 'sponginess,' and 'matting.' Top-flight golfers have stated their preference for the playing qualities exemplified by well-kept (1) Bermuda turf, (2) fescue turf, and (3) bentgrass turf. The worst enemy of good shots on the fairway is deep, soft, lush, over-watered turf. A small divot usually indicates better playing conditions than a large divot."

In Miami I was telling others that one of these days we would see Zoysia on fairways, not only in this area - in Florida, but in other sections as well. The idea did not seem to receive favorable attention. Lo and behold, we had walked about three holes on the golf course when we came to a fairway that was practically solid Zoysia. It was dense and weed-free, with the lowest possible maintenance cost. They were not irrigated, they were not fertilized. I can foresee the day when there will be a great many more Zoysia fairways in this country, particularly in the transition zone.

Tees of Merion bluegrass were failing and turning to Poa annua. The end of the tee had excellent Merion bluegrass. When asked the reason I was told, "Oh, the sprinklers don't quite reach there." I submit that more good fairway turf has been ruined by starvation and over-irrigation than by any other two factors.

In Utah the biggest problem was solid Poa annua fairways. They were having to water practically continuously and copiously in order to hold the Poa annua. Yet, in areas where the sprinkler didn't quite reach the bluegrass was thriving luxuriantly. Had the water been reduced from the beginning, Poa annua never would have made its appearance.

Another landmark in fairway management came about when aerating equipment was developed about 1946, and today we have excellent machinery that can take care of practically any thatch problem. Machines like the Aero-Thatch, the Aerifier, the Verticut; machines made by Ryan, Jacobsen and others are quite capable of handling the toughest maintenance problems on thatch and mat.

All during the years we've talked about clippings. Today we are beginning to develop machinery whereby the clippings can be removed as they are cut, and where the accumulated thatch can be dug out from the bottom and removed so that we always have fresh, new growth on the fairways.

It was in 1950 that Merion bluegrass was shown to the seedsmen for the first time, and its performance was such that many of them did not actually believe it. This is the year that operation Zoysia was envisioned by the Green Section and put into operation at Fairfax C.C. The results of this slow start can be seen today, not only at Fairfax, but at many courses over the country. Operation Zoysia is quite likely to get a renewed lease on life.

Some will remember the flexible combs that were first demonstrated on fairway mowers by Joe Valentine at Merion. For a short time the flexible combs received a good deal of attention, and I am of the opinion that the fairway combs are going to return to popularity. They had a place and they still have a place. Their use reduced crabgrass, and produced better turf for the golfers.

In November 1952 Zoysia seed that had been harvested at Beltsville was processed at Saginaw, Michigan, raising the germination of the unhulled seed from 4% to 80%. One of these days we will see a great deal of Zoysia seed once more planted on fairways.

Dropping back again to February 1948 the Mid-Atlantic Conference at Baltimore had as one of their sessions discussion of warm-season grasses for fairways. Here are some of the points mentioned in the conclusion of this Conference. The warm-season grasses, bermuda and Zoysia are drouth resistant;make excellent summer turf; are wear resistant; heal rapidly; have few weeds; have practically no disease; have no insects of any consequence; resist mismangement; provide good lies, can be cut closely without injury; have wide soil adaptation and the soil can be kept firm and dry for good golf shots and minimum injury to turf.

Many of us recall with sorrow that in March 1948 Timely Turf Topics was discontinued. In 1950 we had field days at Beltsville that attracted hundreds of people in which the products of Zoysia and bermuda research were shown.

From 1953 to 1956 as a representative of a machinery manufacturer, and from 1956 to the present time as representative of a manufacturer of a ureaform fertilizer, fairways have been of particular interest. Now

in 1961 the Mid-Atlantic G.C.S.A. again spent a half day on warm-season grasses reiterating many of the things that were said in 1948. It is highly gratifying to see this attention being given to these grasses which at one time were reviled - today they are highly thought of. In 1950 I sent Charlie Wilson to Louisville, Kentucky to plant some demonstrations of U-3 bermuda and Zoysia. Some Zoysia had been planted there earlier. As a result, many fairways in that area are being converted to these warm-season grasses. In 1953 I planted half of a No. 6 fairway at Woodmont C.C., Rockville, Maryland. Today the entire golf course under Bob Shield's management has been converted to U-3 bermuda for the fairways. Down the center of that No. 6 fairway I planted some stolons or sprigs crowding out the U-3 bermuda. In talking with Carl Bretzlaff he says he has tried just about everything. He believes firmly that Zoysia and bermuda are the answer in Indianapolis.

I wish it were possible to tell the story of the conversion of the fairway turf at Pine Valley into warm-season grasses. Certainly the fairways of the future must first be planted with the sturdiest grasses that can be cut closely without injury from which the clippings will be removed. Thatch will be removed at regular intervals. They will be fertilized adequately and watered seldom, and only when needed. The grasses which will prevail are bermudas, Zoysias, some bent, but bents are going to become less important because of their high cost of maintenance. As improvement comes, bluegrasses and tall fescues may improve for turf use.

It is a privilege to discuss the 1940-1960 fairways in this seminar.

\- \- \-

MY VIEWS ON TODAY'S FAIRWAY PROBLEMS

Colin Smith, Supt., Shaker Heights C. C.,
Shaker Heights, Ohio

I feel complimented for being asked to give my views on the problems that face us on our fairways today. May I start by quoting Dr. Fred Grau from one of his latest articles, "Nothing is completely static, everything is in a constant state of change." Every problem is brought about by the ever-changing condition in nature, plus the increasing number of players who are demanding firmer, closer-cut fairways.

A number of years back, Dr. Cary Middlecoff, the noted golf professional asked Frank Dunlap, formerly of The Country Club, why we could not have fairways as firm and close cut as the greens. Well, I think that this is exactly what we are striving for. Of course, a club would have to have an unlimited budget and a miracle man for a superintendent.

To stop dreaming and get back to a more realistic point of view, I believe the mis-use of water is our greatest fault; most of us are blessed with a soil that has a heavy clay content that forms a perfect seal when excessive water is applied. Next comes that anemic yellow green color of the grass blades caused by the lack of air. The grass starts to thin out and the ever present Poa seed will germinate. Now

you are working up to the real headache.

This real headache, Poa annua, is what I feel is our second problem. Should we try to live with it, or fight it? Sure, the easy way is to live with it, but all the summers will not be like 1960 when all a person had to do was to fertilize and cut the grass. But, what will the members say when those high humidity, high temperature years come, and that lovely green traitor fades out some hot afternoon!

I believe we in the Midwest should fight this fair weather friend with a good all around fairway program. The first step would be to check the pH of the soil and keep it at the right level for the grass that you are trying to raise on your fairways.

Secondly, be sure your fertilization program is correct and adequate.

Third, make use of the tried and proven chemicals.

Fourth, use some means to remove the excess thatch that will surely accumulate due to balanced nutrition and correct watering habits. If by chance you are one of the more fortunate individuals who does not have a fairway sprinkling system, your thatch problem will be a lot less. Also, let's not forget to use the good aerating tools that are on the market.

Fifth, a correct mowing program must be maintained. This step is very important and is taken lightly by many superintendents.

Some forty years ago I watched old "Dolly" pull that brand new 3 gang-mower down #2 fairway and thought, "Boy, isn't that something - three mowers all at once." Then it wasn't long before the tractor with the wide flat wheel and iron spuds came along, pulling first the three units the horse had pulled, then 5, 7, 9, etc. This was great, but do you know that we are still pulling, pushing, lifting, turning and what-have-you, the same cutting equipment that was designed 50 years ago?

I feel as does Paul Weiss and countless other superintendents, we need new designs in cutting units. A lighter, faster operating, vacuum-type machine that would remove most of the clippings, seedheads, etc. In conclusion I would like to thank you and say, "if we push Mother Nature like we have for the past few years, she will give us all the fairway problems we want."

\- \- \-

MY VIEWS ON TODAY'S FAIRWAY PROBLEMS

Albert A. Linkogel, President & General Manager,
Link's Nursery, Inc., St. Louis, Missouri.

Our problems with cool season grasses in the St. Louis area are many. I will eliminate bentgrass for fairways immediately. The local climate makes this impossible fairway grass. We just aren't able to

to keep it. Bluegrass has been maintained as a satisfactory fairway turf in St. Louis. However, maintenance is most difficult during our hot, moist weather, and the hot, dry weather. This covers the St. Louis growing season through June, July and August; sometimes including May and September. This is the time of year that most golf is played, and the greatest demands placed on the bluegrass. Thus, at the time of its growth cycle when the bluegrass should be given its greatest protection, it is subject to severe abuse. This abuse includes moisture stresses, disease, weed competition, plus the short cutting demanded by the golfers.

Our objective was to find a grass that would be most resistant to this combination of hot, moist and hot, dry weather, disease resistant, and free of weed competition. Thus, the U-3 Bermuda was introduced. The U-3 Bermuda was most valuable because its period for best growth, and so its ability to withstand abuse (including the hot dry and hot moist weather, disease, and weeds) was during May, June, July, August, and September. The same period when local golf courses are subject to severe damage. The first U-3 Bermuda in the district was at Westwood Country Club, beginning about 1945. Since that time it has become a part of the fairway turf at most of the private country club. Those that don't have it are in the process of establishing, or planning for the U-3.

Problems have developed with the U-3 Bermuda. These include planting, fertilizing and maintenance, and disease control. The planting problem was overcome with the development of the Link's Planter. This efficient unit permitted the planting of the U-3 Bermuda into established fairway turf. Thus, avoiding interference with play. Other methods for planting were utilized. These include the use of the manure spreader to spread the stolons, and the use of Bermuda seed. These last two required complete fairway renovation. The seeded Bermuda was not winter-hardy and is, therefore, only a temporary turf.

Then the problem of proper fertilizing and subsequent maintenance developed. It was necessary to learn what was proper fertilization of the U-3 Bermuda. We have still to learn more about this fertilization. One local club applied less than 4 lbs. of actual N per 1,000 sq.ft. per season and had an excess amount of growth. Another club applied slightly less than 6 lbs. per 1,000 sq.ft. per season and could have used more. The difference in this case was timing. We are concerned with rates of P and K, especially for the last fall fertilization.

Local maintenance programs have been as follows:

1. Very short cutting as early as possible in spring. This gets the turf off to a good start, eliminating a large part of the previous year's dead growth.

2. Early feeding of adequate N-P-K to encourage recovery in late spring and early summer. This avoids contributing to excess growth through the remainder of the growing season.

3. Additional feedings throughout the year - enough to give color and growth only when needed. This is usually only nitrogen, applied at a minimum rate to maintain a reduced rate of growth. Too much nitrogen at this time can make four mowings per week necessary.

4. Summer cutting height should be as low as possible to avoid the fluffiness that will develop under higher cutting.

5. Fall feeding could be an organic fertilizer applied in early September. At least early enough to assure starch production and storage of starch in the roots before the plant becomes dormant. This can best be done by using a fertilizer with a ratio, such as 1:1:1, or 1:2:2. The higher phosphate and potash enable the plant to store these starches so badly needed in early spring regrowth. Avoid only excess nitrogen at this late date.

6. Some disease has developed on the U-3 Bermuda in the last few years. This includes dollarspot, leafspot, and spring dead spot. The spring dead spot is the most serious to date. Our local St. Louis Turf Research is cooperating with Mallinckrodt Chemical Works to find a control for this disease.

The Meyer zoysia is a more recent introduction for fairway turf. We have no fairways in play to date. We do have one fairway at Westwood Country Club planted with three inch sod strips on 1 ft. centers. This was planted in late May 1960. This Meyer zoysia could go a long way toward solving the maintenance problems realized with the U-3 Bermuda. The Meyer zoysia is as tough, or tougher than the U-3 Bermuda. In the St. Louis area it is green six weeks before the U-3 Bermuda. With proper maintenance mowing requirements would be reduced. Once established the fertilizer requirements would be minimum.

The cost of establishing the Meyer zoysia is a major problem. We are waiting for the new Zoysias, hoping that a seed will develop, or a new variety that will grow a Zoysia plant superior to the Meyer zoysia. This selection of superior grass varieties can only be done by groups such as the Midwest Regional Turf Foundation. This grass breeding program at Purdue, and at other universities throughout the United States, will aid in solving our fairway problems of the future by breeding and selecting superior varieties of present selections.

\- \- \-

SEEDHEAD PREVENTION ON BENTGRASS NURSERY

Albert A. Linkogel

This is for seedhead prevention on bentgrass only. I have had no experience with this problem on bluegrass, Bermuda, or Zoysia. However, it would seem that the following principles could be used with these grasses. There are three possible procedures that could be used. They are as follows:

1. Using the MH-30 growth inhibitor for seedhead prevention. The MH-30 was applied at 1/2 oz. per 1,000 sq.ft. of 58% active. Applied with one gallon of water per 1,000 sq.ft.

   The time of application is important; this point must be stressed. Look for internodal elongation, when the runners begin to grow rapidly. Then daily observation is required to observe the development of the seedhead in the base of the stem. This can best be done by splitting the stem back of the second or third node to locate the developing seedhead.

Spray as soon as the developing seedhead is observed inside the stem. There will be a slight discoloration of the bentgrass after application of the MH-30. This should be only temporary at the 1/2 oz. rate. This will be accompanied by an inhibition of the bentgrass. This inhibition can last as long as six weeks. At the end of the six week period approximately, a heavy application of nitrogen should be made. In St. Louis this amounts to 1½ lbs. of actual N per 1,000 sq.ft.

What are the dangers of damaging the bentgrass? Of course, an excess amount of the MH-30 will kill your bentgrass. The next lesser degree of damage would be defoliation from a heavy application of the MH-30. However, the proper application of the MH-30 which will give a slight discoloration and the six week inhibition.

One suggestion I would like to make - if using the MH-30, plant rows closer together (3') and feed heavily in spring to encourage as much growth as possible before application of the MH-30. The six week loss of growth can prevent 5 ft. rows from growing together. Also, reducing the amount of plant material available in the fall.

It is possible that your bentgrass nursery may require some weed control after using the MH-30. If this is necessary you can use the post-emergent crabgrass control (AMA), plus one-half the recommended rate of 2,4-D about two months after application of the MH-30. I have also used the pre-emergent arsenic applied in spring to control crabgrass in the nursery. This prevented the crabgrass from becoming a problem during the period of bentgrass recovery.

2. This second method is mechanical, and works best on older nursery stock. This is especially related to bentgrass nursery that is going into its second spring. This spring of 1961 it will be covered with last year's growth, mostly dead grass. As soon as the weather permits you can use either the Verti-cut, or Aero-thatch to remove most of last year's dead growth. This will leave bentgrass nursery that is similar to sod. Observations should then be made as the bentgrass grows this spring, and as soon as seedheads start to develop, have your nursery mowed. Thus, removing the seedheads and not having to spray with the MH-30.

3. Another method that could be used would be to plant your bentgrass in early spring, as soon as the ground and weather permit. In St. Louis this spring planting will not produce seedheads the same year planted. Of course, it would be essential to feed heavily to encourage growth for sufficient stolons the fall of that same year.

\- \- \-

TURFGRASS MIXTURES - INFLUENCE OF MOWING HEIGHT AND NITROGEN

R. R. Davis, Ohio Agricultural Experiment Station,
Wooster, Ohio

I. Bentgrass in Mixtures:

Bentgrass has completely taken over any grass used with it in tests at Wooster. Furthermore, it spreads into adjacent plots and eventually takes them over. Table I shows the percent of the sod area occupied by bentgrass five years after seeding the various grasses and mixtures in the Wooster test.

Table I - The bentgrass content of selected treatments five years after seeding.

	% Bentgrass Height of Mowing	
	3/4"	2"
Mixture or Grass	%	%
Bluegrass - bent - redtop	100	100
Common Ky. bluegrass	74	45
Chewings fescue	35	42
Red fescue - Merion	49	19
Merion Ky. bluegrass	55	12
Creeping red fescue	41	24
Pennlawn fescue	17	0

Bentgrass was more competitive when the sod was mowed at 3/4 inch than when mowed 2 inches. However, bentgrass spread in all plots regardless of mowing height. This test was not irrigated. Bentgrass would probably be even more aggressive under irrigation.

II. Bluegrass varieties:

Eighteen varieties, common lots and breeder's selections of Kentucky bluegrass were seeded in September, 1956. They have been mowed at 3/4 inch and 2 inches since establishment. Three pounds of nitrogen per 1,000 sq.ft. as ammonium nitrate have been applied annually, half of it in September and half in April. Table 2 shows the weed content in 1960 as influenced by variety and height of mowing, and the reaction of the varieties to leafspot (Helminthosporium vagans).

Table 2 - The weed content and disease reaction of some Kentucky bluegrasses

	Weeds per 10 sq.ft. October 1960		Helminthosporium 5-23-60	
Variety	Mowed 3/4"	Mowed 2"	1= least	10=most
Breeder's Merion	8	0	2.0	
Penn. K-1 (51)	10	1	1.0	
Wash. Poa	38	2	3.2	
Minn. Common lot	103	3	6.5	
Delta	102	11	7.0	
Park	105	8	9.2	
Ky. Common lot	108	5	6.2	
Neb. Common lot	150	16	8.2	

Merion, Penn. K-1 (51) and the selection from Washington make a tighter sod which offers more resistance to weed invasion than Delta, Park and the common lots. At least one reason for the tighter sod is their resistance to leafspot. All of the varieties contain less weeds when mowed 2 inches high than when mowed at 3/4 inch. There is less advantage to mowing Merion, Penn K-1 (51) and the Washington selection at 2 inches than the other varieties and common lots.

The bluegrasses better able to keep out weeds are also better able to keep out white clover (Table 3). The height of mowing does not appear to affect the degree of clover invasion.

Table 3. The percent clover invading Kentucky bluegrass Oct. 12, 1960.

Variety	% Clover when mowed at 3/4"	% Clover when mowed at 2"
Breeder's Merion	11	1
Penn. K-1 (51)	2	2
Wash.Poa	1	15
Minn. Common lot	15	6
Delta	5	18
Park	9	17
Ky. Common lot	26	18
Neb. Common lot	20	29
Avg. (all plots in test)	13	14

III. Lawn Grasses and Mixtures

Twenty grasses or mixtures were seeded August 28, 1958. Each received two levels of nitrogen fertilization (1½ and 5 lbs. N/1,000 sq.ft./year) and 2 heights of mowing (1" and 2"). The resulting sods were analyzed the fall of the seeding year and each fall thereafter. One point of interest is the influence of nitrogen on bluegrass - fescue mixtures (Table 4). A high level of nitrogen favors the bluegrass, while a low level of nitrogen favors fescue. Merion has dominated mixtures in which it was seeded, at least up to the present.

Table 4. The influence of nitrogen fertilization of bluegrass - fescue mixtures.

Mixture	Seeding rate/1,000 lbs.	% Kentucky bluegrass in sod Oct. 21, 1960 High N %	Low N %
Pennlawn fes. 60%, Common Ky.blue 40%	1.5	72	34
Ky. 31 fes. 90%, Ky. blue 10%	5	82	63
Creeping red fes.60%, Merion blue 40%	1.5	97	91

Another point of interest is the influence of mixture, mowing height and nitrogen fertilization on the amount of redtop remaining in the sod after two years (Table 5). Redtop is not able to survive the competition of Merion bluegrass, but it is a prominent part of other mixtures in which it was seeded. The coarse texture of redtop makes it undesirable in a sod. Redtop is favored by high mowing and a high rate of nitrogen, the same treatment that favors bluegrass. Redtop has been observed to survive with common Kentucky bluegrass for more than 10 years, making its "Short-

lived perennial" classification very doubtful for the Wooster, Ohio area. Where redtop and ryegrass were used in the same mixture, redtop dominated the sod after the ryegrass died. Other mixtures containing only ryegrass and bluegrass are now essentially 100% bluegrass where no more than 1 lb. of ryegrass per 1,000 sq.ft. was seeded. A light seeding of ryegrass appears to be a better quick growing companion for Common Kentucky bluegrass than redtop. Of course, where the situation does not demand a quick growing grass, both ryegrass and redtop had best be left out of the mixture.

Table 5. The influence of mixture, mowing height and nitrogen fertilization of the redtop in the sod.

		Redtop in Sod - Oct. 14-18, 1960				
		High Nitrogen		Low Nitrogen		
Mixture	Seeding rate/1,000 lbs.	Mowed 1" %	Mowed 2" %	Mowed 1" %	Mowed 2" %	Avg. %
Merion bluegrass 85% redtop 15%	1	0	0	0	1	0
Common Ky. bluegrass 85% redtop 15%	1	7	24	6	22	15
Domestic ryegrass 50% red fescue 25% Ky.bluegrass 15% redtop 10%	3	37	67	6	26	34
Domestic ryegrass 70% Ky. bluegrass 20% redtop 10%	3	78	91	45	64	70

IV. Nitrogen Fertilization and Weed Content of Merion Kentucky

Three forms of nitrogen, many rates, frequencies and times of application are being used in a test with Merion Kentucky bluegrass. If all the other variables are grouped, the influence of nitrogen rate on the weed and clover content of Merion is shown in Table 6. With adequate nitrogen the 3-year-old Merion makes a tight sod that keeps out virtually all other vegetation.

Table 6. The weed and clover content of Merion as influenced by nitrogen fertilization.

N per 1,000 sq. ft. per year	Weeds per 10 sq.ft.	Clover in sod
lbs.	no.	%
10	0	0
7	1	0
5	4	1
2	8	5
0	22	15

AN EVALUATION OF VARIETIES, STRAINS AND TYPES OF KENTUCKY BLUEGRASSES

W. H. Daniel, Turf Specialist, Purdue University,
Lafayette, Indiana

The evaluation of bluegrass production can best be covered by someone closely related to the field. Mr. Arden Jacklin prepared the anticipated acreage of bluegrasses to be harvested in 1961 in the Northwest.

Estimated Acreages of Ky. Bluegrass Selections
to be Harvested in 1961 in Western U.S.

Areas	Merion	Newport	Delta	Park	Uncert.
	a	a	a	a	a
E. Wash. & N. Idaho	7,600	180	1,490	330	1,700
Grande Ronde	500	1,200	100	-	200
Grants Pass Medford & Klamath Falls	250	150	-	-	100
Madras	2,100	1,200	50	-	1,800
Williamette	2,700	1,050	-	30	2,700
Calif.	350	-	-	--	-
25,000 =	13,500	3,780	1,640	360	5,800

Compiled by A. W. Jacklin, Merion B. Ass'n., N. K. Co., 12/60.

He reports 1961 Merion near 1960, but 1961 Newport will be three times over 1960.

Estimated 1960 Production of
Poa Pratensis Selections

Selections	Millions of Lbs.
Merion	2.6
Delta	.6
Park	1.
Newport	.3
C-1 Source	.7
Arboretum	.04
Common	25.

Estimated by W. H. Daniel 1/1/61

For performance data the author acknowledges the assistance in preparation by reports and letters from over twelve turf research workers throughout the humid areas of the United States.

Let us consider three case histories on who develops a bluegrass. Merion was selected and tested for turf performance in a limited way. Subsequently passed out for seed production; it has limitations for the seed grower in low tonnage, difficult to clean, and slow to start. For the processor it is expensive and often light weight seed. For the homeowner it is slow starting and high priced. Nevertheless, after ten years of public sales, its demand is continuing to climb as judged by tonnage per year.

In contrast, what has happened with C-1 bluegrass? Here a selection out of Newport, which was subsequently developed by a group of seed growers, has provided approximately one-fourth as much seed being available in 1960 as Merion itself. Meanwhile, it has been selected for grower characteris-

tics, heavy seed, excellent fall vigor, easy-to-handle seed, high yields. Now its problem is, where is the market? Where has it been tested? Where is the educational process to be mobilized that will grant consumer acceptance?

Let's consider a third example. Park (formerly Minnesota 95) was a combination of 16 clones out of an original 360. It was released to seed growers based on limited testing in Minnesota. Production has moved forward rapidly, but the susceptibility to leafspot appears to put it in the class with Arboretum and other leafspot susceptible selections as not being recommended in several states.

Production of Park Bluegrass

1936 - 360 selections collected in Minnesota
19-- 15 selections combined

	Acres	Lbs.
1953	6 planted with	12
1954	6 harvested	2,100
1957	140	21,000
1958	400	50,000
1959	3,000	300,000
1960	4,500	1,000,000
1961	5,000 + 360 NW	?

Park bluegrass shows early seedling vigor probably due to its heavy seed, but its leafspot susceptibility limits its performance to the cool night areas for maximum benefit. Delta appears to be an inbetween, having some susceptibility to severe diseases, germinating and surviving satisfactorily for medium quality turf.

Merion Bluegrass

From the grower's standpoint Merion is difficult to start; the seed yields are comparatively low; the seed is hard to clean, and other problems are well known. From the seller's standpoint the high-priced seed raises questions as to its added performance, and he must carry a strong educational program to merchandise the higher cost seed. When the seed reaches the user, it is slow germinating, and the seedlings are very slow getting started. Why, therefore, is there such a demand for Merion bluegrass?

Just two things - because it is able to respond to good management and possesses leafspot tolerance. For these reasons, wherever other conditions do not cause its demise, Merion has been the favorite for those wanting maximum quality.

The limitation of Merion utilization seems to be closely correlated with maximum soil temperatures. In the Chicago area, 1955 was the only year hot enough to favor what has been called Curvularia damage. To the contrary, after only 2 years of trials, by 1953, close observers quit recommending or selling Merion in St. Louis, but remember initially in 1948-50 St. Louis was considered the place where the leafspot resistance of Merion would make it the most favored grass.

Concerning the above, Juska states, "Where adapted and for those who properly manage a Merion lawn, the turf is superior to other selections obtainable at the present time. Davis of Ohio found weed invasion an indi-

cation of the tightness of the sod. Merion had only 3 weeds when Common had 38 weeds per unit area in his tests. Yet, the stem rust and stripe smut susceptibility of Merion is well known and widely reported.

Newport Bluegrass

Here confusion reigns supreme. During the years 1953-57, small lots of seed secured from Clausen and his co-workers provided approximately 12 Experiment Stations with small plantings of Newport material. In 1958-59 and '60, the current ALTRA organization has provided seed lots which have been planted at approximately another dozen test stations. No station or observer have reported the two planted side by side, same data conditions. A well developed family tree on theC-1 bluegrass shows its development, including the important period of '53-'54 when fall vigor and stem rust resistance were accentuated.

All those testing Newport agree that it needs good to ample fertility for best development. Washington reports stem rust tolerance, but leaf rust damage which is confirmed by Purdue. Juska reports Newport damage by stripe smut and susceptibility to leafspot; however, less than Common.

Duich in 1958 reports Newport looked good until heavy leafspot attack. Following this it became very stemmy. Cummins of Purdue observed similar thinning in mid-summer following seedhead extension, but reported this as a severe attack of leaf rust, which others also mentioned.

Buckner of Kentucky reports the Newport variety was more susceptible to brownpatch than commercial. Roberts of Iowa reported Newport was faster growing than Merion and states, "The first year's growth of Newport has looked good all through the growing season."

Common Bluegrass

Dr. Goetze of Oregon comments, "Where cool nights reduce leafspot damage, Common bluegrass performs well, especially with minimum maintenance schedules."

Buckner of Kentucky in 1960 reports, "Of all bluegrass selections tested, none have proven sufficiently superior to merit recommendation over Common bluegrass."

Juska of U.S.D.A., Beltsville, states very well the broad view of Common bluegrass. "Common is very susceptible to (Helminthosporium vagans) leafspot, particularly when over-stimulated with nitrogen fertilization in the spring. Therefore, it lacks density when crabgrass becomes competitive.

Much has been said about the broad gene base in Common bluegrass. Its broadness seems inadequate on leafspot resistance.

Comparative Seed Field Performance

Selections	Sodding 1-vigorous	Maturity 1-early	Weight 1-heavy	Size 1-large	Yield 100 lbs.
Merion	2	6	10	10	6
Delta	8	1	7	10	8
Park	5	4	4	5	9
Newport	(1)	6	(1)	(1)	(12)
PNW	2	10	3	5	8

Ratings range: 1 - 10
Fifteen Bluegrasses Compared, 1960 Data by
Jacklin Seed Company, Dishman, Washington

Comparative Turf Measurements

Selection	Seedling Vigor 1-9	Seedling Ht. cm.	Leaf Regrowth cm.	Turf Density 1-9	Rust Resis. 1-9	Density Rank in 24
Merion	4	10	6	3	6	6
Delta	6	21	8	4	6	21
Newport, C-1	2	15	6	3	(1)	7
PNW	4	8	8	3	3	15
K-5-47 Penn.	(2)	14	8	2	(2)	(4)

24 Entries planted May 1960, 1960 Data, 3 reps.
Purdue University, 1-most, 9-least OF DESIRED.

Some Bluegrass Diseases and Ratings for damage in humid areas

Leafspot	1	Stripe Smut	6
Melting out	2	Brownpatch	7
Foot rot	3	Powdery mildew	7
Crown rot	4	Leaf rust	7
Stem rust	5	Dollarspot	8
Zonate eyespot	5	Red thread	8
Fairy ring	6	Snowmold	9

By: W. H. Daniel, Purdue 1961
1- most severe 9-least

Leafspot Disease Comparisons on Bluegrass, Purdue, 1956-59

Avg. rating	Selection	Rank in test
1	Merion	1
4	Newport	2
4	Park	3
5	Delta	4
5	Pacific Northwest	5
5	S-21	6
6	Arboretum	7
6	Common Ky.	8

1- best 9- very poor

Daniel of Purdue reports Newport and Merion should compliment each other. Along this line, Roberts of Iowa recommends, "There is enough difference between strains so that we believe bluegrasses should be blended into mixtures rather than pure seedings for best disease tolerance." Data of Jacklin illustrated this below:

Comparative Disease Tolerance

Selections	Leafspot	Leaf rust	Stem rust
Merion	(1)	6	(7)
Delta	4	4	5
Park	4	5	4
Newport	(7)	7	(2)
PNW	3	4	4

Ratings: 1- most desired to 10- least desired
Fifteen bluegrasses compared, 1960 data by
Jacklin Seed Company, Dishman, Washington

Minnesota Work, H. L. Thomas Source

1936 - 360 plants collected throughout state
1953 - 15 combined into Park (Minnesota 95)
1959 - legislative support, so
from 2500 collected
to 300 after greenhouse disease screening
to 50 selected for continued study, plus
7175 collected summer 1960
in early testing stages

WHAT NEXT???

New Jersey has over 40 bluegrasses in turf plots.
Indiana has over 80 bluegrasses in comparative tests.
Juska and Hansen are testing irradiated Merion seed for rust resistance.
Washington State is observing 16 selections and many more; has PNW selection.
Pennsylvania has numerous potentials from within their collection and extensive progeny testing of Merion. Ten have been and are under test for turf performance.

Wouldn't you assume that many could grow satisfactory bluegrass turfs if disease were not periodically weakening the turf? And, don't we agree that one area for major improvement is increasing disease resistance? Certainly Merion's leafspot resistance is desired, but where is the second candidate? As Musser has said, "For the humid regions of the U.S., leafspot tolerance or resistance is a must for acceptability of a selection."

Schery of Better Lawn Institute suggests that if any selection is better adapted, even 10% in a bluegrass mixture should enable it to predominate. This concurs with several states recommending and companies actually blending bluegrass for maximum disease tolerance.

Examples of Blends

St. Louis %	Chicago %
10 Merion	40
40 Newport, C-1	30
20 Delta	20
10 Park	10
20 Common	0

In Summary

There is terrific impetus in the activity of turf throughout the United States, not only at the Experiment Station level, but by private industry. Those at the Experiment Stations have a responsibility to the taxpayers and wish to aid industries. How can they do this? By recommending nothing? By remaining aloof until varieties prove themselves in practice? No! Their job is to test early and convincingly so that seedsmen can be well advised, and from this make decisions favoring performance at the consumer level. Industry faces even larger problems, for you must carry the burden of education, advertising and labeling. Today a blend of five bluegrasses almost covers possible blending. What happens when you have fifteen to choose from?

It will be to the seedsmen's advantage to encourage Experiment Stations to test things thoroughly and to proceed with their own exhaustive tests so superior releases can get support, acceptance and utilization. As Duich of Pennsylvania states, "Since improved turf varieties bring premiums in sales, the seed industry has a challenge to shoulder their share of responsibility." This author feels this has two phases:

1. Make research do a good job, and
2. Keep informed

This speaker is not one to cry "Wolf," for I feel proud of the achievements in seed production, and equally proud of the strides being made in research and education. This is time for working together, of sharing information early, of doing things not half way, but well. Surely with only one bluegrass variety resistant to leafspot, here is a chance to go one step further. With only one or two selections resistant to rust, here is a chance to go further. In summary a plea is made for intense testing, particularly for disease resistance.

\- - -

UTILIZING ZOYSIA

Donald Likes, Supt., Hyde Park C. Club
Cincinnati, Ohio

Warmseason grasses have many advantages over coolseason grasses in the Cincinnati district. Zoysia being a grass that grows vigorously from April to October, will choke out other grasses and weeds that are troublesome during this period. However, if fertilized properly through the warm

season, it will be so vigorous that it will choke out all other competition.

If the heavy fertilizer program is continued after the turf becomes solid Zoysia, other problems arise. Excessive mowing is required. Clippings pile up and thatch becomes a problem. We might suggest that once it becomes solid Zoysia, ease off on the fertilizer and mow often enough to prevent clippings from becoming a problem. Of course, the ideal practice is to remove the clippings.

The main disadvantage of Zoysia is that it is difficult to plant. We have been wrong in our thinking that you can put a few plugs of Zoysia in an established turf and expect them to eventually take over under the same management as the coolseason grasses. We have observed this for the last five years, and if anything Zoysia is being choked out by the cool season grasses, such as bent, Poa and clover. For Zoysia to get the upper hand it must have encouragement during the hot weather. That is, proper feeding and some weed control measures.

We have also observed another mistake in planting this grass. As you know, it is a creeping type grass and can spread only by sending out runners. We have noticed when planting a plug of Zoysia in bare ground, it will take a month or more to form one of these sharp pointed runners. Therefore, when planting, it is important that you use a plug large enough to have or initiate one or more of these runners. Generally a 2-3/8" plug is minimum. It may make as much as a season's difference in becoming established.

We have not been too successful planting Zoysia with the sprig planter. The Ryan Sodcutter with the 3 inch stripper blades looks more promising. Planting 3 inch strips with 1 ft. intervals requires a lot of planting material. In fact, the ratio is 1 to 5. This can be cut in half by raising the sodcutter out of the ground for 2 ft. after it has been in the ground for 2 ft., then repeat. This can be a shorter interval as long as the cutter blades are in the ground 50% of the time and out of the ground 50% of the time. The planting rate then becomes 1 to 10.

The place to plant Zoysia is primarily where you have been unsuccessful growing other types of grass. Favored locations are sunny areas on southern slopes on fairways, industrial lawns and home lawns, and places that get heavy traffic. It may be suitable for some athletic fields, such as baseball and football. The baseball season coincides precisely with the Zoysia growing season. Football extends beyond frost, but those fields with tarpes would have little trouble keeping Zoysia through the football season.

The use of Zoysia is increasing each year. We will have new selections and will see much more of it in lawns, athletic areas and fairways in the next ten years.

PUBLIC RELATIONS AND ZOYSIA

M. M. Parsons, Jr., Supt., Evansville Country Club,
Evansville, Indiana

In 1953 Dr. Daniel started turf speculation at the Evansville Country Club. It was just a few plugs of Meyer zoysia planted at the site of one of the old sand greens near the practice area. The area had very little care, other than cutting. Very few of the members knew what type of turf it was, or for that matter, very few cared. As the plugs filled in and increased in size, most of the members used it to hit their practice shots.

Later a few plugs were planted into number 16 fairway. The two areas on this fairway have greatly increased in the seven year period. Most of the members will now move their balls onto the Zoysia when they land near it. They like the way the ball will sit up on the turf for their approach shots.

Bermuda had been rejected before I moved to Evansville. The reason for this was the intense winter kill in the previous years. Observations have proven that it was not winter kill, but disease, that had taken the large toll.

Mr. Turf of Evansville Country Club, Phil Drachman formerly Greens Chairman, invited a few members to an informal dinner at the Club. There were twenty-two members present when he suggested a program for better fairways. This presentation was an informative talk that started the Zoysia program. Each of those present were asked to donate $ 100.00 for better golf playing conditions. About 60% of those present were in favor of the donations. Only two or three members favored using any of the money to increase the existing water system, which was totally inadequate for this program.

Despite a slow start, the program increased with interest and donations. A goal of $8,000.00 was set for material and planting equipment. The Zoysia Committee made an honor roll, listing each name and contribution which was placed in the Grill Room for all to see.

We investigated the planting machines that were on the market and ordered one that best suited our purpose. The machine, a single row Pray planter, was delivered and assembled. The only difficulty was that the machine was designed to plant Bermuda in open soil. We reworked the planter in our shop. After much trial and error, the planter put the stolons where we wanted them and at the right depth. This may seem simple, but the process involved over 80 hours of work.

The first load of Zoysia sod, consisting of 925 yards, we received was highly touted by the members. One of the members, who is sports editor of the local paper, wrote several articles about the program. The day before that first load arrived we received three and one-half inches of rain. When the semi-trailer pulled into the parking lot, we discovered we had 925 yards of black gumbo mud. The truck could not get to the planting area, so the sod was transferred to our truck and hauled into what appeared to be a large rice paddy.

We received four loads of Zoysia that year, which totaled 3350 sq. yds. Of this amount, 2500 yds. were planted in the nursery area. The

remainder was used on tees and the initial fairway planting..

The members' questions increased as the program advanced. I instructed my crew to answer all questions no matter how trivial. This may have cost the Club a little in man hours, but it satisfied all those interested enough to be inquisitive. During this period the members received monthly bulletins and special letters, informing them of the program's progress.

The toughest part of the whole program was the strangulation of rumors started by misinformation. Several of these were: rate of growth, Zoysia identification, characteristics and the lack of confidence when the Zoysia didn't send out one or two foot runners in the first month.

One of the members heard my complaints of no water in some areas. Within two weeks we received a 350 gpm. pump. One of the other members gave the Club 1,000 ft. of 3 inch pipe. With these two gifts we were well on our way. The extension of the existing water system had made it possible to plant the first fairways. The initial planting was on 16" centers. Three of the first nine holes were planted with dormant stolons. This was a fruitless process. Some of the dormant stolons planted on these three fairways may have taken, but none were visible.

Test plantings of stolons were made through the entire year. Results of this project cannot be determined until the growing season starts this year. The best advice I can give, if Zoysia is planted with stolons on your course, is to answer all questions, become hard-shelled and have the patience of Job.

\- \- \-

STARTING AND MAINTAINING BERMUDA GRASS

Ernie Schneider, Supt., Big Spring Golf Club,
Louisville, Kentucky

Before you start on a Bermuda program for your fairways, it may be wise to face the facts -- decide whether you want Bermuda grass. Although it goes off color at the first killing frost, you still have firm footing during the winter play. Even though it is a little slow about greening-up in the spring, you have good playing turf at the height of the playing season. Now after you have Bermuda, you will have to live with it -- it would be very expensive getting rid of the Bermuda.

So, you have convinced yourself you want Bermuda fairways. It is up to you to sell it to your membership through your Greens Chairman -- tell him the reasons why you would like to have it. Your Greens Chairman can probably arrange a meeting with your Board of Directors; it will be up to you to furnish facts and figures. Be prepared to answer the questions put to you by the Board members. It may be worth your while to call in a reliable commercial grower and planter. He can be a great help to you. They will ask you if you can plant it yourself, or if you want to have it done.

I had my fairways planted to U-3 Bermuda grass by a bonded planter. This was done with no loss of play and with no help from my crew. If you do it yourself decide whether you are going to do a half fairway, an acre, or the whole golf course. The part that you do plant, be sure to do the job well. It is most important to have your soil tested to find out the nutrients needed. This is necessary to growing good Bermuda.

I prefer to plant Bermuda as early as possible, even if it is dormant, sprigged into the soil two to three inches deep. Also, I prefer the scorched earth method, by burning everything off the fairway. This will give faster Bermuda coverage. If you do have some desirable grass and are not bothered too much with goosegrass, then you can spray sodium arsenite at light rates, just enough to control crabgrass. If you destroy goosegrass, you will destroy your good grass also.

Start mowing as close as possible as soon as the Bermuda starts to grow. For maximum growth, fertilize as needed. I got my best growth when the weather was hot and dry, so do not overwater. This year I did not irrigate until after three weeks of no appreciable rainfall on the new planting only. The year old planting was not irrigated at all, except where the soil was shallow because of rock deposit.

My maintenance program uses: one five-gang and one seven-gang, set as low as the mowers will go. The five-gang goes ahead of the seven-gang, down one side of the fairway. He mows around all close corners, traps, etc., then he moves to the next fairway and continues to mow out all close corners; this gives the seven-gang clear running. On the next mowing, he cuts down the other side of the fairway. This offsets the wheel tracks. The following times I. reverse the mowing and cut the opposite way. The fairways are mowed not less than three times a week, regardless of the growth - sometimes four. If they have to be mowed wet, I go back over them the next day. I try to mow when the grass is dry, if possible;this does a cleaner job. By good mowing practice, I believe you can control some of the thatch. This year I mowed the grass even when it was going dormant, up to the latter part of November.

On established Bermuda, the first application of fertilizer in the early spring is 300 - 400 lbs. of 15-10-10 per acre. Then we put on three applications of ammonium nitrate,four to six weeks apart, at the rate of 150 lbs.per acre. For the complete season this is about 200# nitrogen, 40# phosphate, and 40# potash, a 5:1:1 ratio. On the new planting it was a little higher. From now on I will fertilize just enough to maintain fair growth and good color. This may help control thatch. Over-fertilization can lead to bad thatch condition. I double aerified once in the late spring.

Root Pruning. This year I root pruned all the trees 6 ft. from the base of the tree, then moved out 3 ft. and pruned again to be sure all the roots were cut. We had no browned out areas due to roots, as the year before.

I have a ten year old plot of Bermuda in #17 fairway. There are a few diseased spots showing up. This is called spring dead spot in St. Louis. You notice it when the growth begins in the spring. In these diseased areas I plugged four inch plugs of Meyer zoysia. These marked spots will be watched this season. One thing I noticed, the disease occurs in the same area each year. In some of the shaded areas where they get partial sun, and where the Bermuda is thin I intend to plug in

Zoysia. I do not have too many of these areas.

Control of thatch will rate high on my maintenance program this year.

\- - -

PROGRESS IN BENTGRASS MAINTENANCE, 3rd YEAR

Paul W. Neff, Supt., Scioto Country Club,
Columbus, Ohio

A little background is probably needed to acquaint some of you with our problem before I begin, or after I am through you may be wondering "progress from what?"

When I came to Scioto three years ago, the fairways were similar to many others in that what had been bluegrass and fescue, due to the demands of the golfers for closer cut turf and other factors, had become about 90% Poa annua, with a liberal seasoning of clover, knotweed, and crabgrass. There were some spots of bluegrass and bent, but they were so far apart and not uniformly distributed that it seemed even with the best of care they would never fill in. It seemed hopeless to seed with so much competition. Accordingly, I recommended killing out everything and reseeding.

In choosing the proper grass to replant, we seemed to be limited to bent, Bermuda, or Zoysia because of the golfer's demands for low cutting heights. Zoysia was ruled out because of winter color and slow establishment, and Bermuda for the same color objections, as well as uncertain winter hardiness.

When the bentgrass first came up, there was very little Poa annua showing. During late winter and early spring 1959, more Poa annua showed up in thin and bare areas. During the bad weather of August 1959, we lost some bent in areas of poor air and water drainage and in some low areas. We also suffered from a shortage of water due to pump failure (4 weeks duration). In 1960, the bent held its own, but with some population shifting. Most areas improved, with Penncross, which had been but 10% of the seed mixture, becoming the predominant variety. There was a loss of bent at ends of fairways in tractor-mower turn areas, and other high traffic areas.

We have been led to believe, by several agronomists, that arsenic has a definite inhibitive effect on Poa annua, although not as pronounced as on crabgrass. Accordingly, we are using 250 lbs. per acre of lead arsenate annually to build up a toxicity in the soil. In addition, we are using sprays of sodium arsenite, about 1 lb. per acre per week during spring and fall. The lead arsenate is applied early in the spring mixed with Milorganite for easier and more even distribution. This amount of arsenic seems to control grubs, worms and crabgrass. The liquid sprays also kill most broadleaf weeds and some clover.

Mowing is at about 1/2" during spring and fall, with about 3/4"

during the hot weather. All fairways are aerified twice in late October, and dragged with a section of chain link fence to break up the cores. Besides the aerifying, it is hoped these operations will control mat formation.

Fertilization is begun after the spring lush growth is passed on the premise that to feed before the bent is vigorous may help the Poa more than the bent. It is supposed that the Milorganite carrier for the lead arsenate will not become available until the soil warms up. Monthly applications of organic fertilizer are made throughout the summer at about 20# nitrogen per acre, with heavier rates in fall, to total around 250 lbs. nitrogen per acre per year. Iron sulfate is sprayed on during summer months, 3 to 5 lbs. per acre, according to temperature.

We knew, of course, that we would have Poa, and always expect to have some of it, just as we expect to have crabgrass even with the very efficient remedies now available. Our hope is to keep it down to a small percentage, so that when it dies during summer adversity, as it usually does, there will still be lots of grass instead of lots of bare spaces.

I think there is much more to be done on the matter of arsenic toxicity as it relates to amounts of arsenic used. For example, we have some spots where material was spilled when the spray tank was "run over" at the time of the original treatment. That fall the seed never came up in these spots, but the areas were hand-seeded the next spring and are still 100% pure stands of bent. There is no way of telling what the amount used might have been, but it seems to indicate that there is an answer. This arsenic toxicity must be achieved before Poa annua is effectively controlled.

\- \- \-

SELECTIVE DISEASE CONTROL ON FAIRWAYS FOR THE SIXTIES

R. Williams, Bob O'Link G.C.,
Highland Park, Illinois

Recap of fairway evolution:	J. MacGregor and F. Grau Fescue, bluegrass, bent and Poa Coarse to fine Long to short Dry to moist
Recap of disease control on irrigated bent fairway turf:	Spotty up through 1958 Mostly experimental plots by superintendents A few full-scale treatments in '58 Numerous curative treatments in '59 & '60 Numerous preventives in '61 Cost influence $ 4.00 acre to $ 2.00 acre.

Bob O'Link program: 1959		Six treatments of PMA and iron 1 qt. PMA, 3 lbs. iron, 75 gals. water July 22 through August 28 Last 4 treatments within 10 days. Excellent results
Bob O'Link program: 1960	regular	Ten treatments, preventive June 16 through September 7 PMA and iron same as 1960
	experiment with cooperation of Dr. Sartoretto	2½% PMA with chelate iron 40% PMA on trial areas, same results PMA and Thiram mixed, also with iron All seemed very good
Bob O'Link program planned for 1961		Lime at 1 ton per acre pH tests revealed 5.5 to 5.7 Continue PMA and iron Continue work with other new products

OUTLOOK FOR THE 60'S

By Superintendents	Superintendent must assume an attitude of pursuit of excellence in turf for the golfers. Superintendents must stop thinking of fairway management as a large unsurmountable task. Get operations for fairways down to 4 hour or 6 hour jobs. Selective disease control means a greater degree of control of all pertinent factors such as: Drainage, irrigation, wetting agents, dew removal, fertility, grass species, fungicides, thatch, tree roots, compaction, air circulation, mowing, and costs.
By industry and research people	Dependence of progress on research Dependence of progress on industry Dependence of progress on schools
60's should bring	Systemic fungicides Pelletized fungicides (dry broadcast) Better packaging (plastic bags?) Combinations of two or more: Insecticide Fertilizer Fungicide Herbicide Wetting agents Sterilants Fungicides through irrigation injection Mist blower application Improved resistant strains of grass Time lapse capsule fungicides

Factors governing progress:

Interest and number of people in research.
" " " " " " industry.
" " " " " " schools
" " " " " " practical associations
Enthusiasm and aggressiveness of superintendents.
Apply pressure on schools and industry.
Competition between clubs will force better maintenance.
Desire by industry for an expanded market.

Final conclusion: The 60's will bring a natural trend towards refinement and excellence in all phases of turfgrass management.

\- - -

FUNDAMENTALS OF TURFGRASS DISEASE CONTROL

Houston B. Couch, Dept. Botany and Plant Pathology,
The Pennsylvania State University
University Park, Penna.

Diagnosis - the Key to Disease Control. Accurate and early diagnosis is the most important phase of a successful turfgrass disease control program. The entire program is based on the initial diagnosis; therefore, a case of mistaken identity could easily lead to loss of all, or a portion of a stand - even though remedial measures of a sort were being attempted.

In certain cases, symptoms may be secondary, rather than primary, in origin. While elimination of the secondary invaders may reduce the severity of the problem somewhat, control of the disease will not be accomplished until the primary cause has been treated. Treating symptoms,rather than causes, is one of the primary reasons for sporadic failures in turfgrass disease control.

Each time a new disease problem arises, every effort should be made to determine the primary cause, and then recommended control measures should be followed. Waiting for the disease to go away of its own accord, or wishfully thinking that it may not occur again, are open invitations to disaster.

Outbreaks of disease should be recorded in a neat, well planned filing system. This record should include:

a. The name of the disease.
b. Grasses affected
c. Specific location
d. Date of occurrence
e. Environmental conditions for one week prior to, and including the outbreak
f. Control measures applied and their results.

With this approach, the turf manager develops a planned disease control program, rather than having it materialize as a staggered sequence of surprises each, in turn, being culminated with post-mortem expressions of sympathy from the pathologist and advice on renovation from the agronomist.

Fungicides - their Selection and use -- Several factors are to be considered in making selections for the various entrys in the fungicide program. Ideally, a turfgrass fungicide should:

a. Provide a high level of disease control
b. Be comparatively low in cost
c. Not be readily harmful to the user
d. Not injure the plants at dosage levels of at least two times the recommended rate
e. Be compatible with a wide range of insecticides and other fungicides
f. Not leave an objectionable appearing residue on the turfgrass
g. Be easily dispersed in the diluent and not clog the outlets in the application equipment
h. Have a long shelf life
i. Be readily obtained in large quantities when necessary
j. Be conveniently packaged.

Maximum benefits are realized from fungicides only when they are properly applied. This simply means following the manufacturer's directions to the letter. Dosage rates and amount of diluet should be exact - not estimates. Any deviation from the recommended procedure should be a planned one that will produce known results. The most common problem in fungicide use stems from either applying an extra high dosage for quicker control, or reducing the recommended rate as an economy measure. In either case, the user faces the possibility of losing time, money, grass and job.

Fertility and Disease Control. - Knowledge of precise role of fertilizer and water management practices in development of turfgrass diseases is of primary importance to management specialists. Research at Penn State over the past five years has shown that the susceptibility of bentgrass and bluegrass to Rhizoctonia, brownpatch, Sclerotinia, dollarspot, and Pythium, blight can be altered by certain fertility and soil moisture combinations. Brownpatch severity has been found to increase at high nitrogen levels, with normal phosphorous and potassium fertility. When phosphorous and potassium were increased concurrently, however, this susceptibility was offset.

Sclerotinia, dollarspot, is more severe under low fertility, and development of the disease is much greater at low rather than high soil moisture levels.

Pythium blight is less severe under low balanced fertility. Low calcium leads to much more disease development. In addition, disease severity is much greater at low soil moisture levels.

While this information is useful in assisting in disease control programs, it should be emphasized that diseases are not well enough controlled by altering the fertility program. Adequate control can only be accomplished by the proper use of fungicides. The safest, surest program, most certain to produce grass of predictable utilitarian and aesthetic qualities, is one in which the turf manager uses fertilizers to grow grass and fungicides to control disease.

GUIDE FOR THE CHEMICAL CONTROL OF DISEASES OF TURFGRASS

Houston B. Couch

Disease	Material	Rate 1000 sq. feet ozs.	Season and interval of application dates
Copper Spot (Gloeocerco sporasorghi	Same as Sclerotinia below		
Helminthosporium diseases			
a. Melting-out (H. vagans)	Ortho Lawn & Turf F.	4	April-June
	PMAS	1 fl oz	repeated 7 days
b. Zonate Eyespot (H. giganteum)	Dyrene	4 - 6	July - Aug.
	Kromad	4	7-14 days
	Captan	6	
c. Helminthosporium leafspot (H. sorokinianum)	Zineb	2	July - Aug.
	Tersan OM	5	7-14 days
	Acti-dione - Thiram	4	
d. Red Leaf Spot (H. erythrospilum)			July - Aug. 7--14 days
e. Helminthosporium Blight (H. dictyoides)			April - June
f. Brown Blight (H. siccans)			April - June
g. Leaf Blotch (H. cynodontis)			April - June 7 - 14 days
Nematodes	Nemagon	3/4 pint actual material	1 app. when soil temp. is above 50°
	Fumazone		
Powdery Mildew (Erysipbe graminis)	Acti-dione - Thiram	4 oz.	July thru Sept.
	Karathane	1/4 oz.	7- 14 days
Pythium Blight (P. ultimum)	Zineb	2 oz.	July - Sept. 5 - 10 days
Red thread (Corticium fuciforme)	Same as Sclerotinia above		May - June Aug. - Sept. 10 - 14 days
Brownpatch (Rhizoctomia solami)	Calomel + Corrosive sublimate (Calo-Cure, Calo-Clor, Fungches, etc.)	1 oz.+ 1 oz.	July thru Aug. 7 - 14 days
	Tersan OM	5 oz.	
Rust (Puccinia graminis) f. agrostis	Acti-dione - Thiram	4 oz.	7 - 14 days
	Zineb	2 oz.	7 - 10 days
Dollarspot (S.homoeocarpa)	Cadmium compounds	2 oz.	Late June thru Aug.
	Ortho Lawn & Turf F.	4 "	
	Kromad	2-4 "	
	Dyrene	4 "	
	Tersan OM	5 "	
	Acti-dione -- Thiram	4 "	
Slime Molds (Myxoymcetes)	Remove mechanically by mowing or raking, or any of the above mentioned fungicides when disease is evident.		
Snow Molds Fusarium Patch (F. nivale Typhula Blight (T. itoana	Phenylmercury	1-2 oz, 10% solu.	Fall to spring 2-6 weeks
	Calomel + Cor. Subl. Calo-Cure Calo-Clor Fungchex, ect.	2 oz +1 oz	

TURF DISEASES AND THEIR RECOGNITION

M. P. Britton, Dept. of Plant Pathology,
University of Illinois, Urbana, Illinois.

This continually rising standards of excellence in the maintenance of home lawns and other fine turf areas constantly confronts the homeowner and turf manager with new problems. Not the least of these is the problem created by more than 100 diseases of turfgrasses.

Turfgrasses are attacked by four typical disease-producing agents: fungi, bacteria, viruses and nematodes. However, the seven important diseases known to occur in the Midwest are all caused by fungi.

Injuries from turf diseases vary greatly from year to year, and within a season due, in part, to the variability of climatic factors, such as temperature, humidity and rainfall. However, improper watering, fertilizing, soil drainage,mowing and a lack of light and air circulation also contribute toward disease development.

Generally speaking, well managed vigorously growing turf is less apt to be severely damaged by disease attacks than poorly managed turf. The need for fungicide treatments can be kept at a minimum by carrying out the following management practices:

1. Provide adequate surface and sub-surface drainage when establishing new lawns.
2. Mow at a height recommended for the grass species being grown.
3. Many of the fungi causing disease live equally well on clippings, or living grass; therefore, remove the clippings, if possible.
4. When watering, leave the sprinkler in one place for 3 -4 hours, or until the soil is wet to a depth of 5 - 6 inches. Wait one to two weeks before watering again. Water early in the day so that the grass will dry. (This does not apply to bentgrass putting greens).
5. Follow a recommended fertilizer program based on soil tests. Avoid high nitrogen levels during hot weather.
6. Improve light and air circulation by pruning, or removing dense trees and shrubs that shade or border the lawn.

If fungicides must be used, identify the disease correctly and apply a recommended fungicide early, beginning when the first symptoms are evident. Spraying is the preferred method of applying fungicides. To improve leaf coverage, add 1 teasponnful of household detergent for each gallon of spray solution. To avoid turf injury when using mercury fungicides in hot weather, increase the gallonage of water used per 1,000 sq. ft., and make applications in the evening. Be prepared to make several applications of fungicides at 7 - 10 day intervals. Under favorable conditions for severe disease development, applications may have to be made at 3 - 4 day intervals.

Symptoms of Common Diseases in Illinois

Pink Snow Mold. Usually occurs at the edge of melting snow, sometimes under snow, or during cold spring rains. First appears as circular patches 1 to 2 inches in diameter with a fringe of white or pink fungus growth. Diseased areas may enlarge up to 12 inches in diameter and coalesce to cover large areas.

Gray Snow Mold. Symptoms are similar to pink snow mold, but diseased areas become larger. White, blue-gray, or black fluffy fungus growth is usually present over the entire area. Injury occurs under snow and at the edge of melting snow.

Leaf Spot and Footrot. Leaf spots are purple to brown, often have tan centers and purplish marings, may become 1/2 inch in length. Diseased leaves turn yellow and finally brown when infection girdles the base of the leaf or sheath. Crowns, stems, roots, and rhizomes turn brown and rot (footrot). Large areas of grass may be killed by May or June as a result of root and crown rot.

Dollarspot. Small, round, tan, spots suddenly appear in mild (60-85°F), humid weather. In the very early morning a cobweb-like mold growth is visible on the grass leaf blades. When numerous spots run together, large irregular, straw-colored, sunken areas develop. This disease is most prevalent on bentgrass.

Rust. Reddish-brown, powdery pustules on leaves. Infected grass blades turn yellow, shrivel and die. This disease is serious only on Merion bluegrass during hot, dry weather when the grass is making little, if any, growth.

Brown patch. First appears as roughly circular patches of wilted, dark-colored leaves. Later, when the grass leaves dry, the diseased areas become light brown. Sometimes the central portion of the diseased area will be brown and the margin bluish-green. This disease is far more important on bentgrass than on bluegrass lawns.

Helminthosporium and Pythium Blights. These diseases are indistinguishable except by microscopic examination. Both diseases become severe when air temperatures rise about 90°F. on several successive days. The first evidence of disease is the appearance of small circular patches of wilted grass that are bluish-gray in color. The leaves die rapidly and turn tan or brown. Individual diseased areas often coalesce to form large, irregular dead areas. These fungi first attack the crowns, roots and rhizomes; leaf symptoms appear only after most of the roots are dead. These diseases may be confused with grub damage.

Powdery Mildew. White fungus growth (mildew) on the leaf blades of the grass. The disease first appears in heavily shaded areas. It may damage when it remains active for a long time.

Fairy Rings. Show up as circular dark green rings of grass in which toadstools may form following wet weather. A ring of brown grass is often found just inside the dark green ring. During dry weather a brown ring may form outside of the dark green ring. Spiking and hand-watering may reduce drouth damage.

- - -

RECOGNITION OF DISEASES -- GOLF COURSE SECTION

M. P. Briton

It is of prime importance for the turf manager to be able to recognize diseases. Until a correct diagnosis has been made, no disease can be treated intelligently. This is true even though several fungicides have been developed that give adequate control of two or more diseases. A treatment that successfully controls one disease is often of little value with another. Likewise, a treatment that is effective in one region, may not do the job in another.

The superintendent usually relies upon symptoms for disease recognition, and there are two big difficulties in this:

1. The symptoms of some diseases are very similar, and
2. The sumptoms produced often vary from the typical symptoms.

The early symptoms are the key to identification of the disease. After the grass is dead it is often impossible to determine what killed it.

The following information on symptoms of turf diseases is based on the appearance of the diseases on bentgrass putting surfaces:

Brownpatch. (Caused by Rhizoctonia solani) occurs in irregularly shaped areas, usually more or less circular, varying from 1 inch to 3 ft. or more in diameter. The grass in the central portion of the area first turns dark and then gradually becomes a light brown. On the border of the affected area there may be a dark ring of affected grass. This dark border is present only when the fungus is still attacking healthy grass leaves and indicates that the disease is still spreading. The thread-like fungus filaments may be observed in the early morning on the leaves in this darkened area. In each diseased spot there are a great many leaves which have not been infected. The number of these green leaves in proportion to the number of dead leaves determines the color of the central portion of the diseased areas. Consequently, light attacks of brownpatch are often overlooked because the degree of discoloration is very slight. If light infections are not controlled with fungicides, the fungus will continue to infect,and generally extensive browning of the central portion of the diseased area results. If the disease is not controlled with fungicides, the grass can be killed out.

Dollarspot. (Caused by Sclerotinia homeocarpa) occurs in spots on the turf usually no larger than a silver dollar. The individual spots are circular in shape. When several spots run together irregularly shaped areas form. Tufts of the white fungus filaments may be observed on the affected areas of turf in the early morning when dew is still present. As in the brownpatch disease, the leaf blades that have been recently infected by the fungus are dark colored. These wilted dark leaves rapidly dry out in the wind and sun, the fungus filaments dry and disappear, and the leaf blades bleach to a light straw color. Dollarspot may be confused with fusarium patch disease during the cooler months.

Fusarium Patch. (Caused by Fusarium nivale)occurs during cool, wet weather and is usually most prevalent in shaded areas. At the edge of melting snow we call this disease "pink snow mold." Here the nearly circular

diseased areas may attain a diameter of a foot or more. Later in the spring during cold, rainy weather, the fungus produces spots on the turf which are of nearly the same size and appearance as those caused by the dollarspot fungus. Fusarium patch usually develops when temperatures are lower than 60°F., dollarspot when temperatures are higher than 60°F.

Pythium Blight and Helminthosporium Blight. These two diseases of putting green turf are very difficult to tell apart. The first sympton of both disease is a small circular spot of blackened grass blades, these leaves dry out in the sun and wind and usually turn a reddish-brown color. Under some conditions the spots may be a very light straw color. Individual diseased spots generally are not more than 2inches in diameter. Where spots run together, large areas may be killed. Both diseases become severe during periods of very high temperature and are most serious in low spots in greens where soils are wet. Helminthosporium blight will occur on high areas of the green where soils are not excessively wet; Pythium blight generally does not. Our knowledge of this particular disease complex is relatively sketchy and additional studies will have to be made before we can hope to understand the relationships of temperature, moisture and the several species of Pythium, Helminthosporium, and Curvularia fungi which seemingly are involved.

Fading Out or Melting Out is another disease complex in which various species of Helminthosporium fungi are involved. Curvularia spp. again are commonly found in association with the other causal fungi and have been considered by some workers to cause this condition. Here again we are faced with a lack of information,and detailed studies need to be made to clarify the situation. The species of fungi involved in "Fading Out" normally produce a leafspot on the leaf blade, or the leaf sheath. These spots are often indistinct, especially on the sheaths. Normally the first indication we have of disease trouble is the appearance of chlorotic areas of grass. As leaves are killed, a general thinning of the turf occurs. This type of injury normally occurs during periods of moderately warm temperature, 75° to 90° F.

Snowmold. (Caused by several species of fungi) occurs during the fall, winter or spring. The fungi causing the disease are most active when the snow is melting and most of the damage occurs at this time. The first sign of the disease is the formation of a thick, cottony growth of the fungus on patches of turf. At times the injury is confined to the upper leaves of the turf, and recovery is very rapid. At other times, however, the turf is completely killed. In both cases as the grass dies irregular patches of grayish turf become apparent. The time of appearance readily distinguishes snow mold injury from the other diseases.

\- - -

OUR TURF DISEASE CONTROL PROGRAM

George Reynolds, Supervisor, Municipal Golf Courses
Dayton, Ohio

First, let us get a closer look at the subject by checking the definition of some of its terms.

Disease is considered any disturbed or abnormal condition in organic substances; a morbid, or unhealthy condition resulting from such disturbance. Control means to check, a sudden stopping or arrest, to restrain.

May I tell you some of the methods our golf maintenance crews use to check, stop and restrain any abnormal condition that tends to make our turf unhealthy, especially the turf on our greens.

Snow mold do not come on north banks. Keep footprints off green causes optimum moisture - long grass promotes disease.

Dollarspot comes in daytime as wellas nighttime, frequently after cold rain in fall. Always fatal. Fertilize only cure. Hyphae enters blade or grass and goes direct to root.

Pythium - disease believed to be carried on shoes, follows drain lines, no visible mycelia, always fatal. Kills bluegrass as well as bents.

In the development of a fungus, a parasitic plant, Sclerotinia, is always present on grass. It carries the parent plant in the form of a spore which develops into another Sclerotinia. Sclerotinia is inactive, and remains a hard-shelled plant for indefinite periods until the temperature and moisture content of air becomes favorable, then it develops mycelium.

Mycelium has some development when temperature is optimum, and the more humidity the more rapid the growth. Mycelium will appear if temperatures rise to 64 - 68 and remains constant. Mycelium will appear from 30 minutes to 1 hour after sudden temperature drop to 64 - 68°F. Mycelium will also appear after constant temperature of 73 - 85 for 14 hours. Mycelium will not appear if the fall of temperature is gradual to 64 - 68° F. Optimum temperature for development of hyphae is 83°F. Hyphae is the thread-like part of the fungus that enters the pores of the grass plant, secreting a fluid that disintegrates the grass cell walls, allowing the juice to be absorbed by the parasite.

Disease may be checked by cultural means. This includes:

1. Proper watering to avoid redding color due to the plant not getting air from roots in saturated soil.
2. Avoid mechanical injury caused by equipment.
3. Trimming out low limbs in trees near greens to allow air circulation.

I do not know what Thiram does to stop the parasitic action of the hyphae, but the mercury in PMAS precipitates the protein in all organic matter, i.e., it isolates protein and makes it non-soluble, causing the parasite to perish. It does not harm Sclerotinia - just stops its production of mycelium until later when all conditions are favorable for its growth.

Cultural Control Used on Greens

a. Remove dew in morning from grass before temperature of 73° is reached, especially greens facing east and south.
b. Syringe off greens when grass is transpiring water faster than short roots can remove it from the ground. This is very important in late summer when roots are short.

c. Syringe greens to cool them off when temperature is above 90° to avoid Pythium.
d. Inspect greens after sudden afternoon thundershower if temperature has risen above 80°. Apply fungicide mixed in sand to any spots of brown-patch evident, or rub spot lightly with hand will keep from spreading.
e. Change cups twice per day to avoid scald on wet days when play is heavy.
f. Fertilize at night to avoid killing grass near cup.
g. Keep players off greens when frost is on grass.
h. Roll greens in spring to prevent excess drying, or winterkill.

Cultural Control on Fairways

a. Keep heavy equipment off during hot dry days.
b. Keep equipment off when frost is on grass.
c. Roll fairways in early spring to prevent roots from drying out.

Chemical Disease Control on Greens

1. Apply Thiram @ 4 oz. per 1,000 sq.ft. in solution of 5 gal. of water at 400 lb. pressure in late November, or before winter sets in, for snow mold control. Apply again in mid-February at same rate in solution if possible. If not use dry sand, or Milorganite as carrier.

2. Weekly applications of 2 oz. Thiram, plus 1 oz. PMAS in solution of 5 gal. water per 1,000 sq.ft., applied by spray nozzle at 400 lbs. pressure.

   a. Starting about the last week in April, or when temperature and air moisture is favorable for fungus growth.
   b. Delete Thiram about third week in September and apply 3 oz. of PMAS for dollarspot per 1,000 sq.ft.
   c. Apply ferris sulphate @ 1 oz. to 1,000 sq.ft. in above weekly solution to give plant vigor.
   d. Apply chlordane @ 1 oz. per 1,000 sq.ft. in weekly solution to prevent insect injury.
   e. Discontinue program about middle of October, or when night temperatures constantly fall below 60° F.

On tees spray intermittently with 3 oz. of PMAS and 2 oz. of chlordane per 1,000 sq.ft. to control dollarspot on Poa.

\- - -

TURF MANAGEMENT vs. TURF RENOVATION

Ted Smith, West Point Products Corporation,
West Point, Pennsylvania

We at West Point believe that Thatch Control is a parallel problem to compaction; that both are continually building up, and that to control thatch and eliminate compaction it is necessary to verti-cut and aerify on a regular planned basis through the seasons. Thus, our thinking must

be in terms of Turf Management rather than Turf Renovation when we consider thatch control. Let us consider this concept and examine our objectives. We would like to establish a plan of turfgrass management that will:

1. Eliminate the need for periodic drastic renovation.
2. Produce a superior stand of turf.
3. Create conditions for better playability.
4. Enhance the beauty of the course.
5. Produce these conditions without materially affecting present expenditures.
6. Be incorporated into the normal maintenance program.
7. Not interfere with the normal use of the golf course.

Review of the Problem

To produce an acceptable, playable turf, certain necessary management practices must be carried out, even if they interfere with the golfer's use of the course. However, much thought should be given to ways and means of developing a minimum interference. Let's list the necessary practices for good turfgrass management that interfere with the game of golf.

On Greens	On Fairways
Renovation	Renovation
Aerification	Aerification
Verti-cutting	Verti-cutting
Fertilization	Fertilization
Irrigation	Irrigation
Mowing	Mowing
Disease Control	Disease Control
Topdressing	

When turfgrass areas are good we are reluctant to do anything that will mar their beauty, or alter their playability. Necessary practices are put off. Before we realize it, that wonderful turf has gone to pot, then renovation is needed. Now, what are the steps that should be taken to prevent this?

The first major step is to change our thinking from Turfgrass Renovation to Turfgrass Management. A sound, sensible program costs no more than a weak, unscheduled program, plus renovation. If a small fraction of the money spent on complete renovation were added to the normal operating budget, renovation would seldom be necessary, and the course would not have to be closed.

In order to establish a program, we must first consider the basic reasons for loss of turf. Providing we have the right grass, an adequate fertilization and irrigation program, we can conclude that the two basic reasons for loss of turf are compaction of the soil and an excess thatch layer on the surface of the soil. Either one or both of these conditions can lead to partial or complete loss of turf. Both conditions restrict root growth.

Our improved management program must, therefore, begin with a planned system of aerification and thatch control. When soil is aerified many soil cores are brought to the surface which serves as a topdressing.

They make intimate contact with the accumulated surface thatch. Decomposing organisms break down the fibrous thatch material into rich, usable humus. The humus, rich in nutrients, washes down into the rootzone through the openings. One can readily see how soil cultivation and thatch control compliment each other. It is a re-cycling process. Compaction is alleviated; the removed soil is mixed with undecomposed thatch. The thatch slowly decomposes into humus. Soil bacteria breaks the humus down into simple nutrients, which are picked up by the plant roots. The grass plant, therefore, reuses the same materials.

Controlled decomposition is similar to the process that takes place in the old-fashioned compost heap. Air is vital to decomposing bacterial action. Carbon dioxide given off during decompositions must be allowed to exhaust freely from the soil. Lime must be used to aid biological processes,and equally important Nitrogen must be added to help feed the decomposing organisms. So,here we have our formula for the control of thatch:

1. Mix soil with the thatch.
2. Give it plenty of air.
3. Add lime as needed at surface.
4. Keep an adequate supply of nitrogen.
5. Physically remove excess thatch.

Improved management as against renovation means not the elimination of practices, but rather their modification. Many superintendents are already carrying out aerification on a continuing basis. Compaction is the result of natural causes from the texture of the soil, day after day tramping of the golfer, vibration and weight from mowing. It is a gradual development, therefore, if we can eliminate compaction as it develops, we can keep soil conditions nearer perfect.

Based on these conclusions then, aerification should be done more frequently and less severely. It is doubtful that greens can be ever cultivated without some slight surface disturbance. Therefore, rather than do 18 greens at one time, it would be far better from the standpoint of the golfer to aerify a few greens at one time. This could be done on a continuing basis through the growing season.

Accurate records should be kept. A man should be trained to do the aerification properly. He should understand what he is doing and why. Careful cleanup of the green is all important. Ten minutes of the hour should be spent in thoroughly checking the greens, especially the cupping area to make sure the turf is in good condition.

Verti-cutting can also be blended into the aerification program. Thatch, like compaction, builds up gradually. Its control, in a modified turfgrass management program, should be frequent and light. When combined with aerification it will pulverize the soil cores. Greens, with their dense, heavy growth, need additional soil for better controlled decomposition. Thus, if we combine aerification, verti-cutting and topdressing into one operation, greens can be done efficiently and quickly.

Fairway Turfgrass Management Program

A fairway program uses the same principles. Fairways differ from greens in that we have a higher cut; the turf is not as dense; fertilization is not as heavy; topdressing is seldom practiced; irrigation is

lighter; mowing is not as frequent; and grass clippings are not removed. Fairway compaction is severe. Mowers get their traction from the wheels adding forward force to compaction. The players compact the soil, although the fairway area is so large this may be insignificant. The use of golf carts increases compaction.

Aerification then becomes a basic management practice on a continuing basis. Once or twice a year aerifying is not enough to overcome compaction that is taking place day after day. Under improved management not only is compaction relieved on a continuing basis, but equally important topdressing is being incorporated into the accumulating thatch, Verticutting should also be considered an essential part of a fairway grooming, and, like aerification, should also be done on a continuing basis.

Fertilization

Special emphasis should be placed on the fertilization program. Decomposing organisms temporarily use available nitrogen. Nitrogen is essential to encourage controlled decomposition and keep an adequate level for plant requirements. Contrary to pupular opinion, light lime applications should be used regardless of the pH of the underneath soil. Our problem is not with the soil, but with the thatch layer above the soil surface.

Turf care maintenance by improved techniques offers much for our golf courses. Perhaps new procedures are needed! Golf has increased tremendously. Women have learned to play what was once a man's game. The game that belonged to the idle rich now belongs to the business man, the butcher, the baker and the candlestick maker.

The demand on your ability and time is going to be even greater in the years to come. We must prepare for it, and this means making changes. The golf course belongs to the members, and the turf manager's job is to provide what they want. They want good turf all the time. They want to use electric golf carts. We must think more and more in terms of turfgrass management on a continuing basis rather than renovation.

\- \- \-

MACHINERY AND TECHNIQUES FOR STREAMLINED OPERATIONS

James M. Latham, Jr., Agronomist,
Milwaukee Sewerage Comm., Milwaukee, Wisconsin.

John Morley wrote in The Bulletin of the USGA, Green Section, in February, 1929, as follows:

"In recent years, practices in golf courses maintenance have changed considerably. The putting green mowers formerly did not cut the grasses as close as they do today. We used to cut the putting greens every other day. Now we are compelled to cut them every day. With few exceptions, most putting greens were a mixture of creepingbent, fescue, Poa trivalis, Poa annua, and clover. Yesterday, chemicals on a golf course were in very limited use. Today, with the big array of chemicals

being advertised as fertilizers, fungicides, insecticides or what not, the greenkeeper must have some technical information, or a source from which he can obtain such information, unless he is to become a victim of the salesman with the best line of talk. While we all realize that the best education he may get is from practical experience, yet I am of the opinion that knowledge along theoretical lines is helpful."

When the above was written, the "acid-era" of turf management was at its peak. The use of lead arsenate was still being studied by Experiment Stations. Although it had been advocated eight years earlier in Illinois, the usefulness of sodium arsenite would not be proven until Fred Grau's work in 1932 and 1933. The fungicidal properties of mercurial compounds had been recognized for only a few years. Commercial fertilizers were just becoming accepted. Gasoline powered equipment was just coming into widespread usage. Greens Committee chairmen were boasting about maintaining a 9 hole golf course with only 5 men.

Aren't we saying the same things today, but with a few exceptions? Our remarks must be amended by several factors:

1. The total costs have skyrocketed since then - labor, material and freight charges (which affect all purchases).
2. Club membership and rounds of golf played has increased tremendously.
3. Golfers are demanding more perfect playing conditions.
4. Committees are demanding more economical operations.

How can these four requirements be managed today? Mechanization is only part of the answer. There are a great many machines available for use today, most of which have a logical place in professional turf management. But, having them available doesn't solve the problem. These machines must fit into a program to obtain the greatest efficiency per unit of work -- STREAMLINING.

Preparation of topsoil is perhaps the most labor consuming non-routine operation. On most courses it is still a hand-shoveling operation. Many courses already own a front-end loader, a grinder and a rotary, or vibrating screen. With the addition of a flame pasteurizer and 2 or 3 elevators, a streamlined operation can be organized. The slowest operation is sterilizing and that can be done at a rate of 5 cu. yds. per hour. A well integrated system can potentially turn out 40 cu.yds. of screened, sterilized topdressing material in an 8 hour day using 2 or 3 men. Topdressing applications have been improved considerably, through the use of large rotary broadcasters, or the power spreaders. Matting has also been streamlined by supplying power to the drag mats.

Spraying is another operation which costs unnecessary labor. Tank size is the major factor. With 100,000 or more square feet of greens to be sprayed regularly, why have a tank smaller than 250 gallons? In fact, with so much fairway work being done today, a 400 to 500 gal. tank is not excessive. Refill time alone means a tremendous annual bill for non-productive labor.

Fertilizer applications have certainly been improved with the development of rotary, or cyclone-type distributors. Both greens and fairways can now be fertilized in a fraction of the time formerly required.

In construction, special areas such as greens, should not be a

place to save money. All too many new courses "save" by mixing soil components on the site. Most of these must be rebuilt in a few years, doubling the cost of each green. Off-site mixing of the right components in the proper quantities avoids this.

Golf course design is changing. Larger greens, wider aprons and gentle slopes are being used to accommodate more players and make mechanization possible. Soil tests have been developed to accurately measure the capabilities of a certain soil mixture. Good topsoil has long been unavailable in many areas, so it must be made. Composting is one method of accomplishing this. Ray Greiten, Superintendent of Milwaukee's Lincoln Park, has devised a method of composting wood chips and leaves collected by the City. Compost is rich, usable organic matter, and the high temperature of the pile kills weed seed.

Soil preparation must involve some method of sterilization, not only for weed control, but disease and nematode control as well. The new Tarco Soil Pasteurizer is a rapid and satisfactory tool. Methyl bromide must not be overlooked either.

Seedbed preparation tools are being improved continually. High-speed edgers for large and small jobs are mechanically sound. New interest is being shown in spikers, the Maple Lane gangs, the self-propelled Power Spike, and the West Point Spiker attachment. Superintendents have developed tools and devices to cope with particular problems they face. Joe Mack, near Pittsburgh, linked Jacobsen brushes to a Toro mower to increase the effective width for faster brushing of his putting greens. At Elm Ridge, Toronto, Superintendent Bowdin devised a hydraulic lifter to remove large stones buried in construction of his course.

Hydraulics remind us of water and irrigation practices. Charlie Danne of Nashville's Richland Country Club solved many of his bentgrass problems by merely raising the water pressure. In Dallas, Johnny Henry had a green at Brook Hollow that could not be adequately irrigated due to prevailing winds. He solved the problem by installing a few pop-up heads in the collar that could be activated by a single valve. When drying winds are strong, these sprinklers syringe the entire green. In Denver, Jim Haines had a tree problem. Pool construction required elevation of the surface so the tree was left in a well. Root cutting, etc., caused the tree to wilt, so Jim put a sprinkler in the treetop to syringe it on hot, dry days.

The weed problem today should be of no real consequence. Of the many problem weeds of 30 years ago, only two remain not easily controlled - Poa annua and nutgrass. These should be satisfactorily controlled in the foreseeable future. With the many herbicides now being sold, the days of haphazard application are over. New chemicals have a narrow range of "Safety and Success". Too little gives poor results; too much gives grass damage. More labor education is required, not only in the handling of chemicals, but in the handling of machinery as well.

By streamlining the basic operations and educating labor under your supervision, it will be possible to provide economical golfing facilities for all classes of players. It will also enable you to provide a "Welcome" sign to all, whether spelled out in flowers, or in a broad expanse of healthy, uniform, well-kept turfgrass.

- - -

NITROGEN STUDIES ON PLANT TISSUE

James B. Beard, National Science Fellow,
Dept. of Agronomy, Purdue University.

When I came to Purdue in 1957 one of the professors asked me if I wanted to do basic, or applied research. I said that basic research was important, but that I preferred an applied problem. Thus, it was that I undertook to study the problem of root dieback on bentgrass putting greens in mid-summer.

Initially in the summer of 1957, we attempted to stimulate, or maintain root growth by applications of various compounds, such as glucose, sucrose, vitamin B_1, amino acids and other types of growth regulators. These investigations were not encouraging since we could not obtain consistent results.

Our next step was to investigate the environmental factors causing this root dieback. The literature contains much confusion on just what factor, or factors were causing this root dieback. Our studies indicated high temperature to be the main factor, which consistently caused a reduction in root growth. Studies showed that as temperature was increased from 50 to 80°, root growth decreased accordingly, with an almost complete stoppage of bentgrass root growth at 90°F. This does not mean other factors might not cause root dieback, but that temperature is the one that most consistently caused the dieback. Related investigations showed the maximum top-growth to occur at 70°F. As temperature was increased or decreased from this point, topgrowth decreased.

Fructose is the major storage carbohydrate in grasses. The relative fructose levels in the plant give a measure of how well the plant can survive adverse situations. Studies showed fructose levels to be lowest at 70°, and increased either above, or below 70°. When growth was highest, the largest amount of fructose was being utilized. An important point to note is that there was sufficient fructose present at the higher temperatures. Thus, the biochemical reactions, such as photosynthesis involved in the production of fructose, were not limiting root growth.

The environmental studies have showed temperature to be a key environmental factor limiting bentgrass root growth. But, just knowing the limiting factor is only one of the steps involved in solving this bentgrass root dieback problem. Next, we must look at the ways in which we can alter this temperature effect. One possibility is artificial cooling, by means of refrigeration, but this is not yet economical.

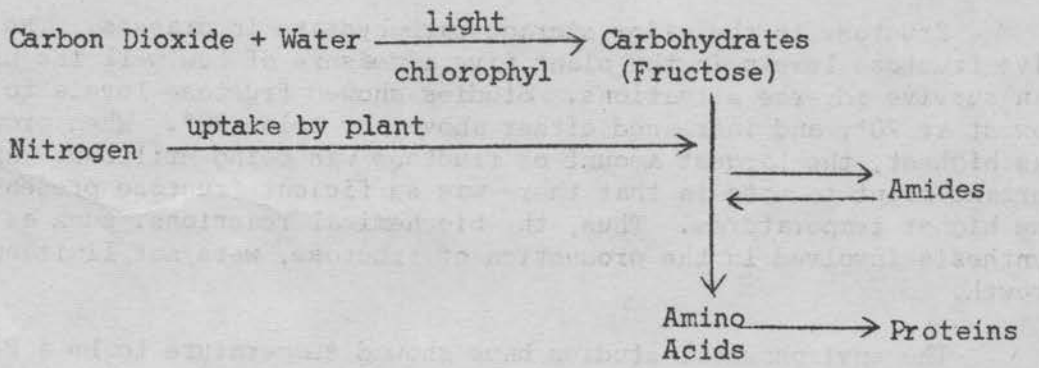
A second cooling method is light applications of water at mid-day, a very common practice. Third, by proper sloping and facing putting surfaces and proper placement of surrounding vegetation, we can effect increasing wind movement and stimulate evaporation and transportation; thus, cooling the vegetative surface. These methods cannot possibly provide maximum cooling during excessively hot periods. Therefore, an alternate method of breeding for heat tolerant species would be desirable in avoiding the temperature effect. It is a long, expensive process to conduct any breeding and selection program. Thousand of species must be observed under field conditions for several years. However, if a biochemical marker

could be developed, we could analyze the plant tissue in the lab, in a matter of days, for certain compounds which would predict heat tolerance of that plant.

The initial approach to this problem was to compare the kinds and quantities of various biochemical compounds contained in both warm and cool season grasses. The cool season grass, bentgrass, and the warm season grass, bermudagrass, were grown under controlled climate conditions at 50°, 60°, 70°, and 80° F., with a constant sixteen hour daylength. The leaf tissue harvested from these grasses was analyzed by paper chromotography techniques, which permits minute amounts of plant compounds to be separated out. Using this technique, comparisons were made of four major groups of compounds: the carbohydrates, the phenols, the organic acids and the organic nitrogen containing compounds, such as amino acids and amides.

Results from this work indicated the warm and cool season grasses varied greatly in the amino acids, amides, and phenol groups. By further qualitative analysis, the individual compounds were identified. The nitrogen containing compounds were selected for further study, since they were of more immediate importance to the turf user.

Before discussing these nitrogen compounds, we should first review the role, or biochemical function of nitrogen in the plant. All living tissue is composed of protoplasm. Proteins are one of the key constituents in protoplasm. Proteins are formed by a series of complicated reactions. To state it simply, nitrogen is combined with carbohydrates to form a protein.



Carbohydrates are formed by combining carbon dioxide with water in the presence of light by the means of phytosynthesis reaction. Carbohydrate molecules can then be combined with nitrogen to form amino acid. Several amino acids combine to produce a protein. The fraction which will be discussed in this research is the amide. The amides are formed by combining one carbohydrate with two nitrogens.

1 Carbohydrate + 1 nitrogen ⟶ amino acid

1 Carbohydrate + 2 nitrogens ⟶ amide

The role of the amides are to store readily available organic nitrogen reserves in the plant. Thus, an amide can supply nitrogens for protein formation at any needed time. The two main amides that we will be concerned with are glutamine and asparagine.

In the following data amide determinations were obtained from controlled climate chamber studies at four temperatures. Quantitative chemical analysis of the bentgrass tissue harvested from the controlled climate chamber showed that the total free ammonia and glutamine levels do not vary significantly. However, the asparagine level was found to be highest at 50° and decreased as the temperature was raised. In bermudagrass the total free ammonia and glutamine levels also remained fairly constant, but the asparagine was highest at 80° and decreased as temperature was lowered.

For bentgrass the non-protein nitrogen level was lowest at 70°, and increased as temperature was raised or lowered. For bermuda the non-protein nitrogen level increased with temperature. This simply indicates that maximum growth utilizes more nitrogen, thus decreasing the level of the non-protein nitrogen.

The second portion of this study was to compare the amide levels of various turfgrass species.

Species	Percent Glutamine	Percent Asparagine	Percent of Total Amide
Bermudagrass (U-3)	3.4	1.2	4.6
Tall fescue	3.5	2.0	5.5
Bentgrass (C-52)	3.5	2.3	5.8
Merion Ky. Bluegrass	6.0	1.5	7.5
Perennial ryegrass	6.1	3.3	9.4
Chewings fescue	5.2	5.8	11.0

Of the six grasses reported, bermuda has the lowest amide level, and red fescue the highest. It should also be observed that the lower the amide level the higher the total annual nitrogen requirement of the plant. There is also a direct relationship with heat tolerance. This relationship must be studied further before any conclusions can be drawn.

A third study involved investigations concerning the seasonal variations in amide levels in bentgrass under natural putting green conditions. Leaf harvests were taken at semi-weekly intervals throughout the entire growing season. Preliminary results show the amide level to be highest during the cooler growing periods and that the amide levels were low under the stress conditions of the hot summer period. However, the free non-organic nitrogen level of the plant was highest during this hot period. This indicates that the plant could absorb sufficient nitrogen, but could not incorporate it into the organic compounds in the plant.

This is a progress report. To date these investigations have more closely defined the point at which temperature is inhibiting the plant biochemical processes. Also, these studies more clearly define the available levels of the organic nitrogen fraction within the plant, and how these levels vary throughout the season. Thus, it will enable the turf user to know more about the actual nitrogen needs and availability within the plant itself.

At the beginning I stated that my interest was in the more applied types of research, but in attempting to find the answers to the practical problems, I was led deeper and deeper into the basic type studies to obtain the how and why answers to a practical problem.

- - -

NITROGEN LOSSES

Mel Hansen, Graduate Student,
Dept. of Agronomy, Purdue University.

Scientists throughout the country have sufficient information to indicate that nitrogen is lost not only through leaching, nicro-organism activity and plant use, but also to some extent through loss to the atmosphere. This gaseous loss, or volatilization of molecular and nitrous oxides, is gaining importance. Nitrogen in a gaseous form is lost from the soil as:

1. Ammonia under alkaline conditions.
2. Elemental nitrogen relased through the activities of dinitrifying soil micro-organisms.
3. Elemental nitrogen resulting from the Van Slyke reaction between nitrous acid and the amino acids, or ammonia, and
4. Nitrogen oxides produced by chemical, or biological reactions of the soil.

The mechanisms of ammonia volatilization is

$$NH_4 \quad + \longrightarrow H_2O \quad + \quad NH_3$$

When ammonium forms of N fertilizer are applied to the soil, the ammonia adsorbs at or near the surface of the soil, and an equilitrium exists between the adsorbed ammonia and the ammonia in the soil solution. The ratio of ammonia loss to water loss remains essentially constant until the soils become dry, or the ammonium on the soil complex is less able to dissolve. Under conditions of equilibrium, ammonia losses cease as water losses cease.

Several soil factors must be considered in the loss of gaseous nitrogen:

1. EXCHANGE CAPACITY. This is the ability of the soil particles to hold cations. Ammonia loss increases rapidly with increasing amounts of ammonia applied, since the percentage of added ammonium held by the cation exchange complex diminishes rapidly as the amount of ammonia increases. Soils which have a very high base exchange are capable of storing more nitrogen.

2. SOIL TEXTURE. It is reported that when applied to the surface of a sandy soil, ammonium nitrogen loses about 20% of ammonia in the gaseous form, while that applied to a sandy loam loses only 10%. In humid regions the ammonia may react directly with the soil organic matter to form organic nitrogen compounds which are not exchangeable. The highest amounts of nitrogen are fixed by acid soils high in organic matter.

3. SOIL MOISTURE. Loss of ammonia occurs only when there is a loss of moisture. Ammonia volatilization and initial moisture appear to be closely related. The application of Urea upon a slowly drying saturated soil will cause some volatilization of nitrogen.

4. SOIL pH. When NH_4-ions are adsorbed on the soil, then Ca ions are displaced, leached, so a lowering of the pH will occur. In addition to the ammonium compounds, Urea and some of the organics may lower soil acidity.

5. SOIL TEMPERATURE. An increase in temperature, e.g., from 10°C to 20°C will cause a greater breakdown of Urea. Ammonium N, in general, is affected by the equilibrium of ammonium between the soil comples and the solution.

At present nearly all work with the loss of gaseous ammonia has been under field conditions. Most of the lab results have been conducted under strictly controlled conditions. Since turf is a major area of fertilizer use, particularly in N, the problem of volatilization must be investigated. How serious a problem it is on turf areas, putting greens, and lawns is certainly not known.

Some of the questions that we hope to investigate are:

1. What form of nitrogen really is lost? Is it ammonia (NH_3), nitrate (NO_3), nitrite (NO_2), or elemental N?
2. When will volatilization occur after a given fertilizer has been applied?
3. Under different moisture regimes what might we expect:
   15 minutes after a rain?
   one hour after a rain?
   after a night free of dew?
   after a night in which heavy dew formed?
4. To what extent will Urea be lost under dry conditions in the Midwest?
5. Will significant losses of ammonia occur on a highly maintained golf green? What might we expect on an open fairway?

With this type of study, the majority of research will be conducted under natural conditions. However, greenhouse facilities will be utilized as needed.

\- \- \-

BASICS ABOUT FERTILIZATION

A. J. Ohlrogge, Dept. of Agronomy,
Purdue University, Lafayette, Indiana

The planet earth is about 3 billion years old. Traces of life have been found to exist during two-thirds of this period. Early life was in the sea. Here all the nutrients had maximum mobility. The nutrients could move to the plant and animal life, and they in turn could move to the nutrients. About 1 billion years ago life appeared on the land. From that time to the present many different animal and plant life types have appeared and disappeared on this planet.

Modern types of plants have been in existence for about 100 million years. During all this period one thing has been constant, that is, the heterogeneity of the land in contrast to the homogeneity of the water.

This is true because, for the most part, atomic structures and properties have not changed during geologic time.

All except three of the nutrients required by plants are immobile in the soil. Plant roots have to grow to these ions which are held by the clay and organic matter of the soil. Only the sulfates, chlorides, and nitrates are mobile and move to the roots. Since this has been a constant, it is not strange that modern plants have attributes which reflect the environment under which they developed.

All roots have the capacity to develop preferentially in localized areas that are particularly favorable for them. Nitrogen and phosphorus are unusually effective in causing root proliferation when placed together. They must be placed together for maximum absorption, and through root proliferation the local absorption system for nutrients is increased.

The rate of uptake of nutrients by a plant is determined by the size of the nutrient uptake area (roots), the concentration of the nutrients in the soil solution in contact with these surfaces, and the nutrient status of the plant. Root proliferation increases the area factor. Fertilization first increases the concentration factor.

Individual roots have a tremendous capacity to tolerate high salt concentrations if the remainder of the root system is in a normal soil. The mechanism involved is not understood. Individual roots also have an amazing conductive capacity. Corn and soybean plants have been grown to maturity when only one root supplied nitrogen and phosphorus. This is a reflection of the impact of nutrient immobility on the evolutionary development of plants. Band fertilization methods capitalize on this attribute to plants.

Plants take up nutrients during the entire growing season. Fertilizers are added to supplement the soil supply. Most fertilizers have their maximum availability at the time of application. Availability decreases rapidly after application even though the plant needs may be increasing. This poor matching of plant need and fertilizer availability has been under intensive study. The turf manager is aware of the advances made with nitrogen. Much greater advances are forecast for the future. In addition to selective coating of varying solubility, specific inhibitors of certain steps in the nitrification process would seem possible.

Coatings of phosphate and potassium fertilizers to give tailored release of nutrients are in the picture. Such coatings may not only vary in solubilities, but might also be temperature sensitive. Opportunities for increasing the efficiency of fertilization would seem to exist in this area.

Soil tests are extremely useful in diagnosing the fertility picture. Such information is only a part of the complement of knowledge which is used in fertilization decisions. The final test is, "How well is the plant nourished?" Plant performance and plant tissue tests provide the answers.

- - -

FERTILIZING FOR GROWTH CONTROL

William W. Milne, Country Club of Detroit,
Grosse Pointe Farms, Michigan

Recognizing the difference in soil, weather and irrigation practices throughout the country, the intention of this article is to point out some of the basic factors that should be kept in mind when the use of fertilizer is being planned for growth control in turf production. Turf needs sunlight, warmth, air and water.

Water acts as a solvent of nutrients; a regulator of plant temperatures and cell turgor, and as a source of hydrogen.

Air supplies the plant and its roots with carbon dioxide and oxygen.

Soils act as a reservoir, or bank, for storing nutrients for plants to absorb through the root system.

There are fifteen known nutrient elements required at all times, some in small quantities for plant growth. Of the fifteen known elements, three of the elements, NPK, are best known to us as tools for turfgrass production.

Nitrogenis used as the main regulator for growth and chlorophyll production. When excessive amounts of nitrogen become available, plants become soft and tender and more susceptible to disease and insects. Nitrates tend to leach from soils.

Phosphorus helps plants in the process of storing energy captured from the sun by photosynthæs, and also in the complex movement of energy to all parts of the plant, plus development of root growth. It tends to accumulate in the soils in available form through repeated applications over a period of years.

Potassium aids in the transportation of carbohydrates through the plant promoting a sturdier plant -- enabling it to resist disease and better withstand drouth. It seems to be the worst offender for leaching through the soil, especially where heavy rainfall exists, or irrigation practices are used. It is also removed when grass clippings are removed.

Irrigation practices have a direct bearing to the efficient use of the above mentioned nutrients from the standpoint that through artificial irrigation, over-watering can fill up the air pores in the soil, causing a tie-up of iron known as iron chlorosis, which actually creates an unbalance of nutrient functions. Leaching also becomes a problem from the standpoint of having to use more fertilizers per growing season in order to maintain available nutrient levels in the soil for plant growth.

The original intent of fertilizer nutrients was to supplement the native soil and to make up for shortages of nutrients existing in the soil. The different types of turfgrass areas and the height of cut required determines the amount of nutrients required. Whether grass clippings are picked up, or left on the sod, is also a determining factor.

Growth control can be regulated by using lighter applications of

available fertilizers at one time, more often during the growing season which in turn will reduce -

1. The number of times turf needs mowing.
2. Excess grass clippings
3. Thatch buildup
4. Waste through leaching, and to a certain extent
5. Disease and insect invasion

The goal for obtaining a healthy, dense turf, whether it be for playing golf or other athletic sports, can best be obtained when the basic fundamentals are observed. There is a wide choice in products to achieve uniform, dense growth, and we can expect further change during the sixties.

\- - -

A TURF FERTILIZER AND CARE PROGRAM
(Pinripally for the homeowner)

Bob Kelley, Portage Oil Corp.,
South Bend, Indiana

Why is an Oil Company in the business of offering services helpful in growing good turf? When our Company started spraying liquid fertilizer in the late spring of 1954, it was with the idea of taking up summer slack, thus keeping our men and available equipment, as well as our office and sales personnel, busy from May through September. 1961 will be our eighth season, and during that time we have served hundreds of customers. Last year we covered approximately 10,000,000 sq.ft. of lawn area. We feel that we have accomplished our original purpose. (Who expects to make a profit - many of you have seen this sign - "This is a non-profit making organization - purely unintentional.")

Now, when this idea of a lawn service program was accepted, problems arose. The first one was learning how to grow and maintain good turf. The second was putting that knowledge into practice. Both of these become real tasks - you know from practical experience. (Makes me think of a man who tries to go up on an escalator that is traveling down - seems as though the more we have learned, the more we find that remains to be learned).

Most of our knowledge about growing grass has been gained through our personnel attending the Midwest Regional Turf Conference every year since 1956, plus attending some of the Purdue Field Days. Also by attending local area meetings sponsored by our County Agent. Of course, we cannot overlook the knowledge gained by practical experience (the trial and error method).

Our lawn service is used mainly by homeowners; to a limited extent by commercial and business firms. It consists of:

1. Aeration
2. Liquid fertilizer

3. Broadleaf weedkiller
4. Crabgrass control
5. Soil insect control
6. Fertilizer + 2,4-D
7. Fertilizer + Chlordane

We don't do any - seeding, cutting of grass, nor watering. Neither have we gone into the spraying of fungicides. (Reminds me of the doctor who made the statemtn - "I decided to become a skin disease specialist because no one dies from a skin disease and nearly everyone has some type of skin disease." There is probably a need for a fungicide spraying service. However, to date we have avoided it. When we sell our services we do so with an earnest intent of helping to grow better turf. We go to the lawn, observe it and make recommendations. Not always are all our recommendations involving our services. We will discuss seeding, watering, cutting. We painstakingly suggest procedure and methods to our customers, and leave cards of information, only to have him proceed in his own manner - then when he has problems we hear from him. (At this point I would like to let the manufacturers know that they aren't the only ones confronted with the problem of getting the customer to read the label.) When our salesman makes a call, he makes short notes of recommendations and conditions for future reference should a question come up.

Aeration - Our greatest aid in selling aeration has been television. Most people do not know its purpose, etc. Hand aeration used in some cases.

Liquid Fertilizer - Water soluble 25-10-20 analysis + 46% of crystal urea + chelated iron + a wetting agent -- use 25 gallons of water and fertilizer mixture per 1,000 sq.ft. We use a 1,600 gallon tank truck which has been thoroughly cleaned - 3/4" hose, pump with nylon bearings. Mixture is constantly agitated by air supplied by a 5 nozzle boom in tank floor. We recommend 5 applications per growing season. Our present fertilizer formula has given good results.

Broadleaf Weedkiller - 2 ozs. per 1,000 sq.ft. in 5 gallons of water. Applied with "Spraymobile" which shields spray and avoids drift of spray. We use 2 oz./1,000 sq.ft. in 5 gallons water of amine form 2,4-D. Results are very good.

Crabgrass Control - DSMA. 6 - 8 oz. depending on temperature. Repeat 5 to 7 days. More interest in crabgrass control than most of the other services. Start spraying before seedheads appear, approximately the first week of July. Applied with Spraymobile - usually add 2,4-D with first application to clean up broadleafs.

Soil Insect Control - 73% Chlordane, 12 oz. per 1,000 sq.ft. for white grubs, Jap grubs, ants.

Fertilizer + 2,4-D - Applied with "Spraymobile" - same formula.

Fertilizer + Chlordane - same formula as above.

We found billboard-type signs on our truck to be excellent advertising.

\- \- \-

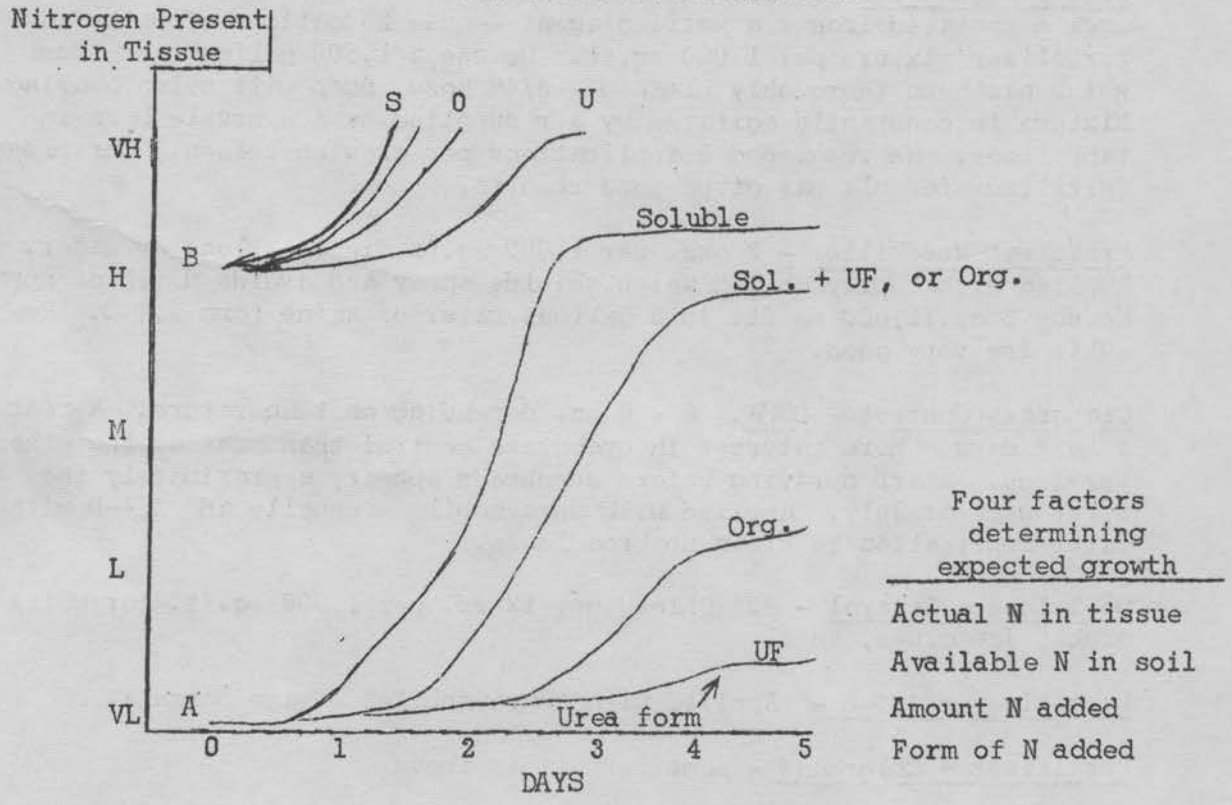
AIDS IN UNDERSTANDING NITROGEN NUTRITION

W. H. Daniel, Purdue University

Much has been said before turf groups about nitrogen availability. Plants need a day to day supply of adequate available nitrogen to maintain growth. There are several ways to consider plant response to nutrition. One of these can be from the initial response of the plant to the applied nitrogen. As shown in the chart below, if the nitrogen in the tissue is very low, it takes a much higher application of available nitrogen to "kick" the plant into active, vigorous growth. If the soil is also deficient in nitrogen, even average rates of available materials may not give the anticipated response. If the tissue is deficient, the soil is deficient and the soil is cold, then the response to a spring fertilization may be particularly disappointing. Therefore, one of the first decisions in planning a fertility program is to have some understanding of the nitrogen available in the tissue, for this determines the amount of available nitrogen immediately needed to procure growth in spite of cool soils, cool air temperatures, or other limitations. However, for such conditions, soluble available nitrogen forms are preferred. Conversely, tissue with adequate nitrogen may respond, even to light applications under similar limitations.

EXPECTED GROWTH RESPONSE

Low Rates N Fertilization



Applying nitrogen to turf can be compared to feeding people. Someone going out to lunch could be compared to foliar feeding. It may not last long, does serve the purpose, may give the plant ample nutrition for a short time. Generally it is expensive in time and sometimes in material.

In our homes many of us have kitchens, with a refrigerator, bins and shelves for storage. By securing a variety of groceries at the stores, we can replenish the kitchen supply to normal, and the food will be stored until later needed Our kitchens can be compared to applying soluble nutrients to the soil, which are dispersed around the clay, organic and silt fractions, and can be held in reserve until needed or utilized by the plant. Kitchens vary in their storage capacity, and so do soils. Sands needing many more trips "to the grocery store" than would clay soils. Sands are so-called "efficiency kitchens" with little storage. Generally "kitchen home-cooking" (fertilizing) is economical, but takes planning.

Many homes now also have, besides their good kitchens, excellent cold storage, or deep freeze units. One would not place poor foods in the deep freeze, then pay for the wrapping-freezing costs. I am pleased with the performance of the ureaforms, which, to me, are of this "deep freeze" type availability. They can be stored, until decomposed, on the site for slower, longer-term release.

When one combines the kitchen and the deep freeze we have mighty good food. Using combined materials it is possible for turf to get adequate, uniform feeding with two applications per year. However, once a year applications will not give as uniform a response, nor the percentage recovery, or response.

Residual Nitrogen

We have made residual studies based on greenhouse, putting green and field plot experiments of the ureaforms. These have been quite encouraging. For example, when we applied on Merion bluegrass from 4 to 20 lbs. N. per 1,000 sq.ft. per season for three years then stopped, we had definite longer residual from the ureaforms than from organics, or accumulated urea. However, this residual is not of a lush, fast-growing nature. On turf areas that have been maintained for three years or more, the residual from UF was evident throughout the following season (1960). We expect to see some further residual in 1961. However, the general home lawn manager would expect to continue to use once or twice a year applications to maintain the lushness desired.

We are continuing several of the residual experiments, using both mixed fertilizers and nitrogen sources. Also, we have one additional type of nitrogen material from the Monsanto Chemical Company under current test.

There has been tremendous progress made in formulation, as well as in making granular, easy-handling products. The organics perform very well in the summer and fall periods after soil temperatures are high enough for bacterial decomposition. In fact, in cool weather organics can be used as refrigerator-type storage of nutrients.

Often the available nitrogen existing in the soil solution may be rather quickly leached, or partially volatilized if it is not used by the plant. Turf managers see nitrogen deficiency after rains. Nitrogen attached to the soil colloids will be less rapidly leached, while nitrogen stored as decomposing organic matter, or slow breaking down particles, may serve even longer as a release source. Many rates have been proposed for providing ample nutrition.

Before starting your 1961 program, determine whether your main reliance is on "lunch," "kitchen," or "deep freeze" feeding. Then, under-

standing whether tissue nitrogen level is low or high, you can wisely plan to initiate and maintain growth throughout a season.

\- - -

SUMMARY OF CRABGRASS PREVENTION

W. H. Daniel, Purdue University

The desire to control crabgrass has created a tremendous market for products. Research and industry have provided several products for this purpose. Three things should be expected of every product:

1. PERFORMANCE - adequate rate, selective, effective, 100% control.
2. CONVENIENCE - non-burning, well-labeled, easy-spreading.
3. ECONOMY - the least of these three values

For many people who have not used crabgrass killers, 1961 should be a trial year when they will use one or more packages as a test demonstration. For example, half of a lawn, or one side of the lawn may be treated. Certainly for most established grasses, no damage is expected, and good control should be secured. Without crabgrass competition, it should be much easier to grow desired grasses. But conversely, crabgrass won't be present to cover up summertime weaknesses.

There is a sequence of germination of plants in bare areas. Knotweed usually germinates by April 1 (March 6, 1961). Crabgrass usually germinates by May 1. Goosegrass germinates approximately May 15. Broadleaf weeds germinate in summertime. Poa annua may germinate in early spring, however, most of it germinates in early fall. Therefore, one problem in preventing crabgrass is the potential of having goosegrass infestation, particularly on golf courses and athletic areas.

On golf greens for 1961 suggestions were made for experimental testing up to one-half of each green with the diphenatrile, or the calcium propyl arsonates. Users were cautioned not to treat entire greens, so that should unexpected adversity occur, they would have some undamaged turf ready for use. To the contrary, if the weedy grasses are prevented on the treated half, this will give place for the cup to be placed during premium times. Midwest leaflet No. 11, Crabgrass Control, available from W. H. Daniel, Department of Agronomy, Purdue University, Lafayette, Indiana, was passed out to all those attending. Additional copies are available on an individual basis. Bulk orders are available at 3¢ each.

\- - -

LET'S LOOK AT TURFGRASS

O. J. Noer, Agronomist (Retired)
Milwaukee, Wisconsin

The assigned topic "Let's Look at Turfgrass" is broad in scope, the only limitation being that those present are interested in golf turf. The discussion today will be limited to personal experiences in the solution of turfgrass problems.

The Superintendent is handicapped by some things that may affect grass adversely, but may make the course more pleasant to play. Height of cut is the biggest bone of contention. The ardent golfer likes a tight lie on fairways, and a true billard-like surface on greens. The touring professional may seem unreasonable at times, but his monetary reward for winning is apt to be large. Club members are apt to be critical where dues are high. Our task is to do the things that make the game pleasant to play. A negative adamant attitude accomplishes nothing. It only creates resentment. The golfer will modify his demand when he understands why, especially if he realizes that every effort is being made to provide the best possible course under existing conditions.

Climate and weather have profound effects upon grass. Climate determines the grass to use. Nobody would suggest bermuda, or any other warm season grass for Alaska. Likewise, a cool season grass would be a bad choice for all-season use in New Orleans. The big question is in the twilight, or transition zone. Bentgrass greens have moved farther south, but seem to have reached a stationary front for the time being. Bermudagrass fairways are finding favor in the belt from Washington and Philadelphia across to Kansas City. So far U-3 performance has been good. There is no point in extending bermudagrass use farther north, because cool season grasses do exceptionally well.

Climate and weather are related phenomenon. Climate is the summation of the average, day-to-day weather at a given place, over a span of years. Variations from the average can make the season bad or good. For example, 1959 was a bad year, and 1960 was a good one for grass. When weather is bad, the right grass, good soil from a physical and chemical standpoint, excellent drainage, including surface, sub-soil, along with good air movement, together with a sound maintenance program may be the difference between success and disaster. Those who depreciate these things think and speak only in terms of good weather.

Meterologists speak of cyclic changes in climate. They cite the dust bowl as a good example. During those dry years buffalograss was the popular lawngrass in Lincoln, Nebraska. When annual rainfall increased, there was a pronounced swing to more attractive Kentucky bluegrass. Winters have been moderate since the change to U-3 bermudagrass fairways. Let's hope they stay that way because two or three severe bad ones in succession might be disastrous for bermuda. To refute that, there is a very good bermudagrass approach at a St. Louis club. It was planted vegetatively many years ago by Bob Foulis.

When grass behaves badly, some people think a soil test will provide the answer. Such tests may be desirable and furnish useful information, but soil tests are no better than the samples, nor the testing method

used. For example, a Canadian club was advised to use 16 tons of superphosphate on fairways two years in succession. The proposals both years were based on soil tests The second recommendation seemed strange, so 2 inch depth plug samples were taken and tested by the Truog method. Soil phosphorus levels were high. The story would have been the same with the Purdue method. As a further check, phosphate was applied in strips across several fairways. There was no difference in grass growth or turf behavior. As a result the second application was not made.

Lime and fertilizer are never fully effective until other major factors affecting grass growth are favorable. Then they, along with moisture, are the things that produce a dense sward of grass.

Usually the answer to the problem can be found on the property. Inspection of grass comes first. Is it the right kind, and is it being cut at the right height? Then comes the physical aspects of the soil. This is especially important on greens and tees, and should include such things as soil layering and thatch. It is not feasible to modify fairway soil by additions of sand, or soil. Aerification may be desirable on heavy soil, and when the turf is matted.

Fairway irrigation may be needed on sandy, or drouthy soils. Darinage is important also, including surface, sub-soil and air drainage. Seepage is a frequently unsuspected culprit on many side hill slopes. It can be the cause of poor green and fairway turf. Damage occurs during fall and spring when soil is saturated with water. To control seepage, tile lines must cross the line of water flow, and trenches must be filled with aggregate to trap water and lead it down to the tile.

Protection of turf from every kind of injury is very important. This is a negative growth factor. Damage may be from traffic, or mechanical wear caused by power equipment. Other types come from fungus diseases, insects, rodents and tree root competition. Sometime disease is the primary cause of bad turf. At other times disease may be secondary to something else. Then, one may overlook the real culprit. For example, leafspot may be blamed when grass falls prey to it because leaf structures had been weakened by iron chlorosis. Had ferrous sulfate been applied promptly at the first sign of the characteristic yellow color, leafspot damage would have been averted. The important thing is to make a correct diagnosis and blame leafspot when it is the primary cause of injury, and not when it is secondary to something else.

The importance of correct diagnosis is illustrated by two Florida clubs. Winter grass was poor both places. One used ryegrass and the other over-seeded with a blue-bentgrass combination, along with a little Poa trivialis. The club with rye blamed it, and the other wished they had seeded with rye. Both lost grass because they had not recognized iron chlorosis and stopped it promptly. Basically that was their problem and not wrong choice of grass. Actually, ryegrass is not considered best for use with fine-textured bermudagrasses.

The necessity for controlling tree roots in greens and tees is no longer questioned. Bad turf performance on some tree-lined fairways has been due to the same thing. Tree root pruning along each side of such fairways has given vastly better turf.

Weedkillers of the so-called selective variety are useful tools

when properly used. Otherwise, they can cause serious and insiduous damage. Good management is just as, and sometimes more important, because a healthy,dense turf resists weed invasion. Herbicides are only worthwhile when they are a part of an improved maintenance program.

The following article appeared in a recent issue of a Milwaukee newspaper. "Ready for use this spring is a new and deadlier weapon against crabgrass and other weed-grasses that spoil your lawn. It is so light in weight that a package big enough to treat 2,500 sq.ft. weighs only 10 lbs. Although it kills crabgrass, goosegrass, foxtail and barnyard grasses in the seedling stage, it does not harm desirable grasses, flowers, shrubs, or ground cover plants. Many tests ____ show that a single early-spring application gives 100% control of crabgrass all season long, under average conditions. Yearly applications are needed only because weed-grass seeds from many previous seasons may lie dormant in the soil for years before germinating."

Most agronomists agree that pre-emergence weed killers have their biggest usefulness in a fair to good stand of grass. In places where ground cover is crabgrass only, turf development comes first, and only then should the use of this type herbicide be considered.

The power driven golf cart presents new problems in turf culture. In some constricted areas cart paths may be the only answer. In some parts of the rough fertilization and irrigation may be necessary to enable turf to withstand severe wear. The same is true of fairways. In any event, revenue from carts is not going to be all gravy. A large part will be needed to grow more grass and repair damage. If for no other reason, carts will be under club control with revenue to them.

Although the impossible of today becomes the commonplace of tomorrow, it is no reason for the wholesale adoption of any radical new innovation, especially if currently used methods are providing satisfactory turf. The better way is to test new proposals in a limited way, and let them prove themselves. Progress is evolutionary, and not revolutionary.

\- \- \-

POTENTIALS WITH GROWTH CONTROL WITH CHEMICALS ON COOL SEASON FAIRWAY GRASSES

W. H. Daniel, Purdue University

We know so little about growth control, but it offers tremendous value for the future. Much we do - fertilizing, cutting, raking, topdressing, watering - actually is growth control. Actually, turf managers have an intense future interest in chemical growth control. Therefore, it is mentioned in this "Seminar on Fairways."

Let's take Poa annua in fairways, as an example. If we could get 80% seedhead reduction and 60% growth reduction, this could reduce mowing frequency and clipping accumulation, and permit more bluegrass and bentgrass survival.

Perhaps on bluegrass, just preventing the stubly character of seedhead booting would provide better turf, particularly on sod nurseries. Whatever chemical is to be used, a counter-actant, or antidote, should be available before wide acceptance.

In 1961 the use of Maleic Hydrazide, as MH-30, is to be tested at 0.5, .75, and 1.25 lbs. actual per acre on Poa annua infested areas. Remember earlier some tried to use MH as a complete substitute for the mower, which, for turf areas, is not necessary. A partial selective job on fairways should be feasible.

Other products, including CCC, will be tested. The CCC shortens inter-nodes only. Some turf managers have used sodium arsenite sprays wisely at .5 to 1.0 lbs. actual/acre, to reduce seedhead problems. Some may wish to try Endothal.

Meanwhile, vertical-thinning serves special cases and offers added manicuring beyond mowing. In the future turf managers must look ahead to more than mechanical maintenance alone.

\- - -

OUR TURF AND LANDSCAPE PROGRAM

Robert M. Duke, Western Electric Co.,
Indianapolis, Indiana

The Shadeland Works of the Western Electric Company is located on the east side of Indianapolis. One of many Western Electric manufacturing locations, we make all the telephones for the Bell System. As with most industrial firms, Western is vitally interested in being a responsible member of the community. As such, it endeavors to maintain good community relations, and equally as important, promote good employee relationships. We believe that one step in this direction is an attractive, well-maintained plant.

During the growing season, mowing is one of our biggest items. Exactly 10% of our total labor was expended in mowing last year. Most of our areas are small and are filled with trees, evergreens and shrub beds. We depend, for the most part, on the self-propelled gang-mower due to its maneuverability. Our grass plots are flat and have practically no drainage. During rainy periods we find it necessary to hold up our mowing schedule to avoid seriously rutting and compacting the turf.

With much turf growing along building walls, a small rotary trimmer is a rapid method of mowing grass next to the building. Our rough areas in the rear of the property are mowed with a hammerknife, or rotary mower, operating off of a tractor PTO. Again due to the size of our grass plots, we use the broadcast-type of spreader almost exclusively. With the three point hitch on our tractor, we can load quickly and operate in cramped quarters.

Our fertilizer program is based on the results of soil analysis made

by Purdue and on the recommendation of Dr. Daniel and others. Our program initially used balanced fertilizers. As time went on, the phosphorus and potash levels increased to what seemed to be excessive amounts. As a result, in 1957 we applied Ureaform at the rate of 10 lbs. per 1,000 sq.ft. in a single application. In 1958 we used Ureaform again at the rate of 15 lbs. per 1,000 broken up into two applications. Our phosphorous and potash levels had decreased by this time, and in 1959 we applied 10-3-7 early, UF in the summer, and finished with Urea as required to maintain good color, putting on a total of about 4.5 lbs. nitrogen per 1,000 sq.ft. In 1960 about the same amount of nitrogen was applied, with a spring and fall application of 10-3-7, and a summer feeding with Ureaform. This year we find that our phosphorous level is again high, and we will use only Ureaform for the nitrogen supply, with muriate of potash where required.

Our shrubs and trees are fertilized once annually, normally in April. A balanced fertilizer with an acid base is broadcasted around shrubs and evergreens. We drill holes for our tree fertilization, using a portable generator and drill with two inch auger. Our soils are very badly compacted, and we have been able to use the Aero-Fertil process on our shade trees about every three years. This consists of drilling a series of concentric holes in and beyond the rootzone area of the tree, using the generator-drill combination. A special gun, using compressed air, and with tapered barrel, forces air through the sub-surface area. When moisture conditions are correct, the soil is fractured, fissured and pulverized. The gun is valved, and after the first air is shot into the hole, fertilizer, sand and other materials can be forced through this same area below the surface. Fertilizer distribution is very good. The use of coarse sand, and in our case calcined clay aggregates, will hold the fractures and fissures open, permitting roots to move out more rapidly and helping to overcome the problems connected with a tight impervious soil.

We use a tractor drawn sprayer with an 18 ft. boom for herbicides and fungicides. Crabgrass isn't too much of a problem with us, and we use only post-emergent sprays when necessary. We haven't used pre-emergent chemical crabgrass controls.

Thatch Removal

After ten years of maintenance, the buildup of mat and thatch has become a problem. It appeared that we were having more and more difficulty in getting water, nutrition and air through the layer of organic material on the top surface. This buildup continued inspite of regular aerification and maintaining a rather high pH. After talking about it for some time, and with the blessings of management, we began a major program of thatch removal last fall.

The tool we used was an F-6 Mott Hammerknife mower, equipped with straight knives. Some areas were aerified twice as the first step, but the majority of the turf received no aerifying. The Mott normally carries 92 knives. All but 19 of these were removed in the first operation, which left a knife spacing of approximately 3-1/2 inches apart on the reel. Our depth setting was 1/2 inch below the bottom of the thatch. This slitting brought a lot of material to the surface, as well as some soil. The residue was removed. The next operation saw the Mott equipped with 92 renovator knives raised some, and moving at right angles to the slitting operation. Equally as much material was taken out this time, but the surface

disturbance was not as apparent.

Our biggest problem labor-wise was in picking up the material which was laying on top of the grass surface. The sheer bulk of it required a lot of manpower. We rented a sweeper, which performed quite well, but was still not the answer. We found that the sweeping should immediately follow the Mott operation, otherwise the material dried out, became quite dusty, and was a miserable job for the men who were cleaning up.

Recovery, at least to a satisfactory degree, following this thatch reduction program, was rapid for the bluegrasses and fescues. However, the bent we have did not respond to water and fertilizer, and they still appear off-color. We anticipate an annual fall program.

Our objective is to provide a beautiful,attractive setting for our plant. Any turf care procedure aiding this is considered and used as needed.

\- - -

USING FLOWERS - PLANTERS

John McCoy, Supt., The Cincinnati Country Club,
Cincinnati, Ohio

Planters, as distinguished from beds, are a means of growing plants away from natural soil areas. Planters may be either permanent, or movable and of wood, stone, brick or other construction. They may be located in patios, on steps, window ledges, walls, floors, or as hanging baskets.

In front of our Club House we have a circular planter, rock-walled, 35 ft. in diameter; the center 15 ft. used for flowers, the remainder in bentgrass. On wide railings beside the steps (or end walls, if you choose that term), to the main Club entrance. And,also, a second similar entrance we have 8 semi-permanent planters, or boxes, each $2\frac{1}{2}$ x 3 ft. of concrete construction to match the railings and painted to match the steps and railings. At other locations we have rock-walled, or brick planters holding shrubs or flowers, or combinations of both.

In the rear of the Club House we use wood boxes to separate an outside dance floor and the swimming pool. On top of a patio, wall boxes also serve as a railing during the swimming season. All these boxes are 18 x 40 inches in plan, with tops 18 to 20 inches above base location, and painted light green to match light posts and other arrangements in the area. Some smaller wood boxes are used on window ledges.

We have a small greenhouse and grow most of our planting material for beds, planters and other areas, either from seeds or cuttings. Cuttings are made from geraniums, fuschia, begonia, coleus, ivy, vinca, chrysanthemum, and some shrubs such as azalea, mock orange, evergreens, etc.Cuttings are best made from new, or near new growth, and are started in sand on a bench which is warmed by an electric heating cable, thermostatically controlled at or near 70°F.

The house itself has hot water heat and ventilation, both thermostatically controlled with the temperature maintained from 50° to 60°, depending on how fast we wish plants to grow. On warm days, the temperature will rise above this. In windy and cold weather, the temperature may drop almost to the critical point, then extra electrical heat is used, or other protection provided.

Grown from seeds are petunias, our largest crop with about fifteen varieties, snapdragons, zinnias, marigolds, dwarf dahlias, salvia, etc. Seeds are started in flats in rows; the rows act as an aid in preventing damping off, a fungus disease working similar to diseases on bent. If damping off starts in seedlings, it may run out a row, then stop and not spread to an adjacent row. We use a mixture of three-fourths ground sphagnum moss, and one-fourth sterilized soil as a starting medium. The sphagnum moss aids materially in preventing damping off. Seed flats are placed directly on sand in the starting benches at 70°, the same temperature as used for cuttings, covered with a sheet of plastic to retain heat and moisture during germination. Most seeds of mentioned varieties will start in four days, some in less time.

As soon as growth starts, that is when the plants are about one-fourth inch high, the plastic covering is removed and the flats placed in a cooler area so that the plants develop in 55 to 60° temperature. If grown on a heated bed, they would become weak and spindly. At a cooler temperature growth is slower, the plant is stockier and more resistant to disease.

Most seedlings are transplanted to peat pots when quite small, three to four leaf stage, and are not removed from the pot when planted in the bed or box, as the roots grow through the pot wall and later disintegrate in the soil. We pot approximately 2000 petunias each year, besides numerous other plants and cuttings.

Our potting and growing soil is a sandy loam, comprised of good garden soil with sand and peat added. No fertilizer is added to the potting soil, but plants receive weak solutions of soluble fertilizer as needed. Soil used in boxes or beds, or in permanent planters, receive liberal amounts of complete fertilizer before the plants are set out, and no further fertilizer during the season.

Our earliest plantings are pansies used in beds and planters in front of the Club House. These are put in early in March in bloom and removed in May. By that time the blossoms are smaller, the weather is warm, and it's time to replant with a summer crop. Either cannas or begonias are used in the circle in the summer. The railing boxes receive a mixture of trailing vines and blooming flowers. Another change is made in the fall when evergreens, such as yew or juniper, replace the flowers through the winter months.

We start our cannas from roots in the greenhouse in pots, or boxes, so that they are approximately 1 ft. high when set out. They then grow rapidly, start blooming early, continuing to bloom until heavy frost in the fall. We prefer a dark red variety, and carry the roots over from year to year. Roots are stored in vermiculite and kept at a 40 to 45° temperature as far as possible

Boxes placed between the pool and the outside dance floor are planted

to petunias only, of varigated colors, and are in bloom when the pool is opened the latter part of May. They will bloom profusely until Labor Day, when the pool is closed. The boxes are then emptied and stored until the following season. Other boxes nearby the pool on a patio wall, have white blooming plants only - petunias, geraniums mostly, on the side facing the Club House. This by request of the Club hostess, who has charge of flower arrangements within the Club House.

On the opposite side of these same boxes we use any color combination of flowers we choose, along with many trailing vines. Some high ledge window boxes receive a similar mixture, with the vines trailing several feet. In a planter beside the children's pool, we use bright colors, yellows and reds predominating, with low-growing plants next to the pool, and taller ones to the rear. The children do not bother these plants, partly because a nurse is usually with the smaller children, and the fragrance of dwarf marigolds may be a deterrent factor. Most of the plants used are relatively disease resistant. Water requirements vary with location, and some flowers require more water than others. Boxes set up off the floor or wall dry out quite fast and often require daily watering, including Sundays and holidays.

In the garden we grow some flowers for cutting for the Club House, such as snapdragons, mums and gladiolas. Also, the Club House personnel may help themselves to flowers anywhere for Club House use. We plant 3,000 glad bulbs each season, starting early in the spring, with later plantings spaced at about two week intervals until early July, to provide the Club House with glads from mid-June until Labor Day.

You may say all this adds considerably to the course maintenance work. It does. We carry a large crew throughout the entire year, and it provides work in the off-season and on bad weather days, especially in spring. Flowers add much to the Club surroundings and pleasure to the members and visitors. I am sure they are worth all the effort required. If it is what the members desire, it is our business to provide it to the best of our ability.

\- - -

BEAUTIFYING THE GROUNDS WITH FLOWER BEDS

Paul Voykin, Supt., Calumet C.C.,
Homewood, Illinois

Golf course superintendents in the Midwest area are responsible for more than just maintaining grass. Golf clubs provide swimming pools, tennis courts, curling rinks and gun clubs. Another area that many superintendents have responsibility for is beautifying the grounds with flowers. It requires only a few moments a day to pause and admire the beauty of nature. Yet, it is a job considered important enough at some clubs to require the employment of as many as three full-time men for the summer, plus an annual expenditure running into hundreds of dollars for the supplies.

A superintendent does not have to be a horticulturist to grow flowers. The nurseries are only too willing to help and give advice, but some artistic imagination is required, and it is definitely a challenge in a new kind of architecture.

Now, gentlemen, if you will sit back and relax, I will proceed to show you a collection of slides showing flowers at country clubs. I will not elaborate too much, except to give the name of the club, the superintendent, and the flowers. The pictures will speak for themselves. (Thirty slides were shown of Chicago and golf courses, and their flowers: Glen Oaks, Olympia Fields, Ravisloe, Idlewyld, Calumet, Ruth Lake, Beverly, Hinsdale, Glen View, Park Ridge, Flossmoor.

Of all the plants growing in this world, flowers are the most beautiful - for they were put on this earth by our Maker to please the eyes of men.

\- \- \-

WILDLIFE AND GOLF

A. G. Brotzman, Supt., Erie Shores Golf Cours,
North Madison, Ohio

This may seem to you a rather odd topic for a meeting of this kind, but Conservation affects the lives of nearly all of us, even those who live in urban areas. Time only permits some comments on bird life, which need help and are desirable. Our experiences at Erie Shores seem to indicate that superintendents can do much to help.

Golf has enjoyed a period of rapid expansion, made possible by the ever-expanding suburban population. As a result, many of the places where birds and animals formerly made their homes have vanished. Where once we had a swamp we now have a Marina. Where once we had undisturbed brush and woodland, we now have a housing development.

Why is a golf course an ideal place for a sanctuary? Well, first of all, it is nature at her finest. Where the skill of the architect and the superintendent have combined to balance the turf, the water and the landscaping to form a haven for the tired businessmen and their families. Where better could you find a spot to have as a haven for birds? Many courses have ponds or streams, areas of undisturbed brush or woodland. Also, a superintendent enjoys seeing things live and grow and thrive.

Before our course was open for play we erected a Martin House. We have always liked these birds and they are great favorites with the golfers. They certainly earn their keep by devouring millions of flying insects.

The birds of the Woodpecker family are interesting and helpful birds, but unfortunately their numbers are dwindling. Destruction of their forest homes and predators account for most of this decrease. We

have purposely left a few old snags to encourage their nesting. There are many species of birds which we could discuss if time permitted. Your local Audubon Society will be glad to help you set up a conservation program.

By far the most interesting experiences we have had at our course have been with the wild geese. These birds without a doubt are the most intelligent of our waterfowl. They exhibit traits which we as humans would do well to emulate. For purity of character and devotion to their families, they have some of us backed right off the map. Anyone who has had the opportunity to observe these noble birds and feed them cannot help but profit from the experience. Our entry into the field of goose conservation was quite accidental.

Two years ago, during the hunting season as I looked out of the window one October morning, I saw a wild honker standing by the edge of our lake, so I grabbed my gun, started for the pond, my Springer Spaniel Duke at my side. I really did not expect to get within range of this bird, but to my surprise I was able to walk within a few yards of it. Finally, the bird took off and I fired, dropping it in the middle of the pond. How stupid can one be? I didn't recognize a friend when I saw one. The dog at once set off to retrieve it. When he got about halfway back to shore, the goose suddenly came to life, and so violently did it struggle I thought surely the goose would escape. I waded in the edge as far as I could, and finally succeeded in grabbing the bird. I looked it over, and decided it didn't look too much the worse for wear, and I resolved I would try to make it live.

I succeeded and the following spring put it out on the pond, having first clipped its wing. We had determined it was a female and my son Bill promptly named it Gertrude. She became quite tame, and was a favorite with the golfers. We later acquired a mate for Gertrude. Now, we wondered whether the wild birds would stop on their way south since we had two of their kind on the pond!

The answer came on 7:30 A.M. October 11 when I looked out the window and saw six wild geese, their wings set, coming in to land on our No. 6 fairway. This is what we had waited so long to see. Our geese were talking to them, and soon they settled down to feeding. The following week eleven more came. That weekend was nice and we had several golfers out. I thought the geese would leave, but they were content to share the course with the golfers. They had discovered in a very short time that the golfers would not harm them. They probably think golfers are a bit stupid - but at least they know they are harmless. The players thought this incredible, that 17 geese were walking around the fairways and swimming on our pond. It was hard for them to believe that these wild creatures, coming all the way down from Hudson Bay could possibly become this tame. But it was true, and clearly demonstrates that geese, and for that matter other birds, will become your friends if you will let them.

We eventually had a total of 25 geese on our pond, including 3 snow geese. Wild ducks came from time to time, but they weren't as dependable as the geese. One example of how quickly they came to know us as friends occurred during the hunting season. The geese had been out on the big lake during the day, and about four o'clock headed back for our pond. Some hunters in a field near the course commenced firing at them, but the birds were too high. They came sailing right in within 50 ft. of a foursome. They knew the golfers as friends. The movie you

are about to see is a collection of random shots of the geese and other things about the course.

In summary, let me mention a few things you might do to further the cause of Conservation. Many of the tasks involved come during the off-season. Without too much strain you can construct some of the different types of bird houses which would house Martins, Wrens, or Bluebirds. You can provide food during the winter months. In plantings consider the various shrubs which offer food and protection such as the Viburnums, Buckthorn, Multiflora rose, Mountain ash, or the like. Controlling predators would be a big step in the right direction. Probably the Fox, Great-horned Owl, the Crow,and last but not least the common house cat, vie for top honors as the most notorious outlaws. During the winter,fox hunting can be a rewarding sport. Crows are smart and feed their young with the song bird eggs they steal.

What will be your reward for helping these creatures? First of all, your efforts will be repaid a thousand times by the good the birds will do about your course. They are appreciated by the players, and their songs are always welcome. But, more than this, the satisfaction you will get from helping will more than offset the trouble it takes. Remember, God has given man dominion over all things, so the question is, not what can we do, but what shall we do.

\- \- \-

SOD PROMOTION

Ben Warren, Warren's Turf Nursery,
Palos Park, Illinois

The word "promotion" generally calls to mind an advertising program, involving newspaper space, billboards, radio and television commercials, which extols the merits of a product. These activities are essential parts of an effort to create, or expand a market for a product. However, I would like to treat them as part of a well-rounded program.

Such a program may be divided into two general categories: those efforts which are best done by the individual firm, and those in which success can only be accomplished through associated action. Certain areas of market expansion can best be approached by cooperative efforts. Stimulation of interest in governmental use of our product is suspect if attempted by individual firms, but association activity is free from such handicap. Influencing specification, either governmental or individual so as to favor the use of nursery instead of field sod, is one area in which association suggestion will have more weight than individuals.

Any activity which, by its nature, promotes the general use and acceptance of sod by the public, should be financed by the industry as a whole, rather than individual firms. Product promotion such as carried out by Sunkist Orange Growers, Milk Producers, Allied Florists, and, even closer to home, the Merion Bluegrass Association, are further instances

of successful product promotion by associated effort.

Closely correlated with this cooperative effort should be the individual firm's activity, which, with our product, should more than match group effort. Promotion by an individual firm can be divided into several phases, all of which are inter-related.

1. Without a quality product the best planned selling and advertising effort will produce little of lasting value. There can be little disagreement with this, but there is an area of quality control that seems to be mishandled at times. We all have fields, at times, that for some reason are not equal to the quality normally maintained. It seems a mistake to market such material to the general public as a No. 2 grade at reduced prices. This practice will both weaken the grower's reputation, which promotion should be striving to enhance, and have a depressing effect on the overall price structure. Such material would be better marketed to large users, such as highway work. We have found that sod we consider inferior for average home use, is rated superior when compared with the norm in highway use.

2. Another area important to successful promotion is that of service. This applies to both pre and post-sales efforts and requires the sodgrower to be well informed in all the aspects of turfgrass management. Printed material, advising pre-planting preparation, selection of varieties, post-planting care and long- term maintenance plays an important part in handling vegetative grasses and should be part of well-planned service. The willingness to maintain an interest in the product after it is in the customer's hands, and to be able and willing to advise in its care, so that it performs satisfactorily, contributes immeasurably to the creation of goodwill.

3. Most of us in the sod business are growers, or farmers at heart. Growing a quality product and offering a reasonable amount of service are activities with which we are familiar. When venturing into the field of advertising techniques, we are getting out of our element. Professional advice is certainly indicated as a requirement in planning an effective program. The large spenders of advertising money seem to agree that only about 50% of their money is spent effectively. If professional effort is no more rewarding than that, amateur effort would be somewhat less. The knowledge I have in this field has been acquired in the past few years by contacts with some advertising people, and living with our program. I have developed a few opinions.

A program should be financed within a very strict budget, which has been established by a percentage of gross sales. There are many temptations by salesmen of other media and various promotional ideas to deviate from a budget. Short-term up and downs in business may be tempting to either expand or contract the established budget. Relatively long-term continuity in the same media is essential to effectiveness.

Purchase of space must be subject to some hard-nosed bargaining in some publications. The pricing and rates seem somewhat more involved than we are accustomed to. The effectiveness of a program must be judged by long-term results. My final opinion is that I am a miserable judge of effective advertising copy.

\- \- \-

WATER, FERTILIZER AND MOWING - THE THREE ESSENTIALS

Dale Habenicht, H. & E. Sod Nursery, Inc.,
Tinley Park, Illinois

We in the sod industry are interested in producing high quality sod within a period of one year. Each of us is faced with different environments and different soil conditions. However, water, plant food and mowing is required to produce good turf wherever it may be.

In the northern climates most of us try to seed from the middle of August until the middle of September. Before this is begun, we take soil tests of our fields to determine the present soil fertility. A pH value below 6.5 indicates lime should be applied. If phosphorous or potash is low, this is the time to boost them into the adequate, or high availability ranges.

After seeding, continued surface dampness is most essential for fast, uniform germination. Generally rainfall alone is not adequate, or dependable to provide sufficient moisture, except possibly in peat soils. We try to irrigate all our seedbeds for a period of four weeks. Light waterings every day keep the soil moist for maximum germination, and encourages fast seedling development.

When the seedlings have sufficiently established themselves, watering is reduced so that the soils dry enough to fertilizer the seedbeds. We apply a 2:1:1 ratio fertilizer, using 1.5 lbs. of nitrogen per 1,000 sq.ft. This is generally done about October 1. The fertilizer, plus moderate fall temperatures and weekly waterings, stimulates the seedlings to form their second leaves and fill in. By November they should have developed enough to withstand the severe winter temperatures. The success of a good stand for stripping the following year depends mainly upon the growth achieved during the initial fall period.

The first thing we try to do in the spring is to fertilize with a 2:1:1 ratio fertilizer at the rate of 1 lb. of nitrogen per 1,000 sq.ft. Weather permitting, this program is started in February or March.

Mowing is the big problem in the spring. With cool weather and plenty of moisture, the grass is growing very rapidly. Merion definitely must be cut twice, or possibly three times a week - Kentucky twice a week. We mow both grasses at 2 inches. Rainy weather sometimes prevents regular mowing, and we, therefore, designed our own machine similar to a large vacuum sweeper. Removal of clippings reduces the danger of disease and allows air and sunlight to get to the young seedlings. The problem of thatch building up is also kept to a minimum.

We prefer pull-type fairway gang mowers because greater acreage can be covered each day and the cut is more even. It is very important to keep the mowers adjusted frequently. Every couple of hours they should be set so that the reel just lightly touches the bed blade. This adjustment also keeps the mowers sharp for a much longer time. Once a year the mowers should be machine ground. If wear on the bed blade becomes uneven, lapping-in monthly during the season may be necessary. If crossing roads or bridges is necessary, push-type mowers with hydraulic lifts are preferred.

Reel mowers do an inadequate job when rough cutting is required. A rotary mower operated from the power take-off will do better when cutting heavy grass, weeds and long seedheads. During the summer, when plant growth slows down, mowing may be reduced to once a week.

We try to irrigate so that the turf receives an inch of rainfall once a week throughout the entire growing season. During the spring months frequent rains generally give sufficient moisture. In the summer and fall months, rains become more scarce and irrigation becomes a MUST. Some fortunate nurseries, however, are located in areas where irrigation is not necessary.

We fertilize Merion once every four weeks with Urea at the rate of 1 lb. of actual nitrogen per 1,000 sq.ft. Kentucky bluegrass is given two applications of Urea during the summer at the same rate. If irrigation is unavailable on a certain field in the summer, we use a sludge-type fertilizer. About October 1 our established turf is given an application of fertilizer at the rate of 1 lb. of nitrogen per 1,000 sq.ft. - ratio 2:1:1. We have found this feeding program, when used throughout the growing season, to be the most efficient, both from the standpoint of fertilizer cost and turf maintenance. Generally 1 lb. of actual nitrogen per application applied 6 to 8 times in the growing season does best for Merion and Creeping bent; 4 applications are adequate for Kentucky and Delta bluegrass.

Our aim, with maximum effort, is to have the turf filled in completely and the rhizomes developed sufficiently so the sod will hold together. When this stage is reached, we decrease the application of fertilizer on Merion to once every 6 to 8 weeks. Merion will develop faster on loose soils with a high water holding capacity. Kentucky bluegrass prefers a heavier soil.

Our entire program is designed to develop a turf in salable condition within twelve months. The faster sod can be produced, the better position a Nursery will be in to compete on the market.

\- - -

LABOR AND ITS SUPERVISION

J. L. Holmes, Midwest Agronomist, USGA Green Section,
Chicago, Illinois

(Abstract report from the 1961 USGA Green Section Educational Conference. More complete articles are appearing in the USGA Journal during 1961).

There was considerable pertinent information presented. The first talk entitled, "The Scientific Approach to Management," by David Lilly, President, Toro Manufacturing Company, contained a wealth of pertinent data highlighted as follows:

A. Field of management supervision is the art of accomplishment through people.
   1. Every industry needs a thorough management and labor study.

2. Golf course management is a two-headed problem:
    a. More extensive use of the grounds.
    b. Increased operational expense - 70% of the budget is salaries and wages, so immediately you can see the need for a thorough management study.

B. Scientific, or agronomic approach, is nothing new. USGA, industry, extension workers, university people, etc., have delved into this, but nothing has been seriously accomplished with dissemination of managerial information.

1. Objectives:
    a. Where are we going?
    b. What are we trying to accomplish? Provide an organizational objective to build and maintain the best possible course within moral, financial and legal limits. The most important accomplishment for the superintendent is to plan objectives and follow them through, thus deciding what, when, where and by whom will the job be done.

C. Plan annual budget and program on orderly basis:
1. How much can be done:
2. What must be sacrificed?
3. Knowledge of club events.
4. Traffic flow.
5. Increase of play.
6. Sell your program to the highest authority.

D. How long to do the job and how it is to be done -
1. Always check and determine definitely.
2. Two-thirds of idleness is due to ineffective supervision.

E. Superintendent must have responsible assistant.
1. He cannot effectively control more than 10 men.
2. Assistant helps in training all employees sufficiently to carry out their assigned jobs.

F. Function of superintendent.
1. Supervision of all facets of the operation.
2. Evaluate program with committee, or chairman.
3. Check on men constantly - with such things as time studies.
4. Encourage and develop men.
5. Decision making and analysis.

The second talk, "Training of New Workers," was given by William Bengeyfield, Director, USGA Green Section, Western Office. Bill passed out two 5 x 8 paper cards to the audience, and quite casually and negligently explained how to make a "painter's cup," a fourth grade problem, which few could accomplish. He then explained why so few could make the "painter's cup" -

1. No attempt to motivate.
2. Poor relationship with audience.
3. Poor environment.
4. Lousy explanation.

He then carefully and expertly explained how to prepare a "painter's cup." Those who attempted the second time were immediately successful. Mr. Bengeyfield pointed out that perhaps we now knew how a new man felt the first day on the job.

The third talk, "Daily Planning and Programming" was delivered by Tom Leonard, Supt., River Oaks C.C., Houston, Texas. Tom gave an excellent talk based on "the chain is only as strong as its weakest link." In other words, your entire program should be strong in all respects, such as:

A. Start with yearly plan.
B. Break it down to cover the various seasons, such as:
   1. Slack season could be easily the weakest link, so needs the most complete planning. Plan and think out all possible jobs.
   2. In the spring plan for bad days and the hard work necessary to get course in shape.
   3. During the playing season, work must be broken down into monthly and weekly programs built around golfing activities and daily accomplishments.

C. Ten points Tom bases his program on:
   1. Listen to the weather man.
   2. Plan daily work to interfere least with play.
   3. Always plan and discuss with foreman, or assistant.
   4. Prepare so that scheduled work can be completed.
   5. Place employees where and with whom they can work.
   6. Be extra cautious about job priority assignments.
   7. Plan alternate daily work program.
   8. Train employees according to work assignments and list those assignments.
   9. Always keep employees informed.
   10. Safety must be planned and stressed.

Mr. Andrew Bertoni, Supt., Meadowbrook C.C., Northville, Michigan, gave a superb talk, entitled "Planning for Safety." He stressed that "accidents can be reduced through theory and practice."

A. Theory - a state of mind. A good man wants to improve. Help mental attitude --educate workers -- develop a zealous attitude toward safety. Personal problems affect potential carefulness, or safety. Be interested in personal problems of employees.

B. Practice:
   1. Train crewmen to watch out for self and other workers. Keep in contact and check on each other, especially when someone is working alone.
   2. Wear helmets, when needed, and distinctive uniforms.
   3. First aid kits carried on equipment - men carry one.
   4. Use mirrors and regularly check breaks on machinery.
   5. Maintain equipment in excellent condition at all times.
   6. Check youths extra-carefully.
   7. Chemicals - special precautions - instruct workmen, as necessary. Andy has developed a system of putting chemicals down into the spray tank.
   8. Do not place heavy material high. Train men on proper methods of handling heavy material.
   9. Hire outside tree trimmers and contract other outside assistance to handle especially hazardous jobs.

10. Keep shop clean, lighted, well-ventilated.
11. Check fire extinguishers as necessary.
12. Life savers and ropes at all ponds and lakes.
13. Seek out and correct any hazards, such as car ramps, etc.

"Importance of Superintendent in Training and Direction of Workers" was given by Dr. Gene Nutter, Exec.-Secy. GCSA. He explained the tremendous growth in golf play and the acute necessity to develop capable men for replacements, and for newly developed courses. The superintendent must successfully blend technology, humanology, and business administration in all operations.

The fundamental problems that superintendents must face in training of workers includes:

1. Few club members are aware of heavy play effect on turf; longer play-damage by carts. Superintendent must educate members, as well as crew.
2. There exists general lack of knowledge of the role of superintendents in the operation of a club. He has been a "behind the scenes" man who must receive greater recognition.
3. There is currently not an adequate reserve of qualified superintendents. Training facilities are inadequate and not enough new men are being properly trained.
4. Methods currently being employed to train new men are:

    a. GCSA and other college scholarships.
    b. Educ tional meetings.
    c. Correspondence courses.
    d. On-the-job training.

\- \- \-

(Editor's Note). The following four abstracts and reports are out of material presented at the 1961 USGA Green Section Meeting on the subject of Labor Management. The service of Mr. James Holmes, and Mr. Robert Williams in preparing these is appreciated.

EFFICIENT USE OF MEN AND EQUIPMENT - R. Williams, Supt. Bob O'Link G.C.

1. Perspective of club costs to grounds costs.
    a. Grounds equal to about 10 to 12% of total club expense dollar.
    b. Generally speaking, clubs spend as much or more forcaddies and carts as they do for grounds maintenance.

2. Evaluating today's superintendents.
    a. Efficiency and standard of maintenance depends upon superintendent.
    b. Five out of six clubs have superintendents who do not belong to GCSA.

3. Qualification of "efficiency":
    a. Different courses have different objectives.
    b. What is efficient at one club can well be waste at another.

4. Job analysis.
   a. Observation
   b. Is there a better way to do this job?
   c. Twelve men on 160 acres equals 13 acres a piece.

5. Interference.
   a. Both ways, players and workmen.

6. Routing and assignment of work.
   a. Reduce wasted motion.
   b. Plan ahead. Keep ahead of play.

7. Equipment studies.
   a. Irrigation.
   b. Mowing
   c. Spraying - fertilizing.

8. Use of chemicals for efficiency - supplement equipment.

9. Use of analytical techniques shows progress.

10. Pilot studies recommended for specific data.

THE GOLF COURSE WORKER - HIS RELATIONS WITH THE MEMBERSHIP - Al Radko, Eastern Director, USGA.

1. Follow chain of command, with communications, etc.
   a. From employees up through superintendent, etc., vice-versa.

2. Workmen on the course are always under observation from golfers.
   a. Sometimes golfers get wrong impression of efficiency.

3. Mutual courtesy required between golfers and workmen.
   a. Need for better understanding of game by workmen.
   b. Need for better understanding of work by golfers.

4. Interference both ways - two way street.

5. Attitude of workmen.
   a. They take their cue from the superintendent's example on dress, neatness, cleanliness, outlook, industriousness, drive.

6. Items of frequent complaint by golfers:
   a. Tees: marker locations, ball washers, towels.
   b. Greens: cups, poles, flags. Both location and condition.
   c. Putting surfaces.
   d. Trap maintenance. Sand and raking. Edging.
   e. Roughs - height of cut - bent.
   f. Roadways -- too many - poor condition.

7. All workmen look for recognition and appreciation.
   a. From golfers.
   b. From superintendent.
   c. It's the small extras that make for success and a happy relationship between workers and golfers.

HOW TO KEEP A WELL TRAINED CREW - Chet Mendenhall, Supt., Mission Hills C.C., Kansas City, Mo. (Past President GCSA).

1. Considerations -
   a. Hours - shorter.
   b. Salary - increasing.
   c. Permanence of employment anticipated.
   d. Fringe benefits, increasing.
   e. Retirement, needed.

2. Most of the crew will be happier with a 40 hour week.
   a. Stagger hours, use a few on overtime.

3. Salaries are a big problem, particularly around industrial areas where the scale is quite high.
   a. Clubs have to resort to older men; handicapped men.

4. Try to build up a steady year-round crew as a basic unit with extra men during the growing season.
   a. Make good selections for your permanent crew.
   b. Sell the club on the idea and the work that needs attention during the off-season.

5. Seasonal help.
   a. College students (intelligent, quick to learn).
   b. Women (good workers for gardening, etc. Foreman) (Forewoman).

6. See that employees know of and understand all benefits and procedures.
   a. Employee training guides. (written pamphlet on SOP).
   b. Educational discussion periods at start of day for better understanding.

7. A well-informed crew soon becomes a well-trained crew.

8. First interview with a prospective employee should reveal as much background as possible as it is most important in developing a good working relationship between the superintendent and the workmen.

ROLE OF THE GREEN COMMITTEE CHAIRMAN IN TRAINING AND DIRECTION OF WORKERS - Rear Adm. John Phillips (Retired U.S. Navy), Fort Lauderdale, Florida.

1. Establish an organization.
   a. Lines of responsibility, chain of command.
   b. Allocation of maintenance tasks.

2. "A profession is intellectual in content, practical in application."
   a. Mastery of academic information and knowledge (science).
   b. Practical application of various techniques (art).

3. Too many young men today aspire to a white-collar job, and do not take kindly to the training and experience necessary to be a good golf course superintendent.

4. There is no set course to follow in becoming a qualified superintendent (many ways).

5. Many mistakes are being made today in golf course construction.

6. The Greens Chairman's responsibility is one of liaison between the club members and the superintendent.

7. Superintendents should know their business and use good diplomacy.

8. Be careful about meddling with the architecture of a course.

9. The purpose of golf course should be to give pleasure to the greatest number of players possible.

10. Labor is a big problem for both the club and the superintendent.
    a. A well-rounded crew is the mark of a good superintendent.
    b. Compliments deserved breed pride and loyalty to all concerned.
    c. A kind word stays with a workman longer than his paycheck.

11. Tell workmen both how to do their tasks, and why they are doing them.

12. Work planning is important. Budgets - efficiency - keep them informed.

13. Keep key areas in top shape. = #1 and #10 tees; Club House area; practice green.

\- \- \-

STANDARDIZED ACCOUNTING SYSTEMS

Dr. M. H. Ferguson, National Coordinator,
USGA, Green Section, College Station, Texas.

Mr. Allen Brown first suggested that the Green Section study the matter of a standard system of accounts. The USGA undertook such a study for the 1959-1960 season. It prepared and sent out 110 sets of one accounting system to superintendents. It included labor and equipment use records.

Needs for a standard system have long been lamented, for clubs and members severely lacked uniformity. The true basis for comparisons must be a single unit, such as illustrated in Table 1.

Table 1. Putting Green Mowing Time

Location	minutes/1,000 sq.ft.
Vermont	6.6
North Carolina	6.2
Kansas	6.2
Illinois	6.4
Virginia	6.2
New Jersey	7.6

Thus, an average of 6.6 minutes/1,000 sq.ft. x 100 times per year is 11 hrs./year x $ 1.60 = $ 17.60 per 1,000 sq.ft./year for mowing greens.

Since the first specification for a true basis is a unit, the second specification must be to have standard printed forms which augment and guide the recording and collecting. Many have devised individual systems, and yet few conscientiously use records as management techniques. The USGA system devised and distributed for study included:

a. Definition of golf course parts, or features.
b. System attempts to arrive at unit costs of maintenance.
c. Biggest item is labor. This depends upon daily time ticket for accurate distribution of costs.
d. Provides for summaries of costs.
e. Provides for setting up depreciation schedule and reserve fund for equipment replacement.

Reaction of collaborators

a. Mixed (Approximately half said system was good and workable)
b. Most common criticisms:
   1. Too complicated
   2. Men can't read or write. Cannot fill out daily time ticket which is basic to system.
   3. Lack of familiarity compared to system already in use. (In several cases participants in study criticized complexity of system, and offered sybstitute systems. These seemed equally complex to the system we devised. Therefore, lack of familiarity is a barrier, or deterrent).
c. Needs additional items.
   1. Place to record superintendent's time, sick time, vacation, etc.
d. Use as is -
   Comparisons of costs among municipal courses gives key to strengths and weaknesses. Helps supervisor to detect points for emphasis in the management program.
e. How much time?
   2 hours a week was average. Those who keep adequate records believe this is not too much. Many did not keep up with study because they said "it takes too much time."

There is reason for believing that there is a need . This system will work (but may need modification by some). It will not likely be adopted where an adequate but different system already is in use. There is reason to believe many superintendents will never keep anything like complete records. One man, an old and good friend, sent his copy of the study back unmarked with this comment - "If this system helps greenkeepers to keep greens in good condition through hot and humid weather, without the crabgrass, then system is good; otherwise, not worth while to bother with it."

\- \- \-

THE EVALUATION OF CALCINED CLAY AGGREGATES FOR PUTTING GREEN ROOTZONES

Robert Montgomery, Former Graduate Student,
Dept. of Agronomy, Purdue University

We are aware of the increased interest in golf in our country in recent years. This increased interest has brought about the construction of

many new courses, and has created problems on our existing courses. The principal problem encountered on many courses is the maintenance of the putting green because of the heavy traffic which causes soil compaction. Since soil compaction may proceed slowly, it goes unnoticed in many cases until it is too late to prevent a grass failure.

Soil compaction decreases the infiltration rate, which in turn requires that the water application rate be lowered. It also decreases the amount of large pore spaces, which in turn decreases the permeability and air diffusion rate. These are physical soil properties which may cause putting green grass to fail. Several workers have tried blending various soil components and/or mineral and organic amendments together to resist compaction, and yet maintain a desirable structure with adequate non-capillary pores. This study was concerned with the use and evaluation of calcined clay aggregates as additives, or replacements of soil mixtures for the construction of putting greens.

Tests conducted in the greenhouse indicated that calcined clays served as rootzone material and showed possibilities for being adapted to putting greens. From these results a field study was planned on the experimental putting green where we could measure the effects of weather and wear under use. We contacted various companies which mine their raw clay from Illinois, Mississippi, Georgia and Florida. They provided six sources of calcined clay aggregates, plus one non-calcined, which were mixed in various proportions with sand, soil and peat, or used alone to make a total of 26 rootzone mixtures. Table 1 shows some of the ratios and mixtures used.

Table 1. Ratios by volume of some materials used in rootzones, Purdue.

Entry	Calcined clay	Sand	Peat	Soil	Reason
1	0	4	1	1	91% sand
4	1	3	1	1	dilution
5	2	3	1	0	no weed seeds
6	2	2	1	1	economy
7	2	0	0	4	?
8	3	1	1	1	rebuilding
9	4	0	1	1	replace sand
10	5	0	1	0	prescription
3	0	0	0	6	soil only

One experiment was designed to evaluate how deep a mixture should be. This experiment was comprised of a mixture by volume of six parts of a calcined clay and one part peat. The mixture was placed in 40 sq.ft. plots, at depths of 0, 1, 2, 4, 8 and 12 inches, and replicated three times. A second set of plots were used in a source and hardness study. The experiment contained 24 different mixtures, including all aggregates and several ratios of them placed to an 8 inch depth in 20 sq.ft. plots.

A lysimeter type study, the third experiment, included four replicates of six mixtures placed to a 12 inch depth in plastic lined plots. Each had 10 sq.ft. of surface. All plots were planted by October 3, 1959, with Penncross bentgrass. The following tests, or evaluations were made on the plots described:

Samples taken from the plots after one year of weathering; samples subjected to artificial freezing and thawing; and non-weathered; non-

frozen samples were checked for aggregate stability by the wet sieve method. The results indicated a high amount of breakdown on the non-calcined product, and a range of breakdown from none to over 10% on calcined products. Table 2 shows some of the results of these tests:

Table 2. Loss of Large Aggregates Calcined Clay Mixes

Entry	Material	Loss after 20 freeze cycles % of total	Change after 1 year outside % of total
1	G. C. Mix	3	+7
10	Turface	8	0
14	Hi-dri	16	13
19	Oil-dri	19	24
22	Florex	3	0
26	Sol-Spe-Dri	2	+4
24	Cal Star	11	22
25	Not calcined	22	15
3	Soil	3	20

The water holding capacity ranged from .35 to 2.1, with an average of 1.0 inch of available water per foot of rootzone mixture.

The infiltration rate of the mixture was found to vary tremendously. Table 3 gives some of the results:

Table 3. Comparisons of Penetration for 1" of Water after only 1 Year in 26 Rootzone Mixtures.

G. C. mix was				10 minutes
17 were	less	than		10 minutes
4 "	"	"		20 "
2 "	"	"		1 hour
3 "	over			6 hours

One of the most interesting observations that we made was that by adding one-third of a stable calcined clay to two-thirds soil, infiltration was 386 times faster than soil alone. Another important fact was that infiltration was 1500 times faster on the calcined than on non-calcined clay. Leachate measurements were made following rains. Mixtures containing calcined clay aggregates continued to let water percolate through the mixture, but as soil plots became compacted, leachate recovered became less.

The range in bulk density was from .40 to 1.44 grams per cc. The pore space was inversely related, ranging from 82 to 42% after one year in tests. Tables 4 and 5 show some of the variations in porosity.

Table 4. Variations of porosity of Some Turface Mixtures

Entry	Ratio	Large %		Total %
1	0-4-1-1	22		44
4	1-3-1-1	32	Sand	56
5	2-3-1-0	36		59
6	2-2-1-1	30		61
7	2-0-0-4	20		58
8	3-1-1-1	36		70
9	4-0-1-1	35	C.C.	73
10	5-0-1-0	41		77
3	soil only	7		44

Table 5. Variations in porosity of some rootzone mixtures, 1960

Entry	Large %	Total %	
1	22	44	GCM
10	41	77	
14	41	82	
19	30	75	
22	44	80	
26	43	82	
24	35	76	calcined
25	4	67	Not C.
3	7	Soil 44	only

It is believed that the rootzone for good turf should contain from one-third to one-half large pores. The Table showing mixture ratios shows most of the mixtures met this standard. However, one can see that the soil fell well below. It is of interest to note that when one-third C.C.A. was added to the soil, we obtained one-third large pores. This fact probably accounts for the tremendous increase in infiltration gained by adding the C.C.A. to the soil.

The second table on porosity points out the reason for the slow infiltration obtained on the non-calcined product. Here we see 35 in contrast 4% large pores with the only difference being the lack of calcining. All mixtures appeared to have an adequate oxygen content (average range 13.2 - 14.5). However, all mixtures had a higher oxygen diffusion rate than soil alone. Plant responses were measured by establishment, winter survival the first year, turf quality, and root development.

From these studies the following conclusions were drawn:

1. Calcined clay aggregates do offer desirable possibilities for golf green construction.
2. Non-calcined, or inadequately calcined aggregates, do not remain stable after weathering, and should not be used in or on golf greens.
3. Some calcined products are more stable to the action of freezing and thawing than are others. (Each Company should produce most stable possible).
4. When a stable calcined clay aggregate is mixed with a soil of medium fine texture, infiltration is much faster than in a soil alone.
5. The 8" depth of mixture seemed to be adequate when sub-surface drainage was provided.
6. High-quality creeping bentgrass turf was grown on several mixtures which included calcined clay aggregates.
7. At least 8 of the mixtures tested were encouraging; one of the more promising under the tests conducted was 2 parts of a stable calcined product, 3 parts brick sand, and 1 part peat.

Questions Yet to be Answered

1. Will these calcined products continue to hold up over a period of years?
2. How well will the established turf on the various mixtures withstand the winters?
3. How different must management of fertilizers, fungicides and water be from established procedures?

\- \- \-