

1977

**TURF CONFERENCE
PROCEEDINGS**

Sponsored by the

MIDWEST REGIONAL TURF FOUNDATION

and

PURDUE UNIVERSITY . West Lafayette, Indiana

February 28 - March 2, 1977

PROCEEDINGS OF THE
1977
MIDWEST REGIONAL TURF CONFERENCE

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W. H. Daniel, Executive Secretary
Midwest Regional Turf Foundation
Department of Agronomy, Purdue University
West Lafayette, Indiana 47907

A copy of these Proceedings has been mailed to:

- The 630 attending the 1977 Midwest Turf Conference
- One person of each member organization within the Midwest
Regional Turf Foundation not represented at the Conference
- List of those in educational activities

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MIDWEST REGIONAL TURF FOUNDATION MEMBERSHIP 1976

In prior years a special leaflet has reported membership. The listing below, organized by states, gives current support (1976), as well as the number of years of membership according to our records.

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 Cog Hill G. & C. C., Lemont, 30
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 E. I. duPont, Chicago, 25
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 Flossmoor C. C., 30
 Forest Hills C. C., Rockford, 30
 Geneva G. C., 6
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 Paul Granger, Des Plaines, 1
 Green Acres C. C., Northbrook, 2
 Greider Sod Farms, Carlock, 3
 H & E Sod Nursery, Markham, 24
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 Clifford Helwig, Naperville, 3
 Hinsdale G. C., Clarendon Hills, 2
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 Roseman Mower Corp., Glenview, 23
 Seaboard Seed Co., Bristol, 6
 Sears, Roebuck & Co., Chicago, 16
 Shoreacres, Lake Bluff, 30
 Leon Short & Sons, E. Peoria, 10
 Silver Lake G. C., Orland Park, 30
 Sportsman C. C., Northbrook, 15
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 Ball State University, Muncie, 8
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 Beeson Park G. C., Winchester, 5
 Board of Park Comm., Ft. Wayne, 21
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 Broadmoor C. C., Indianapolis, 30
 Brookshire G. C., Carmel, 6
 Edward R. Burns, Carmel, 1
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Horner Farms, Inc., Union Grove, 12
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Harold W. Glissmann, Omaha, NE, 19
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Miracle Hill G. C., Omaha, NE, 15
Mock Corp., Pittsburg, PA, 13
The Toro Co., Minneapolis, MN, 27
Vaughn-Jacklin Seed Co., Spokane, WN, 10

PRESIDENT'S REPORT

Danny K. Quast, Supt., Milwaukee Country Club
Milwaukee, Wisconsin

It has certainly been an honor to be president during this Bicentennial year. It has been a pleasure to work with Dr. Daniel, Dr. Freeborg, and the Board of Directors, who all have a sincere interest in the growth of the Midwest Regional Turf Foundation.

This has been a key turf foundation and members have been loyal to it since 1946. It is always nice to reminisce; however, we must not look at this as a turf foundation of the past but as one of the present and of the future.

Time will bring forth many important names in the field of Turf Management, and from these people many new ideas for research. I firmly believe that with our continued support, much of this research will still be going on at Purdue. I believe, just as many of you believe, when it happens it will happen here.

You get as much out of something as you put in it. Dr. Daniel has put most of his professional career in this foundation and its goals. Just like Dr. Daniel, we must get involved, must be a part of. What greater tribute can you pay the Midwest Regional Turf Foundation than to insure its perpetuation? How do we do this? By joining, and after that by participating. Hard work put into this foundation by so many over the past thirty years should not be paid back with apathy.

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MIDWEST TURF CONFERENCE

W. H. Daniel, Executive Secretary
Purdue University

More than 625 attended the 1977 Midwest Regional Turf Conference at Purdue University, February 28 to March 2.

Water Management was the central theme for the varied program. However, other timely topics were included, such as physical fitness, building machines to fill a specific need, artificial turf in the Busch Memorial Stadium, St. Louis, reclamation of land as related to our energy resources, photograph aids in turf management, and promotion and teaching new golfers.

Indiana Golf Course Superintendent's Association allocated \$400.00 for Purdue student labor. This was announced at the banquet. This contribution not only helps individual students but supports research as well.

Other awards included the GCSAA Scholarship Award presented by Palmer Maples, Director of Education, to Randy Bellinger (\$500.00). Henry Lyons of the Upjohn Company presented scholarships of \$250.00 each to Ken DeBusscher and Matt Lindner.

Kermit Delk, Superintendent of the Springfield Country Club, Ohio, was elected President of the Midwest Regional Turf Foundation Board. He succeeds Danny Quast of the Milwaukee Country Club, Wisconsin. Others newly elected are: Vice-President, Bud Camp, Lebanon Chemical Co., Ft. Wayne, Indiana; new Board members: John Morris, Highland Country Club, Indianapolis, Indiana; Tony Kramlik, Fort Wayne Country Club; Wayne Otto, Osaukee Country Club, Mequon, Wisconsin, and Dick Trevarthan, Prestwick Country Club, Frankfort, Illinois.

WHAT YOU SEEK YOU CAN GET

Stan Frederiksen, Mallinckrodt Chemical Co., Retired
Ferguson, Missouri

Thank you sincerely for the very real privilege of being with you again at yet another Midwest Regional Turf Conference.

Dr. Daniel and Dr. Freeborg really are 'past masters' in the art of choosing provocative topics for their Turf Conference programs. And the one assigned to me - "What You Seek You Can Get" - is certainly no exception. Each of them knows what it is to throw out a challenge, and it is a poor unmotivated individual, indeed, who won't respond with great relish to the kind of challenges these fellows provide for us.

Once upon a time a kind and understanding father, on a beautiful October morning, asked his eight year old son to go out into the yard and rake all the fallen leaves into a single pile. Little Joe was, to say the least, terribly upset, and for at least two reasons. First, the yard was huge, with leaves literally covering it. Second, Joe had just been savoring the idea of getting out with the 'guys' for a game of touch football. With his fond hopes for some hours of fun now dashed, Joe glumly went outside. A half hour later, when Joe's Dad came out he found Joe sitting on the top step of the porch, with his chin cupped in his hands, glaring intently at the yard full of leaves.

"What are you doing?", said Joe's Dad. Joe replied, "I'm wishing - wishing for all those leaves to be in one big pile." "How are things coming?", asked Joe's Dad. "Terrible", said Joe, adding, "I've been here wishing for a half hour, and the leaves haven't moved." "You just aren't wishing in the right way", said his Dad. "Now you watch this." Joe's Dad picked up a leaf rake and started raking the leaves. As he did, he kept repeating aloud the phrase, "I wish all these leaves were in one pile!" And guess what? In about twenty minutes all those leaves were in one pile. "There you are," said Joe's Dad. "See what I mean?"

"Aha!", said Joe. "No fair! You were raking while you were wishing!" "Just so," said his father. "You can make any wish come true if you DO something to help make it come true." To say this another way, you can get whatever it is you seek - IF you DO the things necessary to get what you want.

Just what is it that you are seeking? Is it money? Is it better turf? Is it the acclaim of your membership and friends for a job well done? It is "status"? Is it Freedom? Is it the ability to 'get by' without working? Is it a trip to the moon? Is it to "reach the unreachable goal"? Whatever it is, YOU CAN GET IT - IF (A), you set what you want as an absolute goal or 'target', and work ceaselessly toward it, and (B) you are willing to pay the price.

The story is told of the famous woman concert pianist who had just concluded a really phenomenal performance before an audience consisting of the members of an exclusive Women's Club. Accolades and acclaim were given her by everyone in the audience. Women fawned over her. One woman, in particular, was elaborate in her words of praise for the pianist, who was none other than the world famous Miss Gina Bachauer. Said this admirer, "I'd give anything to be able to play the piano like that!" To which Miss Bachauer replied, quite unexpectedly, "No you wouldn't." Seeing her well-meaning admirer was puzzled, somewhat embarrassed, and more than a little hurt, the gracious Miss Bachauer replied and hastened to comfort and reassure her. Said she, "Please don't be offended. I greatly appreciate your applause and

acclaim. However, you said you would do anything to be a concert pianist. May I tell you that I learned middle C on the piano when I was so young that I don't even remember learning it. Since I was ten years old I have practiced on the piano not less than eight hours every single day, seven days each week. Now think over your statement again. Would you be willing to give up eight hours every day for over forty years in order to perform as a concert pianist?"

The admirer, with some humility, acknowledged that "No", she would not be willing. In other words, SHE WAS NOT WILLING TO PAY THE PRICE!

One of the real prerequisites to success - to getting what you want - is to know what you want. This requires that you adjust your focus upon this thing, or these things, that you want. Are you focusing upon what's right there before you? Or, are you looking beyond the immediate, at the ultimate goal some distance down the road?

A rather exciting article, titled "Marketing Myopia" appeared over fifteen years ago in the Harvard Business Review. As you know, 'myopia' means 'nearsightedness or shortsightedness' - the phenomenon of seeing what's right before you, but being unable to discern what's beyond, in the distance. In the article, the author chided just about all businesses for being shortsighted. But he took particular delight in 'needling' some specific businesses and industries. For instance, he said that the oil companies were so myopic that they continued to focus their attention on better gasolines and oils because they thought they were in the oil and gasoline business. "Wrong!", said the author. "They were in the ENERGY business." He went on to say that if the "oil" companies would just take a look, they'd find that the average American woman hates to go into a filling station, for any reason! She will almost be willing to run out of gas rather than drive into a filling station. For this reason, said the author, the oil companies should be looking, not for better or more efficient oils and gasolines, but, rather, for new forms of energy such as (for instance) solar energy, nuclear energy, and the like, so that any car owner can, if he or she wishes, replace their oil/gasoline engine with a simple solar cell, under the hood, and be able to drive some 45,000 to 50,000 miles on a single charge of the solar cell, without ever having to drive into a filling station for any reason!

In the same article, the author said that the railroads, in about ten to fifteen years, would be essentially out of business, because their executives and senior corporate officers mistakenly believed that they were in the "Railroad" business. "Wrong again," said the author. They were not in the "Railroad business", they were in the "Transportation business", the people-moving and products-moving business!

How right was that author? Just take a look at the fix in which the so-called "oil" companies find themselves, with few petroleum reserves, and very limited capital with which to explore for more such reserves. Then take a look at the sad plight of the "Railroad" business. Where are the railroads? Just about gone. Why? Because the officers and directors of the railroad companies had 'Marketing Myopia' - they didn't look beyond the immediate future of that time, to what we presently call the "here and now". NO ONE WAS PLANNING FOR NOW, WHICH, AT THAT TIME, WAS THE "FUTURE"! As a result we now have what? "Amtrak". And this is

nothing more than a "has-been" in transportation - a people and materials-moving operation which has largely been supplanted by the trucks, planes, barges, and other forms of transportation, which are mostly self-supporting, while you and I are paying good tax dollars to subsidize what should have been allowed to die long ago - the inefficient, expensive and clumsy transportation form we know as 'railroads'. And all this because of "myopia" - the failure to look toward, and plan for, the ultimate target and goal - the FUTURE.

You and I know many people, now in their chosen fields and professions, because they knew what they were seeking long ago, and they strove and worked toward those targets and goals. I know a young man of thirty who is a cardiac surgeon. It happens that he knew, when he was in the sixth grade, that he was going to be a cardiac surgeon! And he never lost sight of that goal. On the other hand, we also know of both men and women, now middle aged, who still don't know 'what they want to do, or be'. As a result, they keep floundering around, seeking what they choose to call 'happiness', never seeming to realize that true happiness is not an end result or goal, but rather the simple process of striving toward that goal!

What you seek you can get? Is that a truism? You bet. One of the famous golf course superintendents is Bob Williams, of Bob-O-Link Golf Club in Chicago. Bob is one of the most astounding innovators and thinkers and doers I have ever known. He has been a superintendent for over forty years. Long ago he set his sights ahead, always ahead! He established 'five-year plans' which are the model for similar plans at courses all over the United States. Each year he up-dates his five-year plan, to eliminate what has been done, or which has, for some reason, been removed from his list of goals, and he inserts in their places new targets and goals. He never loses sight of those goals, is always striving to make sure of their accomplishment. In the process, over the years, Bob has had another overriding goal - to up-grade the profession of the Golf Course Superintendent, and to train men to become top professionals in this field. Can any of you possibly imagine the satisfaction and down-right happiness that must be Bob's right now, in 1977, as he 'points with pride' to one of his former employees and former 'students', Ted Woehrle, Superintendent of Oakland Hills Country Club at Birmingham, Michigan, who has been selected by his peers as President of the GCSAA? Such is another goal that Bob Williams and Ted Woehrle, too, have not only sought, but achieved!

Just how do you achieve that sometimes elusive 'success'? There are any number of ways. One is to learn every facet of the job above you, so that you will be able to 'take over' the minute your predecessor moves upward or vacates his position, or you are called upon to fill in for him. 'Go to school' on those you admire most, seek to emulate them in every way you can. Educate yourself, as you are doing, indeed, by attending great educational conferences like this one. Practice humility, the art of realizing that no matter how much you know, someone else probably knows just a little more. Find out what that 'little more' is, and then learn it and make use of it. Be on the alert for opportunities. Someone has said that if you are doing something the same way you did it last year you probably are doing it wrong! What it means, in essence, is that opportunities in droves are confronting you all the time - to do something you didn't do at all last year - or to do something better this year than you did it last year. If ever you feel you are able to sit down with your feet on your desk and tell yourself, "Goodie, I'm all caught up", at that moment you are indeed on the down grade - heading for inferiority!

Why do the really successful people succeed? First of all, they expect, and work toward success. They don't know the meaning of the words, "It can't be done." Instead, when they encounter a problem or obstacle, they ask themselves, "What do I need to do to get this done?" Then they find out, and they do it! Secondly, they don't wait to be told what to do. By and large, they are 'self-starters'. They really challenge themselves! All of you know the story of the mountain climber who, when asked why on earth he determined to climb Mount Everest, said, "Because it's there."

You and I know one of the greatest self starters in the entire world of Turf. His name is Tom Mascaro. It was his motivation, along with that of Drs. Jack Harper, Fred Grau, Bert Musser, Joe Duich, and others, that made possible the Pennsylvania Turfgrass Survey of 1966, which, once and for all, showed the tremendous value of turfgrass; in fact, proving that turfgrass was, at that time, the largest agricultural crop in the State of Pennsylvania! When health problems began to limit Tom's activities, he moved down to Florida. Did he just sit on his 'duff'? He did not. In 1974 the State of Florida published its own Florida Turfgrass Survey, showing the tremendous value of turfgrass in Florida - disclosing, in fact, that it ranks second down there only to the citrus crop. Take a look at the inside of one of the front pages. There, among the names of those responsible for bringing about that fine survey, you will find the name of (you guessed it) Tom Mascaro. Note that what Tom seeks, he gets!

When success is elusive do you, like so many others, tend to place the blame for not attaining it upon others? At a sales meeting one time, one of the speakers invited each of the salesmen present (there were twenty-five in the group) to write down, and send up to him, a brief note giving the reasons why he lost a sale, or failed to solve a problem, or in some way fouled up. Do you know that twenty-four men in that group put the blame on someone else?

In one case, the fellow said, "I got the order, but the Shipping Department didn't ship it on time." Another said, "My boss just wouldn't give me the back-up I needed." Still another said, "The laboratory made the specifications too strict, so that the material I wanted couldn't be produced according to specifications." And so it went, until the speaker read one from the twenty-fifth man. In his brief note this man said, in effect, "Whenever I encounter a boo-boo or a problem or a bad situation, I've found, usually, that the fault was nobody's but my own! Either I failed to communicate what I wanted done, or I was a really poor motivator. In short, any time I didn't get done what I wanted done, I boiled it down to one thing - I was a lousy manager!" How many of us, here in this room, are ready to make such an acknowledgment?

The other day, I heard on the radio, and then read in the paper, the story of a remarkable talk by Mr. W. Clement Stone, who, among other things, has accumulated some four hundred million dollars, is happy in what he is doing, and certainly, in most of our minds, must be considered a success. I would say, for example, that what he seeks, he gets!

What's Mr. Stone's secret for success? Believe it or not, it is "PMA"! He says that success is generated by PMA, and by this he means POSITIVE MENTAL ATTITUDE! Says Mr. Stone, "What the mind of man can conceive and believe, the mind of man can achieve." I believe him. He says that it doesn't matter how high you set your goals, if you are willing to pay the price. And this doesn't

necessarily mean in terms of money. Rather in terms of dedication, determination, and plain hard work. Remember, you can 'wish' the yard full of leaves to be in one pile, IF you do some raking! It takes effort, along with the wishing.

Most of us know what we want - and even how to go about getting it. Where we get bogged down is in our inertia, our almost complete lack of the very important element of success called motivation! Are you a real motivator? Are you a real 'self-starter'? If so, your success is assured because I'm sure you know what you want, and how to get it. Making the very first move to start that process toward success is the tough one. Can you do it? Of course you can. What you seek, you can get!

Just one more thing. It is important to do a bit of soul searching when you start your quest for success or continue the good start you've already made. May I suggest you ask yourself the question that I heard from Richard Evans when he was the commentator during the Sunday morning hour of music by the Salt Lake City Tabernacle Choir. During the discussion on how you determine whether you are on the right track, in your heading for success, Mr. Evans said that every man should ask himself the very serious question, "WOULD YOU HIRE YOURSELF?"

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EDUCATION - WHAT IS IT ABOUT?

Palmer Maples, Jr., Director of Education, GCSAA
Lawrence, Kansas

Someone said the only way to have an intelligent conversation is to first agree on the definition of all words that would be used in the conversation. Let's review some definitions:

Education

1. The act or process of imparting or acquiring general knowledge and of developing the powers of reasoning and judgment.
2. The result produced by instruction, training or study.
3. The science or art of teaching.

Knowledge

1. Acquaintance with facts, truths, or principles.
2. The body of truths or facts accumulated by mankind in the course of time.

Art

1. The quality, production, expression, or realm of what is beautiful.
2. The class of objects subject to aesthetic criteria.
3. The principles or methods governing any craft, skill, or branch of learning.

Science

A branch of knowledge or study dealing with a body of facts or truths systematically arranged and showing the operation of general laws.

Any skill that reflects a previous application of facts or principle.

Teaching

To impart knowledge or skill - to instruct.

Example: species - scientific name

Centipedegrass is Eremochloa ophiuroides

Bermudagrass is Cynodon dactylon

Our objective would be to acquire that particular knowledge that we would use as we perform our responsibilities. Example: A golf course superintendent.

1. Golf Course Management

"through the green" - whole area of the course except

- a. teeing ground and putting green of the hole being played
- b. all hazards on the course

The putting green is all ground of the hole being played, which is especially prepared for putting or otherwise defined as such by the Committee.

The teeing ground is the starting place of the hole to be played which is rectangular in shape, being two club lengths in depth, with the front and sides defined by the outside limits of two tee markers.

Therefore, to consider Golf Course Management we must know something of the rules of golf.

Another response - Golf is played on grass, which can be described in quantity and quality.

Grass grows depending on: soil, water, air, nutrients and physiology of plants.

Grass mowing means understanding machines, gears, belts, motors, and fuels.

2. Area Management

- a. entrance roads
- b. parking lots
- c. driving ranges
- d. swimming pools
- e. tennis courts

3. Landscaping

- a. plants
- b. maintenance of plants
- c. planning use of
- d. planting and removal

4. Structures

- a. buildings
- b. fences
- c. bridges
- d. shelters

5. Equipment

- a. purchase, loans, leases, rents
- b. storage
- c. repair
- d. service
- e. parts inventory

6. Personnel

- a. hiring
- b. training
- c. appraisal for:
 - 1. dependability
 - 2. quantity or work
 - 3. initiative
 - 4. cooperation
 - 5. quality of work
 - 6. aptitude
 - 7. personality
 - 8. judgment
- d. supervising
- e. dismissal

7. Materials

- a. purchase
- b. storage
- c. inventory
- d. application: fertilizers
pesticides
Government alphabet agencies: EPA, OSHA, IRS

8. Budget

- a. preparation
- b. explanation
- c. execution

What budget does - objectives

- 1. planned use of income
- 2. defines limits of operation
- 3. estimate of expenditures
- 4. judge of management

9. Record Keeping

- a. budget
- b. plan of work
- c. reference for reports

10. Knowledge of Golf

11. Reporting and Advising

- a. Green committee
- b. Club board
- c. Golfers information

As we consider objectives what our response will be depends somewhat on our education and experience.

Some responses

- a. Seek counsel of fellow superintendents
- b. Seek counsel of other professionals
- c. Question researchers
- d. Attend educational meetings
 - 1. One day - chapter
 - 2. Seminar
 - 3. Turf Conference and Show
- e. College short course
- f. Contact turf and extension representatives
- g. Library - own, school and public
- h. Try your research - proofing and experiencing

To have completed four years at a University says many things. Time involved, acquired knowledge, special areas. Gone into higher learning - what is higher? What is complicated?

Firing order of a car motor is not complicated to an auto mechanic, might be to a lawyer or chemist, but so would a prescription be to an auto mechanic.

Cooperation, coordination, and communication are the three basics of contact with every individual, employer, and employee. These are vital in relating with the professional, club manager, and club officials.

What has all this to do with education? We can say it is involved in all your relationships and responsibilities.

All people are uneducated about some subjects; all people are educated about some subjects in varying degrees. We are all ignorant - just about different topics. As we go through life isn't it amazing how much we find that we don't know.

Each individual has his own accumulation of facts and truths and skills which comprise his knowledge or education. The idea is to know those things that will help us take care of our responsibilities.

Our education then is based on our particular response to an objective.

Let us respond, and keep on getting this EDUCATION!

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GROUNDS AND GAMES OF TURF

David C. Harmon, Manager of Recreational Facilities
The Colonial Williamsburg Foundation, Williamsburg, Va.

We have heard many excellent talks over the past couple of days that have provided each of us with stimulating ideas and mounds of information. Now it's time to sit back and enjoy some of the beautiful gardens of Colonial Williamsburg as well as the old colonial game of lawn bowling.

Do you want a game for your country-club-at-home that everybody can play? One that's easy to learn? Do you want a sport that does not need lots of elaborate equipment which costs money? Do you want a pasttime which can be played in a small space? Do you want something that's exercise yet fun for the whole family?

When you bowl on the lawn you are enjoying England's oldest competitive sport, and one that is rapidly becoming popular in this country. To be sure, you needn't play it on the lawn. In Florida today it is widely played on marl, a mixture of clay and lime over which a sprinkling of sand has been thrown. Certainly it is one of the best of all sports for the lawn, lots of fun, and a marvelous party or family game.

Incidentally, this game of bowls will not damage turf for play is seldom confined to a small area due to the variations in distance and direction which the bowls take. Nor will you find yourself obliged to shift your court about from time to time as you will in those more strenuous sports such as badminton, or volley ball, in order to save your grass from becoming a dust bowl.

But if lawn bowls is somewhat less active than games like badminton, it's first class exercise nevertheless, and a first class reducing sport in the bargain. It involves constant reaching, stretching, stooping, bending and throwing. Unlike indoor bowling, which is often a game of strength where you try to knock down a set of pins with one hard, well-directed blow, in lawn bowls the ball is delivered gently and requires skill and science to bring to a stop just at the spot you desire.

To become expert in this game requires concentrated practice, and yet there is much in it to lead the beginner to explore its fascination. Merely to bowl for fun, however, demands no special sporting skill, which is why everyone can pick it up and enjoy playing in a relatively short time. In fact, there is no age limit to its devotees. It can be played with pleasure by a boy of twelve and his grandfather of eighty. And they can both compete together. Name me another sport, save shuffleboard, in which this is possible! Many of our modern sports are for one age group or sex.

Yes, and it's a cheap sport, too. You do not require special pants or shirts or windbreakers or special clothes or a special kind of court. The bowls are the only necessary implements of play. With care these should last as long as your interest in the game. If you have rubber soled shoes you can play in any kind of costume. Cut the grass closely, roll and water your green carefully. It must be absolutely level, firm and solid. Otherwise it can be any part of the lawn which isn't devoted to some other sport. Why not introduce this year-round sport to your members this year?

At Colonial Williamsburg we have two lawn bowling greens. One is a practice green for beginners using 328 bermudagrass. The championship green is of Penncross bentgrass and measures 120 foot square. These greens are maintained in much the same way as the greens on the golf course. At least twice a year they are aerified and topdressed. Spot topdressing is done quite often in order to achieve the perfectly level surface demanded by the bowlers.

For the next few minutes, let's pretend we are on vacation back in Williamsburg to visit the many beautiful gardens maintained around the restored buildings.

Williamsburg, the capitol city of colonial Virginia, has been restored to its early appearances through the generosity of the late John D. Rockefeller, Jr., and members of his family. The Colonial Williamsburg Foundation, a nonprofit educational corporation was established "That the Future May Learn From the Past". The 170-acre Historic Area contains more than four-score original eighteenth-century structures, 100 colorful gardens and broad greens, and many other buildings that have been reconstructed after extensive archaeological and documentary research.

Just as naturally as the colonists brought with them to America their household belongings, their kitchen utensils, their tools and books, so, many of them packed away in their baggage seeds, bulbs, and even cuttings of their favorite plants. It is to be expected that fruit trees and kitchen-garden produce would have been thought of at the outset, but ornamentals were not forgotten, and before long they, too, were growing side by side with native plants brought into cultivation in colonial gardens. If we accept the testimony of John Josselyn, who first visited America in 1638, many European flowers were mingled with native species from the very beginning of the colonial period.

The architecture of the restored buildings of Williamsburg, and their interior furnishings, are as completely authentic as expert research can make them. The landscape architects have been equally faithful in their task of re-creating the gardens of the eighteenth century. The basic work of investigation involved in restoration is difficult at best, and, once authentic species are known, further patient and critical appraisal is required for the selection of truly old horticultural varieties. Plants are living things, responsive to their environment and to the care they receive, so that individuals of the same species may appear confusingly different under diverse conditions. The problem is further complicated since nearly all garden plants have been selected, crossed, and "improved" since colonial times. Certain plants used ornamentally have been hybridized, either naturally or artificially, for centuries - or even for thousands of years, as in the case of the chrysanthemums. On the other hand, with most native species growing wild, variations from the form and color known to the colonists are relatively slight, so that here one can be reasonably sure that these are essentially the same as two or three hundred years ago. Surviving drawings or detailed descriptions establish some garden forms without doubt, but with others it is not possible to be absolutely certain that the present generations of "old-fashioned" plants are identical with those of colonial days. Finally, when a correct variety is known, there still remains the problem of obtaining it today.

Let me now take you on a stroll through the gardens of the Governor's Palace, the most beautiful in Williamsburg. The building itself is now an exhibition building. Alexander Spotswood, the colonial governor from 1710 to 1722, devoted his personal attention to the construction of this building.

It was not formally completed until about 1720, by which time it had earned the name of "Palace" from the colonists who resented the additional levies required for its construction.

At the Palace, as in the less pretentious gardens of Williamsburg, the formality of English design is seen. Here we find elaborate geometrical gardens, framed with clipped hedges, and accented with topiary work. Standing watch over the garden are twelve yaupons, a fast growing holly native to this area. "Twelve Apostles" were often found on English estates of the period. Additional "deceits" added to the pleasure of visitors. One such is the holly maze, patterned after the maze at Hampton Court.

In a colonial town like Williamsburg - despite being a planned city it was more rural than urban - nearly every family might raise vegetables, cultivate a few fruit trees, and berry bushes, and keep domestic animals. A horse or two, a cow, and maybe some pigs and chickens would have been most common; some households could have added sheep, goats, ducks, and geese; other households perhaps a pair of oxen.

Gardening activity thus fitted into the tight complex of domestic outbuildings and fenced plots typically found on the small town lot: stables, paddock, service yard, smokehouse, well, kitchen, orchard, and perhaps slave quarters. These, along with the hundreds of trees that shade the homes of Williamsburg, re-create the scenic character of the colonial town. The grounds of the Governor's Palace, with their numerous outbuildings and comparatively elaborate gardens, plus a few other more-or-less extensive layouts, show in formal fashion the same combination of domestic function and natural beauty.

The abundance of unfamiliar plant species in the New World and the prevailing curiosity about natural history in the eighteenth century stimulated botanical interest. Men like John Custis of Williamsburg developed specimen gardens and exchanged plant materials and information with other plantmen. Custis wrote a London friend: "I have a pretty little garden in which I take more satisfaction than in anything in this world and have a collection of tolerable good flowers and greens from England." In many Virginia gardens native trees, shrubs, flowers, and food plants shared space with specimens from abroad, imported usually as seeds or bulbs.

Although many traces were found in the ground, none of Williamsburg's eighteenth-century gardens survived intact into the twentieth; hence the designs of today's gardens have been derived largely from English precedents and from evidence relating to sites elsewhere in the southern colonies. Geometric forms, marl or brick paths linking associated buildings, and fences along property lines as required by colonial law, contribute to the setting. Archaeological evidence, maps, written descriptions, and gardening books that might have influenced the concepts of early Williamsburg assisted in the development of appropriate gardens. In the garden plantings, emphasis is placed on materials - both native and introduced - that could have been available to colonial households.

The most elegant of all the private colonial homes is the Lightfoot House. The mansion itself has been tastefully furnished with fine antiques and equipped with modern conveniences in order to serve as an appropriate guesthouse for distinguished visitors to Williamsburg.

As you can see, working for the Colonial Williamsburg Foundation is a most unusual and rewarding position. One never knows what the next phone call will bring.

I would like to close by extending an invitation to all of you to come and spend a few days in this colonial town. I'm sure every member of your family will be stimulated by what has been preserved from our past.

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LOOK AT THAT! SERVICE AREA

David C. Harmon, Manager of Recreational Facilities
The Colonial Williamsburg Foundation, Williamsburg, Va.

Before I begin I would like to mention that this presentation is intended to point out many different ideas one might use to help better organize his maintenance facilities rather than downgrading anyone's operation. While watching these slides one might also say, it must take an unlimited budget to do those things. Yes, a certain amount of money is necessary, but daily organization and housekeeping don't cost a thing. What is needed in most cases is the rebirth of enthusiasm and fortitude in the superintendent. It is my intention to plant a few seeds that will sprout during the coming season and mature into a well-organized, efficient maintenance program.

Top quality golf course management starts at "home" and home is your golf course maintenance area. In my travels to many different golf courses around this country, I have seen acres and acres of beautiful turf, but I have seen few maintenance areas that I would care to talk about. Yet this portion of the golf course is more important than even the first tee.

Just remember, everything that is connected with golf course maintenance starts at the maintenance area. In this location is your own office, your mechanical shop, your warehouse for supplies, your employee training area, even your gasoline station. In fact, I bet you spend more time here than you do at your own home.

The point I'm trying to make is, why not have this area of your responsibility on the same par as your first tee, third green or tenth fairway. Yes, I know, the golfers, swimmers, tennis players and social members don't play or visit here, so why spend the money? "Old John" is doing a great job on the golf course with what he has, so let's forget him. Well, let me tell you right now, no one is going to forget this superintendent and his men while the clubhouse gets a new addition, or a new pro shop is being built, or while six new tennis courts are being constructed or maybe a new swimming pool is on the drawing board. Just remember, without your hard work and that golf course, there would most likely be no need for a golf pro, or the tennis courts, or that large non-profit clubhouse. Your golf course is the catalyst for the entire operation and your maintenance area should be the control center for the operation. But, can you call your golf course maintenance area a control center fit to operate a million dollar operation? Yes, that's probably what

the land and turf is worth on most golf courses. Let's pause for a few minutes and consider what some of the important things are in our ideal maintenance center.

As we proceed, remember the day of governmental regulations is upon us, as evidenced by O.S.H.A., E.P.A.'s pesticide certification program, H.E.W.'s increased emphasis on conservation of our environment and resources - none the least of which is water. What do all these requirements and regulations mean to the typical golf course operation? It means that a lot of things are going to change, including old traditions and habits. Let us now continue with this information in mind.

I know all of you as conscientious golf course superintendents try extremely hard to maintain a top-quality golf course year in and year out as you see here. But unfortunately, some of you, including certified golf course superintendents, don't take as much pride in your own golf course maintenance center as you probably should. Yes, I said maintenance center; not barn, not shed, equipment storage building or some other degrading term. This important area of your responsibility should be called with pride "The Golf Course Maintenance Center". But maybe this looks so poor that barn, shed, or whatever, may be the proper description.

Let's now examine in detail what might be done to upgrade a sagging program. First, what about your entrance? Most clubhouses have beautiful entrances and surroundings such as these and which I'm sure you probably maintain. Why not landscape your entrance road? Then check the condition of your buildings. Remember, you never get a second chance to make a good first impression.

One of the most important features of any maintenance center is the superintendent's office. The superintendent should have a clean, quiet place to sit down at the end of a long day and go over the next day's schedule, finish those reports requested by the greens chairman or just to visit with friends. The office by all means must be heated and air conditioned. The Superintendent's name should be located near the office door along with his assistants and chief mechanic. The office furniture should include a large desk, telephone, filing cabinets, typewriter for a part-time secretary or yourself, adding machine and other supplies necessary to do your job. The superintendent should see that certificates and awards won by his crew and himself are displayed in a proper location. A clean chair should be provided for any visitors. You shouldn't have to unload a dirty chair or pull up an orange crate for someone to use. The assistant superintendent should also be provided with his own office and necessary supplies. In my assistant's office, I have located our central irrigation control panels for maximum security. Just remember, sheets of paneling are not expensive and are easy to install. Try your hand this year. Fix up your office so you can be proud to invite visitors in.

The storage of your equipment is very, very important. The American Association of Agricultural Engineers states in the publication "Planning Machinery Protection" that "some farm machinery dealers say that equipment without housing reaches junk value in about half the time that housed equipment does." They have observed that equipment which looks like junk usually is treated like junk. They also say that housed equipment has a 20-25% higher trade-in value, sometimes as much as 100% higher than unhoused equipment. So let us try to get every piece of equipment inside or at least covered with a plastic or canvas tarp. Don't leave a \$7,000 tractor

outside in the rain and snow. Here now are just a few types of storage facilities that might be used. Shelves can be built inside to store rotary mowers, edgers, and other small equipment in limited areas. This equipment is not heavy to lift and will utilize more floor space for larger units. Why not install a key board inside your shop where all keys to equipment can be hung when not in use? This will prevent equipment from being misused by the wrong employee. In fact, try assigning specific pieces of equipment to individual employees, then watch your repair bills and down-time disappear. Everything in its place. How about that for a goal in 1977? Here rakes, shovels and miscellaneous tools are stored for easy inventory. What about fertilizer storage? All fertilizer should be stored in an area as moisture free as possible. Keep bags up off the floor by stacking on discarded pallets. If you have a large enough area for maximum storage, be sure to take advantage of the winter discounts offered by several fertilizer companies.

From now on it will be the law to store all pesticides in a separate room which can be kept locked and equipped with proper ventilation. Local fire departments should be made aware of what you have in this inventory.

In order to keep all that expensive equipment running day in and day out, it is imperative to hire a qualified mechanic and then provide him with a clean, heated, well-organized shop. It is most important to see that the shop is properly lighted due to the necessity of close-up engine work. I believe you will get more efficient and quality work out of your mechanic if he can operate out of a well organized shop. See that maintenance manuals are kept in a numbered filing cabinet for quick references. Ever try to order parts over the telephone by describing them by looks? Be sure your parts inventory room is always locked to prevent pilferage by a dishonest crew member. Keep those shelves clean and parts in a neat order for easy inventory. If you happen to have several pieces of Toro equipment, I would strongly urge you to sign up for the Toro Red Wagon service. Even golf courses with experienced mechanics will profit from this front door service.

Keeping equipment clean and properly maintained takes time but many benefits are reaped from your efforts. Equipment that is cleaned after it has been used and equipment that is painted yearly will last so much longer. Don't let your men store equipment that looks like this. Board members will be more receptive to your requests for new equipment if they know how you have been taking care of what you now have. All employees should be graded on how well they take care of the equipment that is assigned to them and this report should be included in their personnel file for review at wage increase time. The employee on my crew who gets ahead is the one who does more than is necessary - and keeps on doing it.

The employee locker room is very important in keeping a happy, satisfied crew. This is certainly not going to keep a crew satisfied or an O.S.H.A. compliance officer. Don't forget to provide equal rest rooms for each sex as well as a lounge for females. This is the law! Try assigning a different employee each month to clean the locker room daily. Since labor constitutes approximately 75% of most budgets, by all means use a time clock as your 24 hour policeman. This time clock should be located in or near the locker room. Why not buy an old refrigerator for use in the locker room for lunches? The addition of an air conditioner would certainly improve the morale of the crew.

Bulletin boards, black boards and signs play an important role in my daily communications with the crew. Here is our daily assignment board with foremen's clip boards stored close by. I also find it helpful to use a bulletin board in the office and blackboard near the locker room showing golf course organizational chart and monthly special assignments. Signs are used outside the building for many messages.

Communications are a must in saving time and money during these inflationary periods. Here the general electric portable is shown. I have located such units in our clubhouse as well as on the golf course ranger's vehicle. The superintendent, his assistants and the golf course mechanic should also be equipped with radios. A base receiver such as this can be used also to receive instant weather reports from the National Weather Service. Radios can eliminate many wasted trips back and forth across the golf course. Consider a direct line from the maintenance center to the pro shop. We use such a telephone hook-up many times each day.

If any of you take care of the club's golf cars, treat them as you would your own equipment. Make sure they are kept clean and able to complete one or more rounds of golf each day. The income from these golf cars may just help buy a new tractor or maybe a greensmower for the golf course. Don't forget to provide a work bench and locked parts cabinet for your mechanics. But be sure to keep this area separate from the golf course mechanic's shop. Storing golf cars outside as you see here will only lead to eventual mechanical problems. A covered building for storage is much better but inside storage should be your goal. At our golf course, golf cars grossed more than \$140,000 during 1976. This income can be shared with the golf course operation.

Safety throughout the maintenance center should be at the top of your list. No one wants to see an employee injured because of your neglect. In 1975, it was reported that 238 employees were killed while working on the job in the State of Illinois. The figure for Ohio was 144. All together 12,600 workers were killed last year while performing their jobs. Some of these could have been golf course workers.

Here a red light has been installed to warn the superintendent that the gasoline pump is on. Protective guards must be installed to protect the pump.

Fire extinguishers for ABC fires are located in every room in our building as well as on all major equipment. Eye wash stations must be and are provided in case of an accident involving eye injury. O.S.H.A. states, "Where the eyes or body of any person may be exposed to injurious corrosive materials, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use." Cost of small eye wash stations such as these runs around \$15.00. How about considering the installation of an outside emergency shower close to the area where sprayers are filled?

What are you doing about protecting your building at night from vandals? Look into the possibility of using off-duty policemen during the summer months.

A safety bulletin board should be located in your employees' locker room with safety posters and pertinent information changed on a regular schedule. Install a safety score board outside the shop to remind crew members of their accident record. Hard hats, safety shoes, safety glasses and goggles along with other protective equipment must be provided where necessary to protect the employee. O.S.H.A. states, "Helmets for the protection of heads of workers from impact and penetration from falling and flying objects and from limited electric shock and burns must be provided and meet the requirements and specifications as found in the Federal Register." Cost of most hats runs around \$6.00.

At our golf course we have organized an employee safety committee which meets monthly to discuss problems and solutions to our safety needs. Each person on the committee is assigned specific responsibilities with an oral report given at monthly meetings. An incentive program has been established to reward the safe worker. This is accomplished by the giving away of gifts every 120 days through a lottery system. A safety party is held at the close of each year with my boss and safety leaders in our company on hand to present awards. The amount of money spent to maintain such a program is only a fraction of the amount that could be spent if an employee were to have a serious injury while working.

By all means keep your building clean and organized. What will your boss say if he comes down and finds wasteful conditions while at the same time he is reviewing your request for a new tractor? Keep brooms and dust pans handy throughout your buildings for easy access during the day. I believe good housekeeping practices in the maintenance building will spill over onto the golf course.

Constantly reminding your crew to work safely at home and on the job will pay tremendous dividends to your organization. Post reminders on all dangerous equipment. Use all sorts of signs and stickers where possible. Many of these can be purchased from the National Safety Council at a reasonable cost. Follow O.S.H.A. regulations now before a compliance officer shows up to conduct an inspection of your facilities. A copy of the Federal Register can be obtained at no cost by all employers; therefore ignorance of the law is no excuse. O.S.H.A. is here to stay so one might as well get his ship in shape now. Every day you wait will only cost you more.

To summarize in a nut shell - people can be divided into three groups: those who make things happen, those who watch things happen, and those who wonder what the hell happened. I hope you fall into the first group.

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YOU, YOUR EMPLOYEES AND O.S.H.A.

David C. Harmon, Manager of Recreational Facilities
The Colonial Williamsburg Foundation, Williamsburg, Va.

Did you know that in 1975 there were 12,600 on-the-job fatalities in the United States? Did you know that some 80,000 men and women were permanently disabled at their jobs? About 25 million persons were injured badly enough to be forced off the job for at least one day. Over 250 million man days were

lost. Over three billion dollars was paid in workman's compensation. The rate of incidence of injury and illness cases was reported that year at 10.4 per 100 full-time workers. Statistics such as these is part of the reason the Williams-Steiger Occupational Safety and Health Act of 1970 was passed by Congress. This Act is the most all-encompassing job-safety legislation the United States has ever seen. Yet, how many of your employees know what O.S.H.A. means? Not many, I'm sure, even though this Act was passed strictly for their benefit with the cost to the employers running into the millions of dollars.

Who is affected by this Act? The Act applies to every employer engaged in commerce in the United States, District of Columbia, and U. S. territories. U. S. Government employees are not covered by the Act unless the state has filed an acceptable plan with the Federal Government. Charitable or non-profit organizations are covered by the Act, as are churches and religious institutions when they employ persons in secular activities.

It was the desire of Congress to have every working man and woman covered by some safety and health act, so whether it be the Federal Act, State Acts, or Federal Agency regulations, every worker now or in the near future will come under safety and health standards to insure his or her safety while working.

What are your obligations under this Act? First, employers are required to furnish their employees with places of employment that are free from recognized hazards that can cause death or injury. The employer must also comply with the safety and health standards issued under the Act such as record keeping, reducing hazards, informing employees, etc. The Act also states that "each employee has the duty to comply" with O.S.H.A.'s safety and health standards as they apply to his own actions and conduct. However, the major burden rests with the employer for employee education, as well as for interpretation of what constitutes safety and health standards.

The superintendent has a definite role in meeting the existing standards and in defining and avoiding hazards. Since he is in charge of a large group of employees involved in potentially hazardous jobs, the steps taken by the superintendent to protect and safeguard their personal safety and health are critically important. Any employee, who believes that a violation of job safety or health standards exists, may request an inspection from an O.S.H.A. compliance officer with the guarantee that his employer will not know his identity. The Act also provides that no employee may be discharged or discriminated against because he files a complaint or testifies in any proceedings related to the Act. An employer may take disciplinary action against an employee who refuses to comply with safety regulations or refuses to use the safety equipment provided. However, the employer bears full responsibility for enforcing the O.S.H.A. standards. He must not only provide safe premises and post rules of conduct and safety equipment, but he must also see to it that his employees read the rules and standards, that they understand them, and that they carry them out.

What about inspections? Inspections and/or investigations are performed on a priority basis and complaints by employees and/or employers rank high. First is the investigation of catastrophes and fatalities; following are complaints by employees, target industries and the random inspection of all types of industries and establishments. A Labor Department safety compliance officer may enter any establishment to

inspect the premises at any reasonable time and without prior notification. The Act permits the employer and a representative of the employees to accompany the compliance officer during the inspection. When an inspection or investigation reveals a violation, the employer is issued a written citation describing the specific nature of the violation. In 1977 it will require more than ten non-serious violations before any fine will be assessed. If a business does have more than ten non-serious violations, they will be notified of the amount of the fine, if any, within a reasonable time after issuance of the citations. For each violation, a fine of up to \$1,000 may be imposed; for a serious violation, a mandatory fine of up to \$1,000 must be imposed. An employer may be fined up to \$1,000 per day for each day past the time limit in which he fails to correct a violation. An employer may be fined up to \$10,000 for each willful or repetitive violation of the Act. An employer may be fined up to \$10,000 and imprisoned up to six months for a willful violation leading to the death of an employee; double the penalty for a second offense.

The Act requires that employers keep accurate records and make periodic reports of work-related deaths, injuries and illnesses when medical treatment (excluding first aid) is required. Any accident fatal to one or more employees or which requires hospitalization of five or more employees must be reported to the Occupational Safety and Health Administration within 48 hours. Employers can be required to keep accurate records of employee exposures to potentially toxic materials or harmful physical agents.

What are the immediate standards which must be met by the golf course superintendent?

1. That no employee dealing with toxic materials or harmful physical agents will suffer material impairment of health or functional capacity, even if such employee has regular exposure to the hazard dealt with by such standard for the period of his working life.
2. Development and prescription of labels or other appropriate forms of warning so that employees are made aware of all hazards to which they are exposed.
3. Prescription of suitable protective equipment.
4. Monitoring employee exposure to hazards at such locations and intervals and in such manner as may be necessary for the protection of employees.
5. Prescription of the type and frequency of medical examinations or other tests for employees exposed to health hazards.

Now let us take a look at some of the protective equipment that should be provided by you and used by your employees and also some of the safety equipment and programs you should make available to the employee. A great majority of these items can be obtained by catalog through a local safety supply company.

1. The law requires that your employees be informed of the job safety and health protection provided under the Act. This is attained by requiring you to post the "OSHA Poster" in a prominent place in the establishment to which your employees usually report to work.

2. The Act requires that respirators be provided by the employer when such equipment is necessary to protect the employee. Respirators must be provided which are applicable and suitable for the intended purpose. In addition, employees must be trained in the proper use and limitations of the equipment.

3. Where there is a reasonable chance that eye injury might occur, protective eye and face equipment must be provided under the Act. The equipment must provide adequate protection, fit properly, be durable, be capable of being disinfected and cleaned, and be kept in good repair. It will be up to you and your supervisors to constantly check for violations among your employees.

4. Helmets and head protective gear must be provided where necessary to protect workers from impact and penetration of falling and flying objects, and from limited electrical shock. In the State of Virginia, the O.S.H.A. Director requires approved safety hats be worn by all golf course employees while working on the course.

5. First aid supplies, as approved by a consulting physician, must be readily available. Empty cabinets are a no-no and those found will receive a citation.

6. Protection against noise exposure must be provided. Employers must ascertain that noise levels do not exceed O.S.H.A. standards, and if they do, ear protection equipment must be supplied. Did you realize that the noise generated by a small leaf blower is equivalent to a pneumatic air hammer?

7. Where there is a danger of hazardous materials splashing onto the body or into the eyes, eye-wash fountains and/or emergency showers must be provided.

8. Flammable or combustible liquids must be kept in safety cans of approved size and construction. Each can must be labeled to its proper contents and stored in approved locations.

9. Floors must be kept clean and non-slippery. Exits must be marked, not locked or blocked.

10. Protective clothing (including gloves, shields, safety shoes and aprons) must be provided when chemical hazards, mechanical irritants, radiological hazards or hazards of the environment or processes may cause injury through adsorption or contact.

11. Portable fire extinguishers must be kept in conspicuously located places where they will be readily accessible and immediately available in the event of a fire. On-the-job fires in 1975 amounted to losses amounting to over two billion dollars.

12. Fires are classified into four general categories as follows:

Class A - fires in ordinary combustibile material, such as wood, cloth, paper and rubber.

Class B - fires in flammable liquids, gases and grease.

Class C - fires which involve energized electrical equipment where the electrical non-conductivity of the extinguishing media is of importance.

Class D - fires in combustibile metals, such as magnesium, titanium, sodium and potassium.

In purchasing your fire extinguishers, select ones rated for Class A, B and C fires. Fire extinguishers must be installed on hangers or in brackets provided. Extinguishers not exceeding 40 pounds may be installed so that the top is no more than 5 feet above the floor. All extinguishers must be inspected on an annual basis and recharged if need be or replaced. Don't take any chances and overlook this most important part of your safety program.

13. Most golf courses have their own gasoline pumps, but many are in violation of current O.S.H.A. standards. A suitable fire extinguisher must be located within 75 feet of the pump. No smoking signs must be posted and guard posts shall be provided. All engines must be off when gas is being placed in vehicles. Citations will be issued if you are not providing or following these procedures.

14. Is your maintenance building protected if a serious fire were to occur? Did you know you can have a direct fire alarm system connected to the closest fire station to you? In most areas, for as little as \$5.00 per month, your maintenance building can be protected. Our complete maintenance center has such a system. Heat sensors are located in every room and connected through a master control unit to the local fire station. In the event of a fire, a signal is sent from the sensor through private telephone lines directly to the fire station. Within minutes a fire truck is on the site. The master control unit in the building also is installed with a fire bell to warn employees of danger. This system does have its own battery source in the event of a power failure.

15. Compressed air used around your shop shall not be used for cleaning purposes except where reduced to less than 30 p.s.i. and then only with effective chip guarding and personal equipment. Use an overhead recoil hose holder if possible. This will eliminate someone tripping over a hose left on the ground. Post caution signs at your air compressor.

16. Machinery such as abrasive grinders must have safety guards. When in use, protective equipment must be worn by employees. Machinery must be grounded if it has a motor, heater or compressor.

17. Every place of employment shall be provided with adequate toilet facilities which are lockable or separate for each sex. The sewage disposal method shall comply with requirements of the health department or other authorities having jurisdiction. In all places of employment where employees are

permitted to lunch on the premises, an adequate space suitable for that purpose shall be provided for the maximum number of employees who may use such space at one time.

18. Warning lights can be used very effectively on your golf course equipment to help warn the golfers of approaching maintenance equipment and workers. Equipment can hide in the trees or below a hilltop leaving the employee subjected to a possible head or eye injury. Lights are installed on all large equipment used on our golf courses. Back-up alarms are also installed on large and noisy pieces of equipment. Roll-over protection and seat belts are required on all tractors used for agricultural, industrial and construction applications. This applies to all tractors manufactured after 1969 and over 20 h.p. Check with your local O.S.H.A. office about L.C.G tractors.

19. Signs of all kinds can be and should be used by each of you to warn employees of possible dangers, hazards or to convey your own safety program. Sometimes a picture is worth a thousand words.

20. In the event an accident does occur, fast communications are a must. My crew can communicate almost instantly in the event it is required. All telephones have taped to them the phone numbers of the local security, fire and rescue units and the poison control center in the area. How about your phones? Two-way radios carried by selected employees provide instant communication while on the golf course. What would you do if you needed instant help on your golf course?

21. Standards pertaining to electrical requirements have been cited as violations more frequently than any other O.S.H.A. standard. Some of the requirements are as follows: Each fuse box and/or circuit breaker must be legibly marked to indicate its purpose unless its purpose is evident. The grounding provisions of the O.S.H.A. Standards require that all dead-metal parts of electrical power driven equipment shall be grounded. Wherever wires are joined, such as at outlets, switches, junction boxes, they must be covered. Flexible cords may not be used where run through holes in walls, ceilings, or floors. Flexible cords must be continuous lengths without splices or taps. Equipment connected by flexible cords must be grounded either by a three wire cord or by a separate ground wire.

AND LAST, BUT NOT LEAST, IS YOUR OWN SAFETY PROGRAM. HOW IS A SUCCESSFUL PROGRAM ESTABLISHED?

A successful safety program depends on three essential elements:

1. Leadership by top management.
2. Safe and healthful working conditions.
3. Safe work practices by employees.

Leadership by top management cannot be delegated. The employer or chief executive must be willing to accept the responsibility to set the firm's safety policies, stimulate safety awareness in others, and show his own interest if others are to follow and cooperate. All representatives of management must reflect the same interest and attitudes.

Safe and healthful operations means doing all jobs in the proper and most efficient manner. It also means keeping the work place as safe and healthful as possible. The proper way to do a job should be the safe way. To do his job the

proper way, an employee must learn how to do it; and the best way for him to learn is through training and practice. Just knowing how to do a job safely is not enough. A safe operation requires constant attention and reinforcement by additional training. This can be provided by well-planned, regular safety and health meetings that motivate employees and supervisors to be safety conscious.

Employers often fail to realize the value of a safety and health committee. Frequently, supervisors have been left to "find time" for safety and health responsibilities along with their other "normal" activities. A committee does not take away the supervisor's responsibility; it assists him in his constant efforts to maintain an effective safety and health program.

To be successful, a safety and health committee should be involved in the actual planning of the safety and health program and should have a part in making the program work.

An effective safety and health program means training - training for supervisors and training for employees. It also takes the vigorous support of all levels of management. The effectiveness of a safety program is usually directly proportional to the support of management.

Use of safety posters and signs should be used throughout your buildings. These posters should be changed weekly and kept in good condition. Why not establish a safety bulletin board in your locker room and assign one of the employees to be responsible for keeping it up? Maybe use a safety score board to let the crew know what their safety record is. At our course we have established an employee safety committee which meets once a month. Members change yearly in hopes that each employee will get his chance to serve. At the end of each four month period, those employees with no-accident records are eligible for a blind draw in which different gifts are given away. A yearly safety party is given at the end of the year with cakes, cookies and drinks provided by management. My boss and safety leaders in our company are invited to attend and make special awards. The employee who has done the most for promoting safety on-the-job is presented with special awards and designated 'Mr. Safety' for that year. A safety plaque is displayed in a prominent location in our maintenance center at all times. All the above-mentioned things are but a small expense compared to having one of your employees seriously injured or killed while on the job.

Now is the time to act. Take time to form that partnership with your employees and government. Don't wait till one of your employees is injured or an O.S.H.A. compliance officer arrives on the scene. Don't monkey around with the health and safety of your employees. This is one time where procrastination can eliminate or maim our most important natural resource - you and me.

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ZOYSIA OVERVIEW

Douglas T. Hawes, Turf Instructor and Researcher
University of Maryland, College Park, Maryland

As a New Englander, who arrived in the hot, humid transition zone eleven years ago, I have just recently come to a full appreciation of zoysia. I was

raised on Kentucky bluegrass and colonial and creeping bentgrass with more than ample amounts of Poa annua thrown in. Zoysia was just one of those tropical grasses the Southerners grew.

In my early years in Maryland, bermuda, not zoysia, was selling like hot cakes to new homeowners. Their hydroseeded bluegrass-ryegrass lawns on Maryland subsoils had failed the first summer and they were finding bermuda a cheap, rapid covering turf species. My first experience was with common bermuda in my weedy bluegrass lawn. It took a while to comprehend just how fast that weed could grow. I hand pulled a lot of bermuda out of only 800 sq. ft. before I gave up and decided to grow it instead. I still think of it as a nasty but useful weed. Winterkill, spring deadspot and a high nitrogen requirement make bermudagrass a questionable choice for most turf areas. On athletic fields where ability to recover rapidly from intense traffic is essential, bermudagrass overseeded to 'Manhattan' or 'Pennfine' perennial ryegrass is an excellent choice for the transition zone. But bermudagrass is not an excellent choice for homeowner lawns, golf course fairways or like areas receiving only moderate traffic.

After four or five years in Maryland, I learned that annual bluegrass truly should be considered an annual. Kentucky bluegrass would grow well only where protected from the afternoon sun. Fine fescues were fine for well drained shady areas. Creeping bentgrass survived on putting greens if you had lots of fungicides and water. Tall fescue was a coarse bladed weed which only gave decent turf if mowed three inches or higher, but zoysia survived in sun or shade, mowed or not, fertilized or not.

It really wasn't until two or three years ago that I became a full-fledged zoysia fan. There was no one characteristic that converted me; just years of hopeless disgust with everything else combined with a quietly growing respect for this grass of oriental origin. Let's look at its advantages.

Advantages of Zoysia for Transition Zone

Zoysia, once established, requires a minimal amount of nitrogen, water and mowing. The nitrogen requirement appears to be about 1 to 2 lb.N/1000 sq.ft. This amount gives you a very nice dense turf. Only bermuda and tall fescue seem to need less water than this drought tolerant species. Mowing needs in the transition zone are highest in July and August. Although this grass is often advertized as needing only infrequent mowing, the fact is that more is needed for long term quality turf. Only heavy reel type mowers should be used for best results.

The japonica strains of zoysia are much more winter hardy than even the most winter hardy bermudas. They are, however, still brown from the first frost until spring.

Zoysias can withstand close mowing. There is a nine hole government managed facility just north of the District of Columbia which has had Meyer zoysia greens for the past 24 years. They don't begin to compare with creeping bentgrass greens in putting quality, but the point I would like to make is they have survived for 24 years with a minimum of maintenance at a cutting height of about 1/3rd of an inch. There are two things I would like you to consider here. First, that zoysia is quite capable of surviving under low mowing. Secondly, zoysia may be at its best when managed at a low level of maintenance.

Time and time again I have seen zoysia persisting in quite acceptable condition where it received only minimal management. Dr. Strickland, Maryland's long time turf consultant for athletic fields calls this "benevolent neglect". He claims all turf

species do better with this type of management. I'm not asking you to buy that, but you will find that zoysia is capable of providing decent turf when managed with "benevolent neglect".

Meyer zoysia is not a weed problem like bermuda. It will only slowly invade sand traps and flower beds. I have never seen it growing into shrubbery the way bermuda does. I'm told, though, that it will break up asphalt almost as fast at bermuda.

Last, but not least, if you have to manage turf in or on the edge of a city, it is very tolerant of air pollution. Zoysia's ability to tolerate heat, air pollution, and some shade make it an ideal grass for lawns in heavily populated urban areas of the transition zone.

I would like to note here that in Japan zoysia is the predominant forage species in pasture as well as the dominant turf species on golf courses and lawns.

To be useful, zoysia must be established vegetatively from winter hardy varieties. Horizontal stem material is extremely slow to root. Meyer, the preferred variety, is a very slow spreader. Put these three factors together and you have the basis for understanding why zoysia sod is expensive. This explains the reason for primarily establishing zoysia by plugs or sod. Research is needed to find a way to cause zoysia stolons to root faster.

Mowing is difficult. Heavy reel-type mowers that are kept sharp will give best results. A complaint of bristle-like sponginess appears to be due to a combination of management practices. Excess nitrogen with or without too high mowing results in a slightly unstable footing. The long, stiff bristle-like growth isn't quite strong enough to hold one up firmly. Using a mower that is too light or mowing too infrequently will produce the same results. Close mowing or vertical thinning and sweeping in early spring (or in midsummer) can reduce thatch. Earthworms ingest much dead tissue and reduce thatch.

There are billbugs and nematode problems that can't be ignored. Although the latter of the two pests doesn't seem to be a problem here in the Midwest, they definitely are causing losses in the Maryland area. The conditions under which the turf becomes susceptible to these two turf pests are not known. Both pests are difficult to diagnose, and usually have caused much damage by the time a correct diagnosis is made. More research is needed on these two problems. Excess thatch favors the billbugs.

The brown winter color is disliked by many, but it provides a better sports turf cushion than bermuda when dormant. Zoysia is also much more difficult to overseed in the fall for winter green color. It does appear, though, that if managed to favor Kentucky bluegrass (mid-fall fertilization), a reasonably satisfactory combination turf can be managed without yearly reseeding. Such a combination turf does have the drawback of a patchy fall transition period, though.

Warm-Cool Season Grass Combinations

My present research is with such combinations. I have found that a bermuda-creeping bentgrass combination properly managed provides one with an aggressive

turf which will survive nicely under low mowing. Meyer zoysia and Kentucky bluegrass is another promising combination which I will look closely at in the years to come.

My first study on combination turf used high nitrogen levels ($6\frac{1}{2}$ N/1000 ft²/ season). A program of warm season nitrogen fertilization resulted in bermuda invading all combinations and in the death of the cool season grasses. Zoysia survived, but did no more than hold its own. Under a cool season nitrogen fertilization program, creeping bentgrass and Kentucky bluegrass dominated the plots in spring and early summer. Bermuda-grass would dominate by the end of summer and in early fall. Zoysia still did nothing more than hold its own. Future work on zoysia will be conducted at varying N levels, emphasizing lower N rates which should favor zoysia.

Summary

In the transition zone zoysia is capable of handling the heat, humidity, and pollution with less tendency to be weedy than bermudagrasses. It is also more winter hardy and requires less management than bermuda.

Zoysia is difficult, slow and expensive to establish. It does have pests problems, but these do not appear to be as serious as those of other turf species used in the transition zone.

I think your move from bermuda to zoysia in the Southern Illinois-Indiana area is to be complimented.

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WARM SEASON GRASSES - THEIR ADAPTATION AND USE IN VIRGINIA

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There is a moderate to intense interest in warm season grasses in Virginia depending on the area of the state involved. The interest centers primarily on the adaptation and use of bermudagrass, but to a lesser extent on zoysiagrass as well. The interest in Centipedegrass and St. Augustinegrass is limited to the near sea level areas in Southeastern Virginia, due to the low level of cold tolerance exhibited by these species. Homeowners and turf managers are interested in bermudagrass and zoysiagrass because these species are better adapted for turf in the warmer areas of the state, and are easier to manage than Kentucky 31 fescue.

The transition zone between warm and cool season turf species passes through Virginia and influences turf management practices in much of the state. In this zone there is great variation in climate within short distances. Extreme changes in temperature often occur within a matter of hours and the area is subject to periods of moisture stress with from short to extended periods of drought occurring during most years. The cold temperatures and weather conditions of winter often causes injury or serious loss of bermudagrass.

In periods of hotter summers and mild winters the use of bermudagrass on golf courses especially tends to move northward. The introduction of varieties with more cold tolerance has resulted in the use of bermudagrass for turf especially on fairways and football fields in areas north and west of the traditional bermudagrass areas. The use of zoysiagrass has expanded slower than bermudagrass during the past twenty years, due largely to its slow rate of establishment from plugs or stolons and the cost involved when establishment is achieved quickly by sodding.

Where adapted, bermudagrass and zoysiagrass exhibit superior tolerance to heat, drought and wear to Kentucky 31 fescue. They also will tolerate mowing heights of a minimum of 1/2" and 3/4" respectively, in lawn and general turf areas, and normally are not seriously injured by disease except when conditions that cause a high level of stress are encountered. Both species are persistent but have a tendency to produce thatch which must be controlled or unsatisfactory turf or even loss of large areas of turf usually results.

Much of our work at Virginia Tech has involved overseeding of bermudagrass under green and tee management with temperate species in an effort to reduce the undesirable characteristics of the transition from cool to warm season species. Other work has involved evaluation of promising varieties for use in lawns, athletic fields, fairways, and tees.

The following bermudagrass varieties and strains are currently in the testing program:

<u>Variety</u>	<u>Use or Potential Use</u>
Tifgreen	Greens, golf or bowling
Tifdwarf	Greens, golf or bowling
Tifway	Fairways, tees, and lawns
Tufcote	Athletic fields, lawns, fairways and tees
Midiron	Same as for Tufcote
Burning Tree)	
Snyder)	Being evaluated to determine if they are
8 selections from)	better adapted than the currently used
Appalachian areas)	varieties

Four zoysia varieties are currently in the testing program: Meyer, Emerald, Midwest and 21-15-24. Meyer and Emerald are in general use for lawns scattered throughout the state at elevations lower than 2000 ft., generally below 1000 ft., but persists in the Blacksburg area at elevations of slightly higher than 2000 ft.

Oaklawn and Tennessee Hardy Centipedegrass and one strain of St. Augustine-grass are being observed in plots in Southeastern Virginia.

Common bermudagrass has been used for many years in southern and coastal plain Virginia for lawns, athletic fields, fairways and tees. Tifgreen and later Tifdwarf have gained rapid acceptance for greens in Southeastern Virginia following their introduction. In recent years, Tufcote and Midiron bermudagrass with their greater tolerance to cold are expanding the traditional bermudagrass area north and west, particularly for athletic fields.

Dr. R. E. Schmidt at Virginia Tech is currently expanding research with bermudagrass in south central Virginia. Studies at Blacksburg will be aimed at a better understanding of cold susceptibility and tolerance and at management techniques that will enhance winter survival.

Meyer and Emerald zoysiagrass are used almost entirely for lawns although some zoysia is used around tees and for other special uses on a few golf courses. One baseball infield in a city park has been sodded to this species. It has potential for fairways, formal turf areas in parks, and a much greater use for

home lawns. As more cold tolerant varieties become available and cultural practices that impart a higher level of adaptability are developed we expect the use of bermudagrass and zoysiagrass to increase within the transition zone and to extend northward beyond it for specialized turf use. Satisfactory performance of these species in climatic conditions for which they are only partially adapted can be expected to require the use of well selected varieties and the skill of a highly trained turf manager.

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GRASS SEED YESTERDAY, TODAY AND TOMORROW

Robert J. Peterson, Vice-President

E. F. Burlingham & Sons, Forest Grove, Oregon

The high quality turf seed available today is certainly the result of what we have learned in the past. To an even greater degree, the grass seed of tomorrow will be the result of an opportunity to use techniques we have now perfected, plus the opportunity to continue our research. We can, in the future, produce even higher quality seeds, in spite of the various restrictions which will be forced upon us by environmental legislation.

For a moment let us take a look back at the past. It has not been too long ago that grass seed was a by-product rather than a cultivated agricultural crop. For example, Kentucky bluegrass was stripped from old pastures in the Midwest. In the mid-1920's a group of agricultural leaders in the State of Oregon undertook a study to find a new source of income. This group recorded the following statement:

"Due to its relatively high value per pound and the high yield per acre of small seeds in Oregon, it is recommended that the Oregon farmers enter more extensively into the production of small seeds such as clovers, grasses, and certain vetches."

It was envisioned by these men that seeds might bring into the state an additional income of at least two million dollars annually. In 1976, the annual return is more than seven million dollars in Oregon alone, and it is still growing.

The world looks to the Pacific Northwest as a source of grass seed and the place to have their new varieties increased due to high quality seeds. Today over 300 varieties are being produced in Oregon, and approximately two-thirds of these are turfgrass varieties. Once again, if we look back for a moment at Kentucky bluegrass, Merion was released in 1947, Park in 1957, and Newport in 1958 - not long ago. In the last eight or ten years the number of new cultivars released by both domestic and foreign breeders has increased very rapidly. For instance, our company is producing seed from 61 separate cultivars.

Seed growers who became skilled professionals in the business of growing seed are now moving into second and third generations of persons. Specialization in the production of seeds has been accompanied by the improvising and remodeling of the special equipment needed to perform the necessary functions of seed production.

With that brief background we now come to the subject of grass seed today. The specifics in the production of high quality turfgrass seed involve three major

concerns - genetic purity, mechanical purity, and high germination. Genetic purity is critical to insure that the user obtains seed that is true to the variety selected. Mechanical purity insures the user that the seed he obtains is free of unwanted weed seeds, and contaminating crop seed. The highest germination possible for each specific variety is necessary for early establishment.

The remarkable array of new cultivars improve the quality of turf due to their improved disease resistance, texture, color, vigor, longer growing season, and ability to withstand close mowing. To visit these plant breeders across the United States, as well as other parts of the world is indeed a time consuming process, but I know of no other way to keep current on the materials these people are working with. One of the rewards of this type of effort has been the interesting and enjoyable cooperation between the researchers of the land grant universities and the seed industry.

Turf trials on performance over a wide area are necessary to confirm the merits of these new cultivars. Meanwhile, the potential seed yield must be proven. Some of these new strong turf type grasses are poor seed yielders and some may show rather poor germination. As a matter of fact, some experimentals may produce good turf, but have to be dropped because they are such poor seed producers.

The programs that are involved in production of genetically pure seed may not at first glance seem difficult until you realize that annually we produce in Oregon on approximately 300,000 acres over 250,000,000 pounds of seed. The requirements of certification of this seed embody certain ground rules that must be adhered to. Land history requirements state that any new seeding of a specific variety must be on land that has not grown another variety of the same species in the preceding three to five years, depending on the species involved. In addition, isolation must be maintained between varieties of the same species, 165 feet in the case of ryegrasses, bentgrasses, and fine fescues, and 1 rod or 16-1/2 feet in the case of bluegrasses. These isolation distances must be maintained throughout the life of the stand.

The land history and isolation becomes no small task when you realize the over 300 varieties of certified seed being produced in Oregon. All of our production, whether it be our own proprietary varieties or those of others, are produced under contract and under our own supervision. We employ trained agronomists to work with the grower in selecting fields that are qualified for the particular cultural practices involved.

We have a dozen or more selective herbicides that can be used to help accomplish this task, but precision is a key. To be almost right simply will not be good enough.

Two techniques that have developed in the past seven or eight years are designed to help establish seedling grasses that are essentially weed free. These are widely used, and are called chemical seed bed preparation and charcoaled seeding.

In the case of chemical seed bed, a grower prepared his field for planting in the fall, but rather than seeding he allowed the ground to lay fallow, the weeds and contaminants are allowed to germinate and are then sprayed with a herbicide for grassy and broadleaf weed control. The crop is then planted in the spring without additional tilling. Most of the troublesome weeds germinate during the fall and winter and are eliminated. In addition, if necessary, a herbicide such as paraquat is applied just after seeding but before emergence of the crop.

The charcoal seeding allows a further dimension. Since all our seed crops are planted in rows up to 16" wide, a narrow band of activated charcoal can be sprayed over the crop row at the time of planting and then the field given a broadcast application of a sterilant herbicide. This can all be done in one operation, with seeder, charcoal application and sprayer mounted in tandem. The charcoal over the row absorbs the herbicide, deactivates it, thus protecting the germinating plants. We have not done away completely with the necessary use of spot sprayers, or in some cases hand roguing, but we have reduced these operations to a minimum.

A specific herbicide program is used each fall for control of grassy weed or volunteer plants from shattered seeds. We have indeed come a long way.

The consumer has a perfect right to ask for the highest quality seed he is willing to pay for, but seed is an agricultural product and despite all best efforts it is obvious that not all can meet the highest standards. As an example, when you ask for Kentucky bluegrass which is crop and weed free in a 25 gram sample, that is approximately 100,000 individual seeds without one contaminate.

Harvest of our seed crops starts in late June as the ripe seed matures. Crops are windrowed and allowed to remain in these windrows one week until the moisture content of the seed is in the range of 8 to 10 percent. Seed is combined directly from the windrows using a pick-up attachment. From the combine seed is emptied into boxes which can be clearly labeled and are used for storage until seed is ready to be milled in the cleaning plant. Despite the work and effort that goes into the production of high quality seed in the field, the job is only partially done. The equipment used for harvest must be thoroughly cleaned between each use to avoid contamination and attention to housekeeping in the cleaning plant is essential. The equipment used in the mills must be cleaned between lots of seed as well as a good system of checks as the boxes are being dumped. Any mistake here can indeed destroy an entire lot of certified seed.

As a background for the history of field burning, let me say that the straw residue, unless removed, retards plant growth, reduces seed yield, as well as providing a medium for disease transmission from one year to the next. The most notable disease being blindseed disease which destroys germination of the seed.

The dry summers that favor seed maturation also produce dry, highly combustible straw necessary for an effective burning. A plowed strip four to eight feet wide around each field is maintained as a fire break and cultivated periodically to control vegetative growth. Fire is lighted on the downwind side of the field and allowed to burn against the wind as a back fire. When the back fire has burned a safe distance the perimeter of the field is ignited. Once the field is encircled in fire, the rising heat creates a draft which draws the fire together from all sides, completing the operation in a matter of minutes.

The hazard involved in this operation, other than the smoke which has caused much controversy, is wind shifts which can transform the back fire into a main burn. Permits are required in order to burn, and these permits control the number of acres burned in any one area and are available only when smoke dispersal is good and wind direction is satisfactory in relation to a given field and its surroundings. Objection to this practice came with the increase in population in the valley and especially the south end which is surrounded by hills and can, under certain conditions, act as a trap for the smoke.

Research into a mobile field sanitizer has been in progress for a number of years, along with companion projects to find markets for this one million tons of straw which would have to be removed in order to use the field burner. A million tons of straw, when baled in 40 pound bales, will make a stack approximately 15 feet high, 30 feet wide, and over 100 miles long, and in order to be used it must be preserved in some method for once that fall rain starts, the straw will deteriorate. This obviously means some form of densification and storage if this material is to be used.

With the advent of the fall rain these perennial grass fields begin their regrowth and the cycle is repeated.

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BUILDING A MACHINE - A CHALLENGE

H. F. Carroll, Foxcroft Meadows, Crystal Lake, Illinois

Every development of a machine must have some motivation. In our case, it was the old proverb, "Necessity is the mother of invention".

We are operators of a 600 acre sod farm near Crystal Lake, Illinois, which is about fifty miles northwest of Chicago. We started using pallets in our sod business in 1953. Although plenty of forklifts, built around standard farm tractors were available for loading in the field, the unloading and spotting at the delivery site was a real problem.

A standard forklift is heavy, quite difficult to transport, a little hard to maneuver in close quarters, and costly. We needed a machine for unloading that was: 1. lighter in weight; 2. easier transported; 3. more maneuverable; 4. easier serviced; 5. lower in cost.

In 1956 we made an attempt to build an unloading machine around a Gravelly tractor. It was slow and would not work on pallets that were directly over the drive wheels of the truck. The idea was abandoned.

About that time we contracted our trucking to a group of hard working farm boys who did not mind slinging the sod off the pallets to the ground. We received a lot of complaints on broken sod, and we could not get the sod spotted on the site. At least the pressure was taken off for an immediate need of an unloading machine. As our truckers grew older and a little less 'gung-ho' on the physical slinging of sod, we again revived the idea of a need for a mechanical unloader.

We visited some of the professional forklift manufacturers during 1971. We told them of our need for a light weight device that could be carried on our trucks without sacrificing too much payload. We wanted the device to handle at least 3,000 pounds.

The typical conversation always ended like this:

(Forklift people) "How many do you want?"

(Our answer) "Three, but other sod growers must have the same problem, and other industries have trucks to unload too."

(Forklift people) "We don't have a demand for such a device and we couldn't possibly build just three."

After three such interviews we gave up on finding anyone to make a machine for us.

We decided to try the job ourselves. We reasoned that if a spider can carry twenty times its own weight, we should be able to build a machine that need not weigh 9,000 pounds to carry 3,000 pounds.

In early 1972 the idea of a hinged, oversized, motorized hand truck hit us. Not being engineers, we started building, not drawing. First a crude wooden model to prove the principles. Then a full sized tubular framed model with small bicycle wheels to prove our hinge point locations and our center of gravity calculations.

In about two months our sod farm manager and my 'jack-of-all-trades' son-in-law built a workable machine in our farm shop. It was crude but it worked. It went into use in the fall of 1972, and is still running.

All during 1973 and 1974 we worked literally day and night testing, reading catalogs, interviewing salesmen and all the other things necessary to get 'off-the-shelf' component parts that would best function in combination with each other. All these new parts were incorporated in the original machine to simplify and improve.

In the winter of 1975 we built a second machine incorporating all the changes we had made in the first one, without changing any of our original basic ideas. We took this machine to the American Sod Growers meeting in Kansas City during the summer of 1975 for their reaction. We took orders for twelve to be delivered in March of 1976 and built them in our farm shop.

We wanted to get a public reaction before going any further. By the time we got some favorable reports in April, the tire industry went on strike. From a small carry-over of tires and by shipping some machines barefoot, we managed to build another thirty machines during 1976. We have orders awaiting that will carry us into May of this year. Assembling is now being done in a new 52 x 100 steel building.

We are very appreciative of the encouragement received from our friends in the sod industry. Our own use experiences and repeat orders tell us we have made progress, even though I'm sure we and other people will build even better unloaders in the future.

I hope this story will inspire lots of people, especially the younger ones, that there are lots of opportunities for exploiting new ideas to solve problems in America. The encouraging note is that these ideas can come from little people. We can use the big corporations like Goodyear, TRW, Kohler, etc., by assembling their precision built, mass produced, 'off-the-shelf' products in combinations that will solve our problems. All we have to do is to have the idea and select the right combination of components.

(Two short amateur films were run to show transporting and sod handling capabilities).

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MY CREW BUILT PURR-WICKS

Jack Keidel, Supt., Country Club of Terre Haute
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Terre Haute Country Club is located in the Wabash Valley. Our weather sometimes permits year round play. Our summers usually have high temperatures and humidity. With the combination of our heavy soils and high population of Poa annua, our greens become a case of dynamite during the months of July and August.

In the past years, continuous problems prevailed with four to five greens. After several years of facing the same problems, my greens chairman and I drew up a plan for rebuilding five new greens. All costs were figured, whether our crew or a construction company would do the work. After much deliberation we decided that an additional crew and I would undertake the building of the five greens. We decided to rebuild the No. 1 and No. 10, the two worst greens, the first year, one the following year, and two more greens after that.

No. 10 green is situated in a sunken gully, surrounded by trees, and therefore, has very little air movement. We felt that if we could keep excessive moisture off the surface we could maintain grass throughout the year. The decision was made to use Purr-Wick and its water conservation action.

The elevated tee permitted a flat green on this par 3 hole. There was only one small access to the green. After much hand labor and digging with a backhoe, we developed a Purr-Wick base.

Our plastic liner was taped and then laid. Then 2" slitted pipe was laid in a circular design under the green. We installed our flange and box near the rear of the green. After this installation we pretested our liner and flange and found it held water consistently. Sand samples were sent to Purdue, tested, and approved. Approximately 14" of this sand was distributed throughout the green. With only one way to get on the green, much hand work was required. As the sand was leveled by a sand pro, we watered continuously on the sand to help its settling. We added 2" of peat to the surface sand and rototilled it five or six different directions. Again we came back with the sand pro and leveled, following our watering.

We applied 50# Milorganite, 8# starter fertilizer and 2# Pencross seed per 1000 ft.². After seeding, a hand roller was used and a small layer of straw was applied. After ten days the straw was taken off and the green was first mowed on the 20th day. The following May we opened the green for play.

Our membership is very happy with the condition of the green and its playability. During our extremely dry summer last year no problems were evident. We feel our crew did a fine job with the problems we were faced with, and we are more than satisfied with our Purr-Wick green.

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WATER IN THE SOIL

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Turf managers spend a lot of time and effort in managing water. They are faced with the dual problems of keeping enough in the soil for vigorous grass growth and proper soil resilience and at the same time trying to maintain conditions that will prevent the accumulation of water to the point that it interferes with the turf use.

First, let's consider saturated flow. When the large pores in the soil are filled with water, the soil is saturated or near saturation, the water will move in response to the pull of gravity. We refer to this movement as gravitational flow or saturated flow. Under these conditions the water behaves much the same as water in plumbing. It is flow under pressure. The soil conditions that we are talking about are wet soils, not damp, but thoroughly wet.

Since the primary moving force in saturated flow is gravity, the less obstacle we put in the way the faster and more easily it will flow. The larger the soil pores, the faster the flow. Of course, large soil pores are usually associated with coarse textures, sands or gravel, and with well aggregated, strong structures. In a typical soil profile when we get excess water or saturated flow, it moves readily as long as there are large pores but begins to be restricted when it encounters a layer which has fine pores. The speed of removal of excess water is thus limited by the finest layer in the flow path. If, for example, we have a tile drain at a depth of three feet and a sandy loam soil over that tile except for two inches of silty clay loam somewhere in the profile, the speed with which water will reach the tile will be determined by how fast water moves through the two inches of fine material.

Or let's take another example. We have a medium textured material, a natural soil which we want to drain to get rid of excess water rapidly. We install tile and back-fill over the tile with sand and gravel in order to give a coarse pore system for rapid water flow. However, the top two inches is replaced with the same soil material as before to grow the grass, and we find that the rate at which excess water gets to the tile line is limited or determined by that top two inches of soil. A more desirable arrangement would be to have the sand and gravel come all the way to the surface to give direct access to the tile line through a coarse pore system.

Consider Figure 1 where we have four soil profiles illustrated. We have illustrated the speed with which water will move out of these. In the first case, we have a uniform

loamy sand all the way through and water moves through that rather readily. In the second case, we have a thin layer of finer textured material somewhere in that profile. This behaves as an effective barrier to rapid removal of excess water. In the third case, we have a layer of coarse material midway down the profile. Its effect on the removal of excess water will be essentially nil and the flow rate through it will be the same as it would have been through a uniform loamy sand. The fourth case, however, we have a fine textured material which is very resistant to flow and we have a tile line buried in it but over that tile line we put coarse material and brought that coarse material all the way to the surface. We take care to see that it does not get covered over with fine material through topdressing or grown over with a dense sod. There the tile will be effective in removal of excess water because we have a coarse pore system directly to that tile line.

Now there is another type of flow that we call unsaturated flow. The forces involved here are the attractive forces of soil for water. The water is pulled into the soil. In this case, the finer the pore the stronger the attraction. But as the pores become very fine the speed of movement is reduced. Thus, in anything finer than a fine silt or silt loam we no longer get effective movement of water to plants by unsaturated flow.

We are all very familiar with a type of unsaturated flow that we call capillary action. This is what happens when you set a sponge down in a puddle of water. The water moves rapidly up into the sponge by capillary flow. This is a form of unsaturated flow. The same type of flow occurs in the soil when we water a green from underneath by maintaining a water table 8 to 15 inches below the rootzone allowing the water to move up by unsaturated flow or capillary action to the roots.

Now the effect of coarse layers on this type of flow is quite different. A coarse pore system effectively interrupts unsaturated flow because the coarse pores have a very weak attraction for water. They will not attract the water out of the finer pore system. Thus, as a soil material drains and all the excess water leaves, a coarse pore system will not retain much water. If you have finer zones over it, they may retain more water than they would have otherwise because the coarse zone is not exerting an attraction for the water. By analogy, a blotter full of water allowed to drip until it stopped dripping would contain more water than it would if you put another blotter or paper towel or something underneath to attract the water. If you brought another blotter in contact with the wet one, it would pull some of the water out of it. Thus, a fine layer or a layer of the same texture underneath a soil layer will attract more water from it than will a coarse one. So one legitimate use of a coarse layer is to cause a finer layer above it to store more water than it would have otherwise.

Unsaturated flow or capillary action can move water in any direction. We normally think of it as moving water upward, but it's just as effective in moving it laterally or downward. A good example of this is the syphon effect that is sometimes encountered in a construction such as the Purr-Wick green system. In Figure 2 you see this illustrated. The water over the water table is attracted upward by the sand such that it is brought into the root zone, but at the same time it's attracted upward and laterally over the barrier into the next zone. Since the adjoining zone has a lower water table, the attraction there will be greater since it's under more tension. So we get a transfer of water from the upper pool to the adjacent pool and finally to the next one which is even lower.

So we encounter a continual transfer of water from the higher levels to the lower ones. This complicates the maintenance of constant and adequate water levels under these systems.

This can be overcome by elevating the barrier between the two compartments higher than the capillary rise. When this is done it establishes the height of the barrier just below the surface. This is necessary as you need a capillary rise near the surface in order to supply the root systems with adequate water.

Summary

Coarse layers aid in the movement of excess water only if in contact with free water at the surface. Saturated flow is limited by the finest layer in the flow path. Coarse layers cause layers above to retain a little more water when drainage ceases.

Capillary flow, or unsaturated flow, working with gravity can move water over a barrier and downslope. Water moves in response to gravity (downward) and in response to soil attractive forces (all directions).

Figure 1. The effect of coarse and fine pore systems in the soil on the flow of excess water - saturated flow.

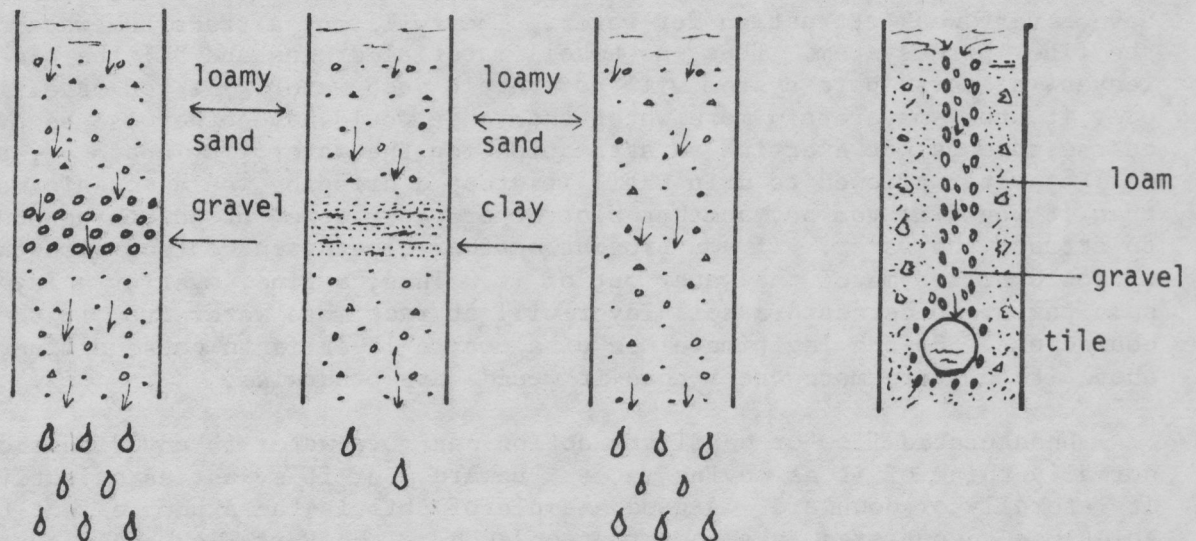
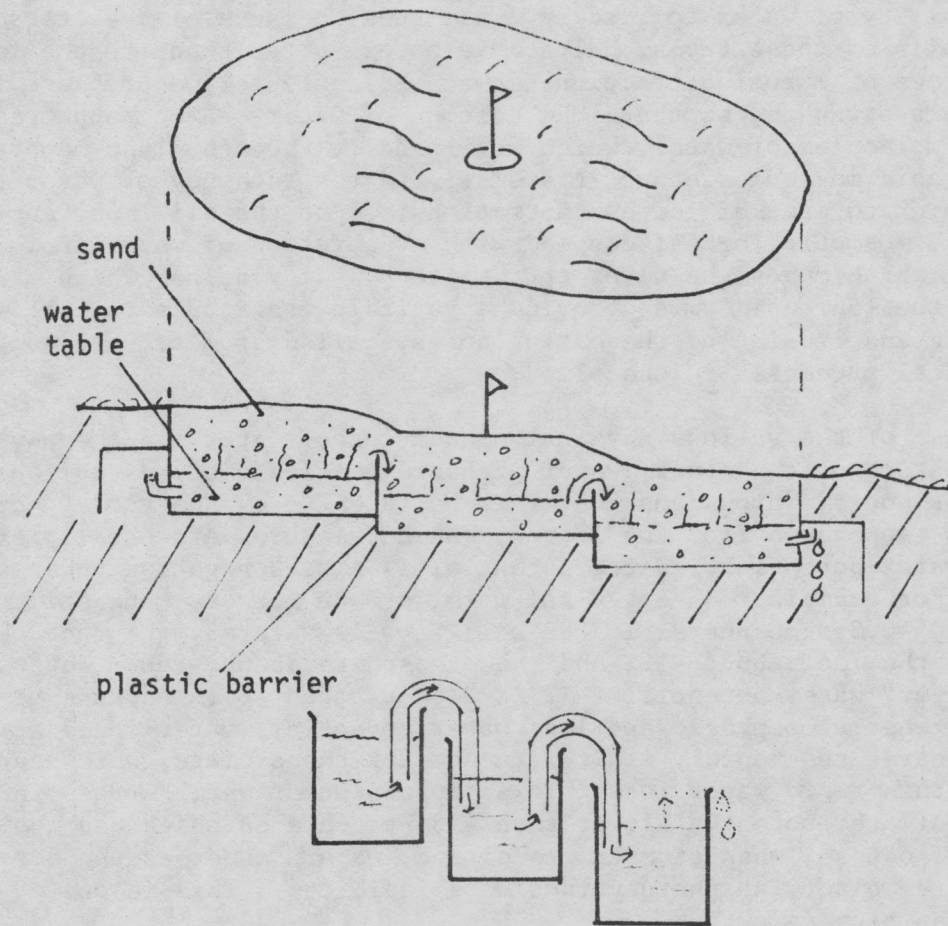


Figure 2. Siphon effect over barriers in Purrrwick green due to capillary - unsaturated flow



WATER IN THE PLANT

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Water is a principal constituent of living things and makes up more than half of the dry weight of actively metabolizing plant tissue. For example, inner lettuce leaves are about 95% water, plant roots about 85%, and grass leaves range from 70-80% moisture. Dormant seeds, on the other hand, contain only 5-15% water.

Water has several functions in the plant. It serves as a solvent for dissolved substances, such as salts or sugars, as a temperature regulator through the cooling effect of evaporation, and as a medium for diffusion or mass flow of materials from one part of the plant to another.

Water has several important physical properties that affect its role in living tissues. Both its freezing and boiling points are high relative to other similar chemical compounds. The fact that it is a liquid between 0 and 100 C dictates that active plant metabolism can only occur with this temperature range and actually only occurs from about 10-45 C. The property of water known as capillarity, that is, the ability of water to rise in small tubes because of the attraction of water for the walls of these tubes, helps move water up the plant to the leaves. The strong forces of mutual attraction between molecules of water cause it to have a high tensile strength, so that long columns of water can be supported in plants. The small molecules of water, which move readily through plant membranes that larger organic molecules cannot traverse, and the tendency of water to move from areas of high to areas of low concentration lead to the all-important phenomenon of osmosis. Osmotic forces, coupled with evaporation of water from leaves provide the energy which moves the water up the plant. Tiny holes, which can open and close, in the leaf epidermis, provide a variable resistance to this water flow. The opening and closing of these tiny holes, called stomata, are controlled by physiological processes in the plant.

Because of the various physical properties of water and the physical and chemical nature of the plant, water pressure gradients are established, especially in daylight hours, which cause water to be taken up by the roots, moved up the plant, and evaporated from the leaves. Such pressures are usually expressed in units of water potential. Water potential is always negative under natural conditions. For example: on a typical warm, dry summer day, the soil water potential is probably -0.3 atmospheres if the soil is well watered, the root about -6, stem about -10, the leaf about -12, and the atmosphere about -900. Water tends to move toward "lower" water potential (-12 is "lower" than -6). Because of the big difference between atmospheric and leaf water potential, water would at times be lost from the leaves too rapidly if it were not for the stomata, which can close and slow down this rapid water loss. This happens under water stress in most plants. Leaves with water potential lower than -18 bars are stressed and the stomata are closed. Of course, when stomata are closed, water cannot escape but neither can CO₂ enter the plant, so photosynthesis is inhibited. This is one of the ways water stress slows growth.

It is the pressure of water inside plant cells which causes them to enlarge, that is, grow. Thus, when water is in short supply, these cell pressures do not get as high and the cells expand less. This is another way water stress limits growth. Actually cell expansion is affected more by water stress than photosynthesis, so a water stressed plant is usually denser and heavier per inch than a well watered plant.

What does all this have to do with watering turf? The significant practical thing researchers have learned from studying the basic scientific aspects of water in plants is that plants can adapt to some extent to water stress. A plant which has been growing for a week or more under mild stress can carry on photosynthesis and expansion at lower water potentials than a well watered plant. Thus, the adapted plant makes more efficient use of its limited water supply. Also, the stress-adapted plant is much more likely to survive a period of severe drought. Surprisingly, a drought-adapted plant is more likely to survive a period of severe cold, also, because the physiological processes of drought-hardening and cold-hardening are very similar.

The moral to the story is that withholding water early in the season so as to cause a mild stress will produce plants which are more likely to survive and make efficient use of a limited supply of water later in the season. Besides, excessively watered turf is more susceptible to disease. In this time of increasing concern about water shortages and the likelihood of water rationing in many areas, with non-essential uses such as watering turf getting low priority, concern about efficient water use by plants is justified.

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ADDITIVES AND WATER

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A discussion of additives and water could probably cover everything from nutrients to pesticides to surfactants. This paper will be limited to (1) some general comments on wetting agents, (2) the use of wetting agents in treating localized dry spots, (3) and a brief review of some recent work at Ohio State on the cause of localized dry spots.

The effects of wetting agents have been studied for a long time. Many suggested uses and benefits of wetting agents may be found in the literature as follows:

- Increased infiltration and percolation of water
- More uniformly wet soil profile
- Decreased bulk density of compacted soil
- Reduced localized dry spot problems
- Increased rooting
- Increased drainage
- Reduced soil moisture tension and increased moisture availability
- Reduced evaporation and water loss from soil
- Reduced incidence of disease
- Improved control of diseases
- Improved control of weeds
- Increased utilization of fertilizer nutrients
- Reduced wilting

Perhaps the list could be even longer. Some of the above have been rather well documented while many have not been proven.

Wetting agents have been marketed for turf primarily to increase water infiltration into the soil and to more uniformly wet a soil profile. What effects do wetting agents have on the properties of water to possibly account for this result?

A contact angle is formed between a liquid and a solid whenever the two come into contact. The properties of the solution and solid will determine the degree or angle of that contact point. Water spreads on a hydrophilic (water-receiving) surface such as glass, forming a small contact angle. However, on a hydrophobic (water-resistant) surface such as wax, a drop of water will "ball-up", creating a large contact angle. When a wetting agent is added to water in contact with a hydrophobic surface the solution should have a lower contact angle and wet more of the surface. Theoretically there will be much less benefit on a non-hydrophobic surface since the contact angle is low and the liquid already spread out.

The effectiveness of wetting agents in actual usage will likely depend on the soil conditions and what the user is attempting to accomplish. Localized dry spots are one situation where wetting agents have had positive effects. Localized dry spots developed on several experimental sand greens at the Ohio State University turfgrass research plots. Water easily infiltrates most sand, of course, but in the case of localized dry spots it does not. Water droplets actually "ball-up" on the sand and do not soak in readily. The sand is hydrophobic.

The effects of several wetting agents at different rates with and without soil coring have been studied (2). Soil coring was more effective in reducing the dry spots problems than was a wetting agent (Table 1). Wetting agents were more effective as the rates were increased to a certain point, beyond which there was no improvement. The combination of coring and wetting agent produced a greater response in turf quality and reduced dry spots than either treatment alone.

Recently the nature of the hydrophobic condition has also been given careful scrutiny (1, 2). A coating surrounding individual sand particles from localized dry spots was observed through use of the electron microscope. The nature of the coating was determined to be organic by ashing and acidic through use of solubility tests. Using sophisticated analysis techniques the coating was identified as a fulvic acid-like material similar to humic acid materials resulting from organic matter decomposition. Formation of Ca and Mg fulvate may occur and on drying it may become very hydrophobic, resulting in a localized dry condition. The authors speculate that the coatings may arise from activities of various basidiomycetes.

In conclusion, a number of management tools may be used to reduce the localized dry spot problem. It is important that hydrophobic soils not be allowed to dry completely prior to irrigation since the soil becomes increasingly water-repellent as it becomes drier. It may also be desirable to pre-wet a hydrophobic soil prior to heavy irrigation in an attempt to improve water infiltration. Soil cultivation, specifically coring, is essential to reduce dry spot problems. Even coring in mid to late spring may reduce dry spot problems during the summer months. And finally, the combination of coring plus the use of a wetting agent has been the most successful practice to date to decrease the severity of localized dry spots.

References:

1. Miller, R. H. and J. F. Wilkinson. 1977. Identification of the organic coating on sand grains of non-wettable golf greens. (Submitted to Soil Sci. Soc. Amer. Proc.).
2. Wilkinson, J. F. 1976. Interpretation of the cause of localized dry spots on sand putting greens. Proc. Ohio Turfgrass Conference. 4 pp.

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Table 1. Effect of three wetting agents applied 15 May 1975 with and without coring on the severity of localized dry spots in July*. Turf quality rating 1-9; 9-no damage, 1-dead turf.

Cultivation	Wetting Agent	Rate 02/1000 ft	Date			$\bar{X}$
			7/8	7/23	7/31	
- Turfgrass quality rating -						
Coring	Hydro-Wet	0	3.5	6	6	4.8
		8	4	5.5	4	4.5
		16	5	8	4.5	5.8
		32	4.5	5.5	4	4.7
	Aqua-Gro	0	4.5	6.5	4	5.0
		8	4.5	7	5.5	5.7
		16	4.5	8	4	5.5
		32	5	8	4	5.7
	Grozyme	0	4	6.5	4	4.8
		8	4.5	5.5	4	4.7
		16	5	6.5	4	5.2
		32	5	7	3.5	5.2
					$\bar{X} = 5.1$	
None	Hydro-Wet	0	2.5	2.5	2	2.3
		8	4.5	6	3	4.5
		16	5	8.5	3	5.5
		32	5	4.5	2	3.8
	Aqua-Gro	0	1.5	2.5	2	2
		8	4	4	3	3.7
		16	5.4	5.5	3.5	4.5
		32	4	5.5	3.5	4.3
	Grozyme	0	3	5.5	2	3.5
		8	2.5	3.5	2	2.7
		16	3.5	6.5	1.5	4.2
		32	4	5	2	3.7
					$\bar{X} = 3.7$	

*Taken from Reference 2.

WATER IN THE PIPES

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We will attempt, through slides and conversation, to show some of the various methods of getting that water into the pipes, and also controlled methods for removal of this water so that the most efficient use of it can be made and the most pleasure obtained from its use.

To get the water into the pipes and accomplish our objective several steps of investigation are called for. Water source, elevation, water requirement, and last, but not least, a working drawing or layout, showing pipe locations, sizes, etc.

Several pieces of equipment and techniques are needed to install the pipe. Polyethelene is most flexible and lends itself to a method referred to as pulling pipe. This method causes less disturbance to the turf, and where soil conditions are suitable it is a very good way of installing the pipe. Also, this pipe seems to be less damaged due to freezing. Maybe from the 'Winter of 77' we will learn new things about buried pipe. The white and blue pipe is called PVC and termed rigid pipe; however, it too has some flexibility. There are various fittings available to the pipe installer.

Electric controllers are used which program your water in the pipes so that it will be used most efficiently. Another method is to use a mechanical valve you merely turn off and on.

There are various sprinklers available to distribute that water in the pipe in the manner you want. The large heads are capable of wetting an area from 80 to over 200' in diameter with from 4 to 50 GPM. Spray heads are capable of wetting an area of from 15 to 60' diameter and delivering from 2 to 7 GPM.

Pumping plants may be pre-fabricated. One such example consists of two straight centrifugal pumps, pressure tank, electric controller and valves with an 800 GPM capacity.

One method of joining the lengths of rigid PVC pipe together includes a coupler, known as a gasket coupler, which merely slides over the end of the pipe. This method makes each joint an expansion joint and is used extensively in pipe 2-1/2" and larger. The other method of joining this PVC pipe is with glue.

To utilize water in the pipes and to distribute it properly, a swing riser is used which gives a flexible connection between the sprinkler and pipe. This decreases the chance for damage by heavy equipment moving over the sprinkler and also allows for repositioning of the sprinkler should it become necessary. Risers are made of either galvanized pipe or plastic.

Redesign or repair of the pumping plant may be necessary. One such installation was experiencing high pressures that kept the superintendent busy repairing cracked pipe. A control valve built especially for this purpose was installed along with other minor changes.

Sometimes a new pump installed along side an older one is practical - possibly where the superintendent added another nine holes. Naturally one pump just wouldn't put enough water in the pipes for the eighteen hole course.

Also, a turbine pump installed in a wet well can serve as a source of water. As we have seen, there are many ways of getting water in the pipes. One familiar to all is the water tower which is an accepted method of putting water in the pipes for most cities' needs.

Proper backfilling of the pipe so that it will better contain the water is essential. Loose soil may be watered in. Other methods would be mechanical tamping, etc.

We feel the method of blowing out the pipe with air pressure is far the most positive method for winter preparation, and the least disturbing. Certainly shut down and start up can be accomplished with minimum effort using this air purge. Another method used extensively some few years ago is drain valves located strategically through the area, but this is a time consuming chore and we recommend air, and if desired, a couple of drain valves.

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OVERVIEW OF TURF IRRIGATION

Carl H. Schwartzkopf, Mid-Continent Director, USGA Green Section
Crystal Lake, Illinois

Water has become a critical, invaluable resource in the United States. Currently, many areas of the country which previously had an ample water supply are experiencing a shortage. Regulations and restrictions by Federal and State agencies are being developed and implemented which will affect our lives in the future. During the drought period that is currently existing in the Pacific Northwest, California, the Rocky Mountain states, the Dakotas and many midwest areas, it is becoming apparent that we cannot take water for granted.

In the mid 1960's, the eastern part of the United States suffered a drought period. During this period, to conserve water supplies, golf courses were among the first to be affected by governmental authorities. Some golf courses were restricted to minimal amounts of water for irrigation, whereas others were entirely cut off from traditional sources of supply. Instances occurred where wells and pumping stations were seized under the right of eminent domain, with financial compensation paid to the courses. The action of many governmental agencies was harsh, unduly harsh, in many cases. If we are to profit from past experiences, we must study the lessons learned and give full consideration when planning and developing irrigation programs in the future.

If golf courses are to have access to water they need for their survival, they must recognize their responsibilities and obligations to practice the conservation of this precious natural resource. In many areas of the country it is necessary to secure the approval of state water controls agencies before sufficient quantities of well water may be used on a golf course.

Today we have an opportunity to exercise control of our spiraling irrigation costs, as well as to fulfill our responsibilities for water conservation. Therefore, when considering a new irrigation system, several factors must be taken into consideration: should the system be automatic, semi-automatic or quick coupling? With the recent labor problems that have been prevalent on golf courses, the trend has been toward an automatic irrigation system. An automatic system, if properly used, can also conserve water.

There are other questions that must be considered before making a decision about an irrigation system. These include: What is the length of your irrigation season? How much water will be needed for each area? What is the availability of labor, the number of golfers, and the time available for irrigation each day? Will the water supply be adequate?

The golfer, the person we should keep happy, must be given primary consideration. If your present watering schedule delays starting times, and if you must irrigate frequently throughout the day, causing inconvenience to the golfer, you should seriously consider automation. If labor is not available for night watering, automation is essential. Unionization is steadily making its way into golf course maintenance; therefore, every superintendent should check closely the restrictions and added costs it places upon his budget.

It is important to select the correct equipment for your installation. Hydraulic or electric valves, cam, gear or impact heads and the type of controller set-up are a few of the decisions that must be made. The terrain, water supply, soil, and climatic conditions should be taken into consideration when deciding on a hydraulic system versus an electric one. Purity and water quality will have an effect on the lasting quality of the sprinkler head.

Suppliers of equipment should be selected carefully, not only to insure prompt delivery on initial equipment, but for future service and repairs as well. Once a decision has been made as to the type of system, the greatest task still lies ahead. This is hiring and controlling the installation contractor. The very best design and the very best equipment are of little value unless they are properly installed. Many golf courses are experiencing continual irrigation problems because, when the system was installed, the quality of workmanship by an inexperienced crew was poor. Some very successful systems have been installed by golf course maintenance crews, but this should not be undertaken unless you have qualified help, as well as experience in irrigation systems.

Very exact specifications must be drawn up for a contractor and he should be notified as to the inspection procedure. The superintendent, or the designated quality control inspector, should have the authority to stop the installation at any time if the specifications are not being followed closely or if changes must be made in the field. No pipes should be laid until depth of ditches is checked; no wiring or tubing laid until the pipe is bedded in; no ditches backfilled until the blueprints are checked making sure all fittings, wires and valves are correctly placed; and no sod laid back until the fill is compacted to avoid settling. Every pipe must be checked for cleanliness, no foreign matter should be allowed in the inside to lodge in the sprinkler screens or valve parts. During installation, you, as a superintendent, or your designated inspector, should devote full time to make certain that no corners have been cut by the contractor. The success of the system definitely depends upon exactness of installation and quality of workmanship. Shortly after the installation has been completed, an "as built" or "as installed" blueprint should be received by the club.

Putting the system into operation is simple if wiring and tubing has been connected properly, if the stations at the controller are marked correctly, and all the foregoing items have been completed.

It is now that you will really appreciate the research that was completed at the outset of the irrigation project. It is now that your decisions on the type of system, the make and type of equipment, the method of installation and the careful inspection program will pay off. If these items have received your first and foremost attention, you'll have made a substantial and long-lasting contribution to the golf course. However, if the decision was reached hastily with little information gathered, and installed on the basis of the lowest bid submitted, the golfer can expect irrigation inconveniences and, even more important, you, the superintendent, would be expected to correct many of the deficiencies both in the original design, as well as in the installation.

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INFRARED STUDY

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I first became interested in infrared photography after seeing some of the work the USDA and the Forest Service were doing with NASA. I am sure that you have heard of infrared, but maybe you do not quite understand what it is.

William Wildman and Jack Clark have an excellent article in the October 1974 issue of Weeds Trees and Turf. In short, they explain infrared principles as follows:

The energy or light spectrum consists of cosmic rays, gamma rays, X-rays, ultraviolet radiation, visible light, microwaves, and radio waves. Infrared is a very large segment of the energy spectrum. One part of the infrared band is known as the "thermal infrared" and is the result of heat being emitted from an object. Infrared color films do not record thermal infrared radiation, but record the "near infrared" radiation which is reflected from an object.

Ordinary color film is sensitive to the complete visible spectrum of light. It contains all three basic layers of film that are sensitive to blue, green, and red light. During processing, the dyes form in these layers and produce a true color image. Infrared film uses only part of the visible light spectrum and is also sensitive to the near infrared portions of the spectrum. During processing, the film is developed with the same dyes that are used on ordinary color film but different wavelengths are used to process the film. Thus, false color results - green is red, red is yellow, and blue is blue.

In addition to green light, green plants reflect large amounts of near infrared radiation. The sun produces visible and infrared light that falls upon a green leaf. Chlorophyll in the leaf absorbs most of the blue and red wavelengths that provide the energy for photosynthesis. But the green light is partially reflected in greater amounts than visible green light. Any problems within the plant tissue will decrease the amount of infrared reflected, but will not reduce the amount of visible green light reflected.

My first infrared pictures were taken from ground level on March 23, 1975, with a 35 mm. camera. Since growth was just starting, photosynthesis was at

various levels on different species of grasses. Therefore, chlorophyll levels of these grasses showed marked differences in near infrared radiation. Unfortunately, all pictures were taken from the ground.

The second group of pictures was taken on June 30, 1975, from the ground. Since growing conditions were excellent during June, very little difference between grass varieties was noted.

I decided that aerial pictures would be more useful. A neighbor who is a professional photographer was employed to take the photos from a helicopter. He mounted two 35 mm. cameras to a single metal bar frame. A double cable release was used to enable both cameras to take matched slides. One camera used color film and the other infrared film. These pictures were taken July 3 which was the 15th day that daytime temperatures were 84 degrees or more, so heat damage was beginning to take its toll.

Aerial slides were again taken September 6. By this date, daytime temperatures had exceeded 84 degrees on 54 different days. Heat damage to Poa annua had been severe. Much to my surprise, those slides showed that the bentgrass had filled in some areas of damage.

Conclusions:

1. Aerial pictures are more informative than those taken on the ground.
2. Early spring slides are as important as are summer ones.
3. Good ground information is important when interpreting aerial photographs.
4. Both color and infrared photographs are important as a comparison.
5. Application or misapplication of chemicals can be very clear from the air.
6. Traffic patterns are very prominent from the air.
7. Water patterns from irrigation systems are amplified in the aerial view.
8. Poorly drained sand bunkers can be identified by the amount of accumulated silt.
9. The health of trees can be compared.
10. Infrared aeriels aid in locating tile and irrigation lines.

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FIVE YEARS MANAGING A PAT FIELD

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As I look back to 1972, the installation of the PAT System at Goshen High School was one of the most exciting projects I have ever been involved with. The planning, the improvising were exciting and challenging, especially the challenge of never knowing for sure just what would happen - only what should happen as described by Dr. Daniel. Needless to say, it all worked out, even better than we had hoped.

By the second year we had an idea at least of what to expect, and this was the year we really began to get interested people from all over the United States in to

view our installation. At the conclusion of 1973, we really began to feel we had an athletic turf that could take abuse, eliminate the wet field problem and still provide the plus factors that real turf could provide. Maintenance was very limited the second year and included only fertilization with 12-12-12 early in the spring and a feeding of IBDU in early August. A limited amount of plugging was done in some of the overworked areas along the 5 yard line in front of the goal posts.

The third year we repeated the first year's process of aerating and topdressing with sand. This proved to give us improved wearing qualities and improved root structure so we concluded that aeration and topdressing with 30 tons of sand would be an annual practice. Our annual soil test showed that we needed to add some potash in addition to the basic fertilization program.

For the 1975 season we again followed our fertilization-aerification and topdressing program. During the 1975 season Dr. Daniel and I, with the help of some of the school employees, installed the automatic watering system. This consisted of installing five sensors at different spacings and depths in the sand of the PAT System with extension of wires to a meter which could be pre-set at any determined point. When a sand dried out so that the reading was below the pre-determined set point, a water line electric valve, which was wired to the meter, opened and the PAT System received a charge of water back through the drainage lines. When the sensors indicated there was ample moisture again in the sand, the meter shut the electric water line valve off. This system worked well after it was installed until about the first of July when we aerated the field. From then on it became rather erratic. Weather conditions provided enough moisture, and time became a problem so Dr. Daniel decided to try it in the greenhouse and next season we would make whatever changes might be necessary to try it again.

The next spring, which was this past spring, we decided our problem had to be in our installation since the system worked fine in the greenhouse. We then dug up the sensors and the wiring, and would you believe our aerifying the previous season had been better than we realized? Needless to say, the new wires were buried deep enough so that during any future aerifying they will not be damaged.

After a rather slow start, the 1976 season soon had us convinced it was a system well worth all the effort we had expended in getting it operational.

I feel, for a high school football field operated with limited funds, limited management, and limited labor available, the automatic watering system is an excellent tool in keeping the turf in a healthy, growing condition. I feel the excellent condition of our turf this year was due in a large part to this watering system. Not once during the 1976 season was I ever aware that the turf had started to wilt, nor was I ever able to determine that it was overwatered.

Very briefly, these are some of the highlights of my five years with the PAT System.

In closing, I would like to say the Goshen school administration and the people of Goshen have been grateful to Dr. Daniel and all the other individuals responsible for the development of Prescription Athletic Turf. Community publicity and interest still remain high, and those involved in the school system feel they have a football field that is superior to any high school field in our area.

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ELEVEN PAT FIELDS

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Many of those attending Purdue's Turf Conference know about the PAT System. It has received a very favorable press. Many of the people across the country, and even in other countries know of it.

The system was created initially in an effort to provide a more satisfactory and dependable playing surface for athletic fields, regardless of the weather.

In review, the PAT System has three major components: the suction system, conservation system, and subirrigation system with soil sensing.

The suction system is designed to remove excess water and to maintain a firm uniform surface for play. In design, this can handle one inch of rain per hour. Most of the fields have two large pumps. We have been pleased with this feature; it works well and fast.

The second component provides for conservation of water. Because of the barrier, the moist sand is isolated from the subsoil. It is possible to retain maximum moisture after rain or irrigation. Further, because the water constantly redistributes above the barrier, it provides very uniform moisture distribution. The conservation system has worked well, although the tendency has been to keep an excess of water. Experience and education have helped correct this.

The third component of the PAT System is soil sensing and subirrigation. This means that when the moisture drops to a pre-determined level, based on soil sensing, the controller opens a valve so that the subirrigation can proceed throughout the drainage pipes above the barrier. In research we have found this feature effective. A meter that costs approximately \$350.00 is the heart of the soil sensing component. A complete soil sensing system has been in use in the Goshen, Indiana, field since 1976. Several times during the season the moisture level has been reduced via the meter so that less water was applied. The rootzone then became drier which meant the roots would grow deeper. This procedure was possible because the manager of the area respected the sensors and was aware of their potential for indicating actual moisture content.

This third phase of the system, subirrigation and automatic sensing, has not yet been installed on the other PAT fields. However, it is a part of the patent, USA 3,908,385 of 30 Se 75, and Canadian 985,516 of Mr 76, as granted to the Purdue Research Foundation. PAT, Inc., of Lansing, Michigan, is licensed for building PAT Systems in the USA and Canada.

Today eleven PAT fields have been constructed and are in operation. The Goshen Field has been a model for experiments. In 1976, the fifth year of use, the Goshen Field was the best ever. Dick Kercher has managed this field.

The bermuda field at Reitz Bowl in Evansville, Indiana, has been a signal success. It is reported they had two heavy rains there in the fall of 1976. When nearby fields were very muddy, the PAT field at Reitz Bowl was in excellent playing condition.

Further, the Reitz team was in the state high school play-off so they used the field through the semifinals. That bermudagrass on sand is really tough. The field has been in for three years; they now have their fourth management crew operating. The turnover in staff has been a handicap.

The Purdue Stadium, under the supervision of Mel Robey, co-inventor of the PAT System, along with Larry Davis, maintenance supervisor, was heavily used for spring practice in 1976. Of 21 practice sessions, 14 were held on the PAT field. It was badly worn. More than 100 players and coaches are on the field each time so the field was well tested.

At the Mile High Stadium in Denver, Colorado, the PAT field is used for both football and baseball.

At the Orange Bowl in Miami, Florida, the PAT System was outstanding in its first year of use. During the last game of the season, the turf cover still looked uniformly good. Jim McLean, part-owner of the Dolphins, recently commented that the PAT field was 'fantastic', and that they were very pleased with its performance.

The big story of the year was not the success of the Orange Bowl, but the lousy Monday night game in Washington, D.C. A game that everyone saw! The story is this. It had rained over one inch throughout the afternoon and continued to rain heavily, for 1.8 inches fell during the game. That is a lot of water. The original recommendation was for bermudagrass to be used in the initial planting of 1975. But to improve appearances, bluegrass was used instead. In 1975 the bluegrass tore badly. In April of 1976 the center of the field was resodded with a thick layer of soil carrying bermudagrass. No greensairing nor topdressing was done. Then the big rain came on October 25! On Wednesday following the rain on October 25 (with another game scheduled the coming Sunday) they used two greensaires plus two topdressing machines on the bermudagrass portion to do what was specified and what should have been done six months earlier. Greensairing after sodding is needed to assure that the water can move vertically and quickly.

Suction takes the route of least resistance. In Washington the suction pulled the water from the greensaired bluegrass along the perimeter but not the ankle deep water above the tight soil under the sodded bermudagrass.

With the energy shortage the price of artificial turf has increased considerably. But so have other costs, including the installations of the PAT System. Concurrently, many colleges are operating on decreased funds, they have faced the explosion of interest in women's sports, and in some cases, a downturn in attendance at sports events. The funds available to build athletic fields have been limited in many institutions. Many athletic departments with older artificial turf that is badly worn are facing the question, "Shall we replace with a new artificial turf pad and cover or should we start over with the PAT System?" Both finances and the anticipated use of the area have to be considered.

What is the future for the PAT System? With minor exceptions, the PAT System is a success. It has taken the natural turf fields from the muddy, grassless, hard and crusty areas to dependable, desirable playing surfaces available for repeated use. Professional players have expressed strong preference for natural turf. It provides a cooler and safer contact surface. PAT offers the professional image desired by players and spectators alike.

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ARTIFICIAL TURF UPDATE

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The AstroTurf playing field at Busch Memorial Stadium is now seven years old and going into its eighth year starting with the opening baseball game April 15, 1977.

By way of background, for better understanding and evaluation of information to be presented later, the following is presented:

1. Use of the Field. Busch Memorial Stadium is leased to the Baseball Cardinals, the Football Cardinals, to universities, circus, high school football games, rock musical shows, etc. There are approximately 80 Cardinal Baseball events, 10 Cardinal Football events, 4 circus dates, 2 to 4 NCAA soccer games, plus miscellaneous other event days so that there are approximately 100 events per year between early April and mid-December of each year. The Football Cardinals lease for the use of the stadium also provides that the football team has the right, and it has exercised that right through the years, to practice on the playing field each day so long as the football practices do not conflict with the baseball schedule. The latter is the prime reason that brought about a decision in 1969 to change from a natural grass playing field to an AstroTurf playing field.

2. The AstroTurf playing field was constructed beginning late December 1969 and, unfortunately, work had to be started during the coldest and poorest construction weather conditions of the season and completed by April 1, 1970.

3. After removing approximately 11" to 12" of the old field, capping water lines and repairing certain sections of the existing subsoil drainage system, 3" of porous material was spread over the entire field. On top of that, 8" of asphalt concrete was laid in three separate lifts, the last lift being approximately 3/4" to 1" thick, which was carefully installed to eliminate depressions that might pond water. A 3/4" energy absorbing pad was then glued to the blacktop and then the AstroTurf was glued to the pad. The cost of the AstroTurf playing field in 1969 dollars was as follows:

Site work (blacktop and rock base, concrete trenches adjacent to all dirt base paths, pitchers mound, etc.)	\$ 277,000
3M Tartan warning track adjacent to the walls around most of the field	75,000
Energy absorbing pad and AstroTurf grass	<u>486,000</u>
Total	<u>\$ 838,000</u>

Initially when the stadium was opened on May 12, 1966, a natural grass playing field was provided. The first playing season in 1966 was not a representative year because construction of the stadium continued up to the first game played in the stadium on May 12 and continued for several months thereafter. Because of daily practice by the football team all the grass was worn out. Prior to the 1967 season, the grass was completely resodded with a good quality zoysia, but overall the field was not satisfactory. Prior to the beginning of the 1968 season, the football portion of the field was sodded with Tifway-419 Bermudagrass, which provided a very satisfactory turf throughout the baseball season, but, as soon as the football team began

its daily practices on the field in early September, nearly all grass between the hash marks of the football field was worn down to the dirt and, of course, in the St. Louis area the growth of Tifway-419 Bermudagrass ceases about Labor Day. Overseeding and pregermination of the field with rye and bluegrass was unsuccessful mainly due to the daily football practices on the playing field. In 1969, the entire playing field was resodded prior to the beginning of the baseball season with Tifway-419 Bermudagrass and the turf provided an excellent baseball field until the football field commenced its daily football practices.

The natural turf field at Busch Stadium from 1966 through 1969 included seven major ideas provided by Dr. Bill Daniel and Dr. Ray Freeborg, who were consultants to us. It encompassed a subsoil drainage system comprised of perforated plastic tile drains on 30' centers parallel to the center line of the football field, pop-up sprinkler heads over the entire field, which could be activated either manually or by automatic moisture sensors, which functioned quite well. Also, approximately 26 miles of heating cables, located approximately 4" below the surface of the ground which encouraged growth of the turf during the colder spring weather immediately prior to the baseball season and during the later part of the football season. During the four-year period of maintaining a natural turf field we engaged the professional services of Dr. Ray Freeborg who worked with the field superintendent outlining maintenance programs throughout the year. Despite these efforts, it was finally concluded that natural grass would provide an acceptable playing field during the baseball season up to the time when the football team commenced its daily football practices on the field and shortly thereafter the turf was worn down to the surface of the ground.

The above experience with a natural grass field caused us to install an AstroTurf playing field for the 1970 athletic season.

We have been asked by many, "What is the life of an AstroTurf field?" It is impossible to answer the question because much depends on whether the AstroTurf field is located inside of a domed stadium, in an outdoor stadium such as Busch Memorial Stadium, in a warm climate where the full effect of ultraviolet light can take its toll on the nylon fibers of the AstroTurf and last, but possibly the most important, is the number of events scheduled on the playing field. In the case of the AstroTurf at Busch Stadium, we are now making a thorough evaluation of the replacement of the playing field for the 1978 season. We are considering artificial turf but, because of the high cost of replacing the field with an artificial turf, we are also giving consideration to natural turf. As long as daily practice by the Football Cardinals remains in the contract the use of natural turf is not practical.

As was mentioned earlier, the total cost of installing the existing AstroTurf field in 1970 was \$838,000. The cost of installing the natural turf playing field in 1966 dollars was \$244,000. To resurface the playing field with AstroTurf in 1978 would cost approximately \$800,000, which includes an additional amount for the installation of a sliding box type of infield (like Cincinnati) rather than the extensive skinned area of the infield at present.

For a comparison of natural grass, the maintenance and resodding each year for the years 1967 through 1969 averaged \$119,000 per year which, projected to 1976 dollars is equal to \$176,000. By comparison, for artificial turf the maintenance costs in 1970 totalled approximately \$66,000 and for 1976 totalled \$123,000. Therefore, there is a net saving of approximately \$50,000 per year to maintain an Astro-Turf playing field rather than a natural turf field.

In evaluating the replacement of the playing field in 1978, consideration must also be given to which type of field, natural grass or artificial turf, is the best for athletes in terms of fewer injuries to players and in terms of providing the best playing conditions in all types of weather conditions. Such an evaluation is difficult because of conflicting information and data that have been assembled with respect to these matters.

The National Football League Players' Association favors natural turf playing fields and claims that there are fewer injuries to players on natural turf. The Players' Association is also of the opinion that a football player's playing career can actually be extended by playing games on natural turf rather than on artificial turf.

Other data assembled in the past by other interested parties (other than the Players' Association) have concluded that there are fewer injuries on artificial turf. One significant difference in data with respect to injuries to players centers around the definition of "what constitutes an injury?" Should an elbow skin burn from sliding on artificial turf be counted as an "injury" in the same sense as a knee, arm, or shoulder injury that requires a player to leave the game? It seems the injury question is not conclusive to favor either natural turf or artificial turf.

As far as which field provides the best playing conditions in all types of weather, this matter is debatable. It is difficult to argue that a good quality natural grass field on a dry day is not the best possible field on which to play a game, but on the other hand, would that same natural grass field provide the best possible playing conditions on which to play a game in the rain or after a 1" rainfall just prior to a game? A case in point was the Cardinal/Redskin game played on October 25, 1976, in Washington, D.C. which was viewed by millions of TV spectators on Monday night TV. The field on October 25, as millions of viewers can testify, was totally unsatisfactory for the playing of professional football.

Of the 24 major league baseball fields, eight have artificial fields and seven of the fields are used also by NFL football teams. Of the 28 NFL football teams, 15 play on artificial fields, while 13 NFL football teams play on natural grass fields. Of the 13 natural grass fields, eight have major league baseball teams playing home games on the same field. At present, domed stadia (Dallas, Houston, Pontiac, Seattle, New Orleans) must have artificial turf.

It is impossible, I feel, to attempt to conclude in favor of either an artificial field or a natural grass field for all open air stadia. The type of playing field must be selected based on an evaluation of the intensity of use, climatic conditions within the geographical area of the stadium, the cost of maintenance labor locally, the economic impact on the entity responsible for paying the cost of installing new fields, repairing existing fields, and the annual cost of maintenance of a field.

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COOL SEASON GRASSES

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This paper will deal primarily with Kentucky bluegrass (Poa pratensis L.). It will deal with (1) the origin and development of Kentucky bluegrass and (2) cultivar evaluations as observed in Ohio.

The Gramineae is one of the largest families of flowering plants in existence and covers a larger percentage of the earth's surface than any other single family. The genus, Poa, numbering over 250 species, contains some of the most economically important grasses in existence.

Poa pratensis L. is one of the most important pasture grasses in temperate climates and is undoubtedly unsurpassed in importance as a turfgrass. Some confusion exists in the literature and elsewhere in regard to the origin and development of this grass because of the large number of common names assigned to it at various times, including bluegrass, browntop, common meadow grass, common spear-grass, English blue-grass, goose-grass, green grass, green meadowgrass, green Poa, greensward-grass, Indian bluegrass, June-grass, and Kentucky bluegrass. It has also been referred to as lawngrass, meadow-grass, prairie June-grass, red-top, Rhode Island grass, smooth stalked meadow-grass, spear-grass, spire-grass, summer-grass, white-top, wire-grass, and yard grass. (1)

Kentucky bluegrass is the name most commonly used to refer to Poa pratensis L. today, even though it is a misnomer. Bluegrass was probably first used to refer to Poa compressa because of its apparent bluish cast, and then later used for other species of the same genus as well. Because of the succulent, rapid growth exhibited on the limestone soils of the State of Kentucky, the grass was called Kentucky bluegrass by early colonists, a name that has persisted to the present time.

There has been considerable investigation and disagreement on the question whether Poa pratensis L. is indigenous to North America. There are two lines of entry by which plants may have naturally come to North America from the Old World. One is by way of Greenland to Labrador from Europe and through Alaska from Asia. Agrostologists consider it to be strong evidence that a given plant was introduced after the discovery of America if the range of the plant is not continuous through either of these routes (1). Poa pratensis L. grows well in temperate and cold climates including up into Canada, but is not native to Labrador or Alaska and is therefore considered an introduced species. In addition, very few species are indigenous to both Eurasia and the Western World. Since there is substantial proof that Poa pratensis L. is definitely indigenous to Eurasia, it would seem that this plant has been introduced to North America by man.

Another source of information which sheds some light on the question is from old manuscripts of the early American colonies. The first direct reference is from William Penn when he reported sowing English grass seed in his courtyard in 1685 (2). There are a number of writings which referred to the absence of pastures in America compared to those in Europe. After being introduced, this grass spread very rapidly to Kentucky, Ohio, etc., and was assumed by later travelers to have been there all the time. The first persons there, however, found it conspicuously absent.

Poa pratensis L. or English grass as it was commonly called then, was introduced along the East coast, perhaps by sweepings from cattle boats which would have had hay of this species aboard. It is fairly well documented that seeding of this grass did occur, and within 100 years English grass could be found in great abundance far to the west. Had the grass been indigenous, it seems obvious that this procedure would not have been necessary or even mentioned. While this line of proof in itself may be open to some question, the wealth of information in this regard presents a good case. (1)

Considerable plant breeding and cultivar development has occurred since the introduction of Kentucky bluegrass to the United States many years ago. However, most of this effort has taken place in the last three decades. As recently as twelve years ago a review of bluegrasses at this conference listed only eight varieties as generally available in the Midwest, another eight from European sources but not available, and eight more as experimental varieties. Today the list of commercially available cultivars is greatly increased along with evaluation of many more experimental selections.

Kentucky bluegrass cultivar evaluation results for Ohio are listed in Tables 1 and 2. Many of these cultivars have provided high quality turf and are highly recommended for Ohio and surrounding states.

Kentucky bluegrass blends consisting of three or four cultivars are more desirable for lawn-type turf than the use of a single cultivar. High quality blends are adapted over a broader range of soil conditions, cultural systems, and generally have fewer disease problems. Blends should probably be composed of a minimum of three cultivars and ones that have proven to be superior on an individual evaluation basis.

A blend study at Ohio State over the last six years consisted of 38 different blend combinations. These blends have not shown the variation in quality during the season that individual cultivars have shown. In addition, most combinations have provided an excellent turf after six years and are very comparable in quality.

References:

1. Carrier, L. and K. S. Bort. 1916. The history of Kentucky bluegrass and white clover in the United States. J. Amer. Soc. Agron. 8 256-266.
2. Penn, W. 1685. A further account of the province of Pennsylvania. p. 297. (Quoted from Carrier and Bort - 1916).

Table 1. Kentucky Bluegrass Cultivar Evaluations - Columbus¹.

Cultivar	Quality ² -Six Year Average		Cultivar	Quality ² -Two Year Average Low Maintenance
	1.5	0.75 ³		
NJE P-56	7.4	7.0	Vantage	5.1
Adelphi	7.3	6.9	Belturf	5.0
Sodco	7.1	7.0	S. Dak. Cert.	4.8
A-34	7.1	7.0	Windsor	4.7
NJE P-5	7.1	6.8	A-10	4.4
NJE P-35	7.1	6.9	Geary	4.4
A-20	7.0	6.4	A-34	4.3
Trenton (NJE P-115)	6.9	6.7	Cougar	4.3
NJE P-114	6.8	6.6	Park	4.3
Vantage	6.7	6.1	Palouse	4.3
Merion	6.7	6.5	Adelphi	4.1
Belturf	6.6	6.3	S-21	4.1
Zwartberg	6.6	6.0	PSU K-162	4.1
Nugget	6.5	6.5	Minn 6	4.1
Campus	6.5	5.9	Kenblue	4.0
PSU K-107	6.5	6.2	NJE P-35	4.0
Windsor	6.4	6.0	WK 408	4.0
Fylking	6.4	5.8	Merion	3.9
Prato	6.4	6.0	Newport	3.9
Primo	6.4	6.2	NJE P-56	3.8
Cougar	6.3	6.1	A-20	3.8
Newport	6.3	5.8	Sodco	3.8
Arista	6.3	5.5	Prato	3.6
Sydsport	6.3	6.1	PSU K-107	3.6
RI PP 1	6.2	5.8	NJE P-5	3.6
Pennstar	6.2	5.9	Campus	3.5
A-10	6.2	5.7	Primo	3.4
PSU K-162	6.1	5.4	Delta	3.2
Palouse	6.1	5.4	Fylking	3.1
WK 408	6.1	5.6	Arista	3.0
Park	6.0	5.6	RI PP 1	2.9
S-21	6.0	5.5	Pennstar	2.8
Geary	6.0	5.5	Trenton	2.6
S. Dak. Cert.	5.9	5.0	Zwartberg	2.5
Minn. 6	5.9	5.4	NJE P-114	2.5
Kenblue	5.8	5.5	Sydsport	2.2
Delta	5.8	5.2	Nugget	2.0

¹Established Fall, 1969

²9-1; 9-best.

³Mowing height of 1.5 and .75 inches.

Table 2. Kentucky Bluegrass Cultivar Evaluations - Columbus¹

<u>Cultivar</u>	<u>Quality</u> ²	<u>Cultivar</u>	<u>Quality</u>
EVB	5.3	WW Ag 436 (Center)	4.7
NJE P-164	5.0	Victa	4.7
WW Ag 463 (HAGA)	5.0	Baron	4.7
Glade	5.0	WW Ag 412 (Bono)	4.6
Galaxy	5.0	EVB 1942	4.6
Plush	5.0	MN OH 94	4.6
Brunswick	4.9	Enoble	4.5
Majestic	4.9	EVB 216	4.5
NJE P-142 (Touchdown)	4.8	Campina	4.4
Cheri	4.8	Bonnie Blue	4.4
NJE P-104	4.7	Aquila-Parade	4.4
Birka	4.7	Gardi	4.0
EVB 282 (Emmundi)	4.7	Tivoli	4.0

¹ Seeded in May, 1975

² 9-1; 1-best. Average of 2 years data

ROUNDUP AND TURF USE

Edward E. Jordan, Senior Sales Specialist, Monsanto Chemical Co.
Carmel, Indiana

I will cover two aspects of Roundup. First, a review of the characteristics or features of the product which will affect the performance, and hence the users' satisfaction with the product. Secondly, a review of the present label and a look at the turfgrass label text recently submitted to the EPA.

Roundup Characteristics or Features:

1. Safety with a 4900 oral LD₅₀
2. Water solubility
3. Contains ample surfactant
4. Readily translocates to stems and root system for total destruction
5. Applied postemergence to green portion of target vegetation
6. Non-selective
7. No soil activity
 - a. Tightly bound by soil particles
 - b. Rapidly degraded by soil organisms
 - c. Inefficiently absorbed by the plant roots
8. Broad spectrum control of both grasses and broadleaves
9. Negligible volatility

Roundup Label Review:

In late 1974 we received our first label for industrial non-crop areas and farmsteads. Marketing in 1975 was restricted to this label.

In 1976 the label was expanded to allow use and marketing of the product on areas prior to the emergence of corn, soybeans, sorghum (milo), wheat, oats, and barley.

Monsanto recently submitted a label text to the EPA for permission to market Roundup in areas to be seeded to fine turf grasses. The objective to utilize Roundup in turf renovation in such areas as golf courses, parks, highway right-of-ways, etc. The text included the following label instructions for use where existing vegetation is growing.

1. Omit at least one mowing to allow sufficient growth for good interception of the spray.
2. Tillage or renovation techniques such as vertical mowing, coring, or slicing should be delayed for 7 days after application to allow proper translocation of glyphosate to take place. (This is particularly important where bermudagrass is involved.)
3. Seeding is unrestricted as to species and timing.
4. Roundup does not provide residual weed control. Follow a label approved herbicide program in accordance to all cautionary statements and all other information appearing on the respective herbicide labels.

Monsanto hopes the request to expand the present label to include the above practices will be accepted by the EPA.

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ROUNDUP AND EARLY SEEDING

Jeffrey Kollenkark, Graduate Student in Turf, Dept. of Agronomy
Purdue University, West Lafayette, Indiana

The purpose of this experiment was to observe any soil residual or inhibition activity of glyphosate when applied to soil, and if it has any effect upon the survival rate of different grasses. Glyphosate was applied to bare ground at 0, 2.2, 3.4, 4.5 and 8.9 kg/ha on May 19, 1976. Eight different grasses were then planted on day 0 and day 3.

No observable differences were seen. Random seedling counts/unit area were made both 16 and 28 days following planting. No significance was found between rates. Germination was good even for planting day 0; it was significant, higher than planting day 3.

Table 1. Effect of the planting date in soil activity

Avg. of all counts	Planting date	
	<u>0 days after spraying soil</u>	<u>3 days after spraying</u>
	111.7	99.4

Notes: 111.7 significantly higher, not explainable. Seen in all rate treatments except 4.5 kg/ha. Probably due to more favorable soil-moisture conditions or weather.

Table 2. Soil Activity of Glyphosate

Grass	Soil Treatment (kg/ha Glyphosate)				
	Control (0)	2.2	3.4	4.5	8.9
Merion Ky. Blue	64.6	72.6	69.8	73.8	71.3
Adelphi "	75.8	81.5	72.2	83.4	61.6
Glade	92.5	80.5	89.9	100.2	82.0
Manhattan Per. Rye	132.8	109.4	105.8	114.6	111.5
Pencross Bent	164.6	148.8	137.2	174.2	133.6
Pennlawn Red Fesc.	111.8	100.9	93.3	102.1	93.0
Annual Rye	139.6	122.3	119.0	131.3	130.1
Ky.31 Tall Fesc.	109.5	114.8	118.0	125.1	106.1

Overall(all grasses) 111.4 103.8 100.7 113.1 98.6

(*values = avg. no. of seedling/100cm²)

Control 2.2 kg/ha 3.4 kg/ha 4.5 kg/ha 8.9 kg/ha
 4.5 rate significant, higher overall, but no rates vary significantly from the control.

SEED SOAK AND BARE SOIL APPLICATION

Seeds of four grass species - bluegrass, red fescue, perennial ryegrass, and bentgrass were soaked in a 1:400 solution of glyphosate to water for 0, 4, 24 and 48 hours and then applied to bare soil to test the effect of the soaking period on the seedling germination. This equals the concentration that would be used to apply 2 lbs/A glyphosate in a 200 gal/A spray, such as might be used in hydroseeding.

The time intervals used showed no difference compared to control. This would have application if existing foliage was not dense. Seed could be applied at the same time. Where turf foliage is dense, spray application followed by delayed vertical renovation and delayed seed incorporation would be suggested.

Table 1. Soil-seed-soaks to simulate hydroseeding

Grass	Control	0 hours	4 hours	24 hours	48 hours
Adelphi Ky. Blue	29.0	29.3	25.0	23.5	24.0
Pennlawn Red Fescue	53.5	69.2	36.5	38.7	42.5
Pencross Bent	50.3	45.0	62.3	46.0	46.7
Manhattan Rye	60.0	71.8	53.2	64.3	63.8
Overall	48.2	53.8	44.3	43.1	44.3

Treatments did not affect any of the grasses significantly.

Seed-Soak Blotter Experiment

Grass	Control	Activated Charcoal	Blotter (no glyphosate)			Blotter Soak + Glyphs.	Blotter Soak + Activated Charcoal
			4 hour	29 hour	48 hour		
Sydsport	78.3	--	73.7	67.0	60.3	0	--
Adelphi	93.7	92.1	93.7	89.3	80.0	0	0
Glade	93.3	--	93.3	88.7	80.3	0	--
Ann. Rye	97.7	--	13.3	9.0	6.7	0	--
Manhattan P. Rye	96.7	96.2	17.0	7.3	9.3	0	0
Pennlawn Red Fesc.	93.0	93.4	16.0	14.0	10.0	0	0
Ky.31 Tall Fesc.	96.7	--	12.3	13.3	10.3	0	--

EXPERIMENT - 10A1C - PURDUE AGRONOMY FARM

Glyphosate was applied at 2.2 and 4.5 kg/ha or 2 and 4 lbs/A to a pre-existing thatchy stand of turf. A control was needed that would also kill the existing turf, but not leave any chemical residues, so a black plastic cover was put over those areas. Red fescue, bluegrass, and perennial ryegrass were seeded in these areas and either raked in, incorporated with a verticutter, or with a Rogers seeder.

Table 1. Thatch Renovation

		Glyphosate		
		Control	2.2 kg/ha	4.5 kg/ha
Adelphi Ky. Bluegrass	Verticut	20.3	24.0	28.3
	Rake	25.0	29.7	32.7
	Rogers seeder	14.0	10.3	2.7
Pennlawn Red Fescue	Verticut	50.7	48.7	32.0
	Rake	80.0	57.0	36.7
	Rogers seeder	57.7	53.3	38.0
Manhattan Perennial Rye	Verticut	53.3	47.7	53.7
	Rake	48.3	46.7	47.0
	Rogers seeder	49.7	43.7	27.3

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FERTILIZER RESPONSES IN TURF

John F. Shoulders, Turf Extension Specialist
VPI and State University, Blacksburg, Virginia

Many turf managers and specialists regard fertilizer as the most important tool in turf management. Fertilizer use affects color, root development, food reserves, vigor, density, cold and heat tolerance, and other factors associated with satisfactory performance. It can either enhance or counteract the effect of other practices of turf management. In Virginia and in similar climatic areas the rate and scheduling of applications on fertilizer, especially nitrogen, may account for the difference between satisfactory and unsatisfactory performance of temperate grasses including Kentucky bluegrass and the fescues.

Consider the role and effects of the three major nutrients normally applied in fertilizer:

Nitrogen - Nitrogen makes up 3% to 6% of the dry weight of turfgrasses. It is a vital constituent of the chlorophyll molecule, the proteins, the cell acids and enzymes and vitamins. Its application produces an immediate and marked response in the turf plant. Nitrogen affects rate of growth, shoot elongation, root growth, density, color, disease resistance or susceptibility, recovery potential, tolerance to heat, cold and drought, and even the composition of the turfgrass community.

Phosphorus - Phosphorus makes up .1 to .6% of the dry weight. It is found in all living cells within the turf plant. It is involved in energy transformations including the transformation of starch to sugar. The role of phosphorus in maturation and seed formation has long been recognized.

Phosphorus is vitally important during the seedling stage when it promotes rooting and establishment. If ever deficient in soils, this is the critical period for low supply.

Potassium - Potassium ranges from 1-3% in dry tissue. It has a role in food formation and serves as a catalyst in nitrogen usage and other enzymatic reactions. Perhaps of greater interest to turf managers is the regulating effect potassium has on transpiration and respiration and its control in the uptake of certain nutrients.

The positive effects of potassium include improving tolerance to heat, cold and drought, reduction of wilting through its influence on the intake and retention of water, improving tolerance to wear and increasing resistance to disease.

This presentation is confined to the consideration of the response of Kentucky bluegrass and the fescues to fertilizer programs at Virginia Tech and elsewhere in Virginia. Warm season species such as bermudagrass and zoysia require an entirely different approach to the scheduling of nitrogen applications.

Furthermore, the assumption is made that the pH will be maintained at a level of between 6.0 and 6.5 to assure nutrient availability and uptake by the turf plant.

It is also emphasized that the fertilizer schedules and rates are those which, over a number of years of experiments at Virginia Tech and practical use throughout the State of Virginia, have resulted in the most satisfactory turf-grass performance under the varied and frequently extreme climatic conditions that occur within the transition zone which lies between the areas where temperate grasses on one hand, the the sub-tropical on the other are best adapted.

With climatic conditions as varied as ours the rates of nutrients and the time of year in which they are applied assumes major importance. The rate and scheduling of nitrogen applications is of greatest concern. Heavy applications of nitrogen in spring have resulted in severe injury, even loss of turf in summer under the transition zone climates.

In Virginia normally 2 to 6 pounds of nitrogen (N) per 1000 sq.ft. is needed on general turf areas each year, the rate depending on the species and varieties involved and the level of turf quality acceptable.

When using fertilizers in which the water insoluble nitrogen content is less than 50% of the total nitrogen, our experience has been that the most satisfactory schedule of application for temperate grasses is 3 applications of 1/2 to 1-1/2 pounds of nitrogen (N) per 1000 sq.ft. applied in September, November and December. An application of not more than 1/2 lb. of N in late May or June may also be needed if the turf exhibits a need for additional nitrogen that season.

Table 1. Guidelines for Nitrogen Applications on Established Turf Areas in Virginia

Month of Application	Lbs. of Actual Nitrogen (N)	
	Lawns per 1000 sq.ft.	General Turf Area Per Acre
September	.5-1.5	20-60
October-November	.5-2.0	20-80
December	1-2	40-80
May 20-June	0-.5	0-20
Total	2-6	80-240

The application schedule given in Table 1 has a number of advantages for cool season grasses under Virginia climatic conditions. It produces a greater root growth and food reserves, promotes faster green-up in spring, results in slower growth during the flush spring growth season, reduces the severity of spring and summer diseases, reduces summer drouth problems and results in improved density, vigor and persistence.

Satisfactory turf performance usually results when phosphate and potash levels remain in the "Medium" to "High" range as determined by soil test. (Table 2). Under Virginia conditions maintenance usually requires from 1 to 3 lbs. each of P_2O_5 and K_2O per 1000 sq.ft. annually. Autumn is the preferred time for application of the major portion of the year's needs for both nutrients on lawns and general turf areas.

Table 2. Guides for Annual Needs of P and K on Lawns & General Turf Areas - Virginia

Nutrient Level Measured by Soil Test	Lbs. of Actual Nutrient			
	P_2O_5		K_2O	
	Per 1000 sq.ft.	Per Acre	Per 1000 sq.ft.	Per Acre
Low	2	80	3	120
Medium	1	40	2	80
High	0-1	40	1	40
Very High	0	0	1	40

There is little visible response to phosphate applications in most situations. In Virginia, on most established lawns on high priority turf areas, the problem is one of phosphorus over-fertilization in previous years and the need to limit further applications.

Potassium may generate a moderate response when applied to turf growing on soils low in potash, especially during stress periods. Little response is noted on general turf areas on which an adequate fertilization program is used.

Although the climatic conditions in Virginia are not the same as those in the Midwest, I am confident that some of the trends in the response of turf to nutrient application we have experienced in Virginia will be useful to you in your further development of turfgrass fertilizer programs.

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WHAT KILLED IT?

R. E. Partyka, Plant Pathologist, Chem-Lawn Corporation
Dublin, Ohio

Although this conference centers primarily around turf, we shall divert a trifle and consider the trees and shrubs that are so necessary to compliment good turf. In fact, have you ever seen a turf area that is utilized by the general public devoid of trees and shrubs? No, you haven't. Therefore, as maintenance people, trees and other woody plants should become a part of your responsibility along with the turf. One of the major concerns of woody plant material centers around their decline or death. This is disconcerting because of the time involved in growing a specimen plant, located in a strategic position for symmetry or aesthetic value.

The first suspected reason for plant decline now appears to be the plant growth regulator materials used in lawn maintenance programs. These materials can cause damage to woody plants if used improperly. However, these materials should not become scapegoats for one's lack of knowledge of other problems that are being covered up. It is often too convenient to blame these growth regulator compounds when the plants die shortly after their use. It is better for one to have a reasonable understanding of how these plant regulator materials work and some of the symptom patterns that might be expected on foliage of plants where these compounds have been misused.

The first group of materials is used to control the development of seeds. This group known as pre-emergent materials such as DCPA, bensulide, siduron, benefin, bandane and pronamide. When used at recommended rates these compounds do not damage established plant material, and therefore are not considered harmful to such plants. Caution must be used to prevent placement of the material in gardens or other areas where seeded material is to be established at a later date. Also, in lawn areas one should be aware that re-seeding will be delayed because such materials will prevent grass seed as well as weed seeds from germinating.

Once seeds have germinated and broadleaf plants are established, another group of materials is used and generally referred to as hormone type compounds. These include 2,4-D, 2,4,5-T, MCP, Silvex, and dicamba and are very effective in controlling broadleaf plants. One of the characteristic symptoms when plants come in contact with these compounds is foliage distortion. This may be severe petiole curl and leaf cupping, to twisting and reduced growth. However, since these are growth regulator type materials, symptoms appear in actively growing tissue. Older mature tissue is generally not damaged when contact is made by accident or through wind drift. New growth also shows very distinct symptoms of parallel veination. This veination occurs when the leaf does not fully expand and the veins are very close together. If the new growth continues to show leaf distortion all season, one has to question if there is continued retreatment in the area or if an excessive amount was applied to the soil and the material is continually being taken up by the roots. This can happen if woody plants are accidentally fertilized with weed and feed materials. Another consideration is the placement of these materials in the vicinity of the root ball of a recent transplant. Watering practices may carry the material to the rootzone and put the plant in further stress in addition to the transplant shock. However, other forces may enter the picture with recent transplants as to whether proper procedures were followed in transplanting. In general, normal healthy plants will grow out of the damage caused by these materials provided there is no further exposure to the plant and rates in the soil are not above allowable levels.

Post-emergent compounds are used to control certain grasses after they have become established. The arsonates are often used in these cases. However, pronamide is being used in some areas for specific weeds. When used properly, action is selective and slow with good results. These materials will also cause injury to woody plants if used close by or come in contact with the plants. The injury caused by these materials is very similar to the next group being discussed.

Non-selective materials are often used around fences, driveways and trees to eliminate all vegetation. Some materials used for this purpose include dalapon, amitrol, Paraquat, and glyphosate. One consideration when using materials of

this nature is water solubility and residual time in the soil. Too often materials besides the four listed are used and some may move to other locations and damage plants. Also, one should be cognizant of root systems of large trees and the possibility of root up-take of the compound placed at a seemingly safe distance. These materials may be slow to show symptoms on some plants and where they do, there is no recourse left but to start with new plant material.

Symptoms from these materials may vary. Some materials will cause outright death of tissue that becomes evident in 2-3 days time. Materials taken up by the roots may result in veinal or inter-veinal chlorosis depending on the active ingredient. Overall yellowing followed by marginal browning and death of the plant may be evident. A contact material may damage only existing foliage with regrowth taking place in a few weeks from the woody tissue.

There are other factors to consider when one looks at woody plant damage and a knowledge of these factors is important. One important point is the weather, not only in recent weeks but 2-3 years prior to the time symptoms became apparent. This is especially important on larger established plants where weather records may help solve the problem. The age of the plant and transplant procedures need careful consideration on recently planted material.

One cannot neglect diseases and insects as possible causes of similar problems. However, most organisms associated with woody ornamental problems do not kill a plant rapidly. In most cases, symptoms or signs are visible on the plant in time to allow remedial procedures to be implemented before the plant is killed. There are exceptions, such as canker, root diseases, or wilt inducing organisms, that often prove fatal by the time they become evident.

Some of the most common causes of plant decline are not associated with the use of herbicides or insects or diseases. Rather, they relate to poor cultural practices that may become evident in a short period of time or may take several years to become obvious.,

In a few cases, fluctuating weather conditions may produce mimicking symptoms that can be confused with other factors. A good example is late spring frost that damages developing buds. Leaves will develop but often appear as if eaten by insects. In other cases low temperatures after buds have expanded may produce foliar tissue that appears to have been damaged by herbicides. Situations like this require careful examination of the problem and good weather records of the area.

The most disheartening problem is that associated with brown or dying leaves on a plant. The symptom pattern may suggest a water shortage in the plant. The question is why and where is the damage evident.

Some plants will react to extreme heat and dry soil conditions so genetic capability of the plant must be considered. This is often true of Buckeye, yellow poplar and sycamore in late summer. However, the symptoms on these plants often result in considerable leaf drop. Plants that do not drop leaves but show severe browning in most cases are suffering from a true water shortage that often leads to the death of the plant.

A common cause of scorch or leaf browning on small recently transplanted material is a limited root system or a poor top-to-root ratio where water loss through the leaves is greater than root absorption. Planting too deep or too shallow and placing roots in different oxygen or water tension levels from normal will stress the plant. Lack of water or over-watering may damage certain root systems. Container grown plants that are root bound may fail to become established in soil and thus desiccate because of moisture shortage at the soil interfaces of the container and planting site.

Older plants, 3-5 years old should be checked for girdling plastic twine around the trunk or plastic around the root ball. Deep planting may not become evident until this time especially if weather conditions were wet in recent years. Examine the trunk for mechanical damage or evidence of insect borers. Graft incompatibilities often become evident at this age.

Older established plants may show decline due to girdling roots, construction damage in the vicinity of the roots or placement of excess soil over established root systems. Fill dirt may change oxygen levels in the soil and kill fine feeder roots. Mechanical damage or black top driveways over tree roots will eventually cause some problems if proper maintenance procedures were not followed at the time of construction. Last but not least, one has to keep in mind the physiological maturity of the plant and weather conditions in the past that may have put the plant in a stress situation.

Probably one of the most important things one should remember about plant problems in an urba-suburban environment is that these plants are growing out of their natural habitats. The normal urban soil is in most cases a completely disturbed mixture of various horizons, compacted by heavy equipment, and subjected to the whims of a public often unknowledgable in the basics of plant growth. Until we develop plants that can tolerate these extreme conditions, problems will continue to appear to the chagrin of the maintenance people and the public.

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ARE YOU SURE THAT'S THE PROBLEM?

R. E. Partyka, Plant Pathologist, Chem-Lawn Corporation
Dublin, Ohio

Probably one of the most difficult areas to diagnose a problem is in the home lawn. Not only do you have variable lawn sites, but you have home owners with different objectives and degrees of interest which will often determine the type of lawn throughout the season.

In most cases, turf interest runs high in the spring after a long winter. At this time of year the turf is responding after a period of dormancy and, barring a few winter problems, it will look good in the spring. The home owner, in many cases, feels that he is at least partly responsible for a good looking turf. As the season progresses, homeowner interest may wane due to other interests and when other underlying problems become more apparent. At this time, customer calls are received by lawn service companies with the question, "What did you do to my lawn?"

Diagnosing lawn problems in mid to late summer, in fact, almost any time, can be trying where there is little history known about the turf or area. Invariably, many questions must be raised and hopefully the homeowner will be able to answer them.

Unfortunately, man has a short memory in many cases or else fails to keep adequate records. Then the diagnostician often finds himself in a quandry when investigating a lawn site. Certain questions and clues may bring him to the proper answer, but in other situations laboratory work is needed to reach a more logical conclusion.

Numerous factors must be kept in mind when troubleshooting a home lawn turf problem. One area includes general maintenance practices such as mowing height for the turf species and mowing intervals. Proper removal of top growth to maintain a good top-to-root ratio on the grass plant is important to maintain vigor. Careful observation of cut stubble will often determine this and in many cases, just a glance at the lawn will tell you how it is maintained.

The area of soils is extremely important and probably creates more problems than anything else. Standard practice when building now is to remove all the topsoil, grade a lawn area with basement clay, and pack it with heavy equipment. On top of this a thin layer of 'topsoil' is placed, and a lawn established by seeding or sodding. The turf responds and looks good for a while. However, later stress conditions may develop where mineral deficiencies occur, soil moisture becomes inadequate, roots fail to penetrate to adequate depths and oxygen tension becomes too low for good root growth. At this time the turf becomes susceptible to other factors such as diseases, insects, or environmental conditions, and problems arise. Some remedial factors can be applied to restore the turf, but they are costly, must be done routinely, and in general, only a mediocre turf can be maintained because of a poor growing medium.

The failure to recognize the amount of water needed to maintain turf often results in undue stress. This is due to the lack of sufficient water, improperly designed sprinkler systems, run-off rather than penetration, or a thatch build-up resulting in a shallow root system. The turf may fail to recover when improper watering programs and higher fertility levels are combined.

Thus, problems that do develop on a home lawn are often interrelated with many factors. Most problems are stress related so case histories and good weather records are important for a proper diagnosis.

When looking at a problem, an overall view is important. Similar situations may exist on other lawns in the area, and may be a key in diagnosis. Homeowners see only their immediate area and are not concerned with other lawns unless others' are better than theirs. Therefore, one should be aware of what is going on in the neighborhood.

Once an overview has been given consideration, concentrate on a small or local area to determine if the pattern fits that of a specific type of problem. The symptom patterns of many pests are definitive. The next step should be to look at individual plants. Observing leaves, stems, crowns, and roots can often point to clues that are helpful in determining the problem.

In cases where several factors may be involved, more work will have to be done by soil testing or other laboratory procedures to help pinpoint the problem. This is time consuming, and often a homeowner is impatient and expects you to solve the

problem on the site. This may not be possible due to the degree of advancement of the problem. However, some recommendations can be made to start remedial procedures until a more adequate answer is found. Knowing the area and time of year will determine what should be done. In cases when temperature and moisture stresses are involved, just watering may be sufficient. Of course, the old answer of, "I water plenty - just look at my bill!" comes up. Just convincing the homeowner to soak one spot for 24 hours will often show a remarkable recovery of the turf and help to prove a point. Knowing the types of problems that can occur and at what time of the year is very important in diagnosing.

Early spring problems are often associated with snow mold damage to turf. This may be true if the snow accumulated excessively in certain areas. Recognizing the dark sclerotia of Typula sp. embedded in the tissue or the pink mycelium growth of Fusarium nivale will often determine if this is the problem. However, one should be aware of other factors that may confuse the issue, such as desiccation injury on high spots or around corners of the building, ice smothering along drives and walk-ways or where children's snow forts were constructed, salt damage, or low areas subjected to freezing and thawing conditions in late winter.

As the season progresses, melting out symptoms may be similar to sod webworm or billbug injury. Careful examination for insects or their damage will help separate the problem. Dollarspot and red thread on home lawns, from a distance, looks similar to dog urine or mower burns. Close examination will reveal typical leaf symptoms of dollarspot and coral pink fungal strands on the ends of the blades will identify red thread. Stripe smut can be readily identified by the sooty spores in the infected blades and general unthrifty appearance of the diseased turf. Slime molds and powdery mildews are often present in turf but only powdery mildew is serious in shady areas.

Fusarium blight has become a serious disease in many new improved turfgrass varieties. A common symptom pattern, the frog-eye effect, has become associated with this disease. Unfortunately, many other diseases may form a frog-eye symptom. In general, Fusarium blight kills the crown of the plant. Brown patch fungus injures the roots and leaves, but the crown will remain visible for a longer period of time, and if weather conditions change the plant will recover. Pythium blight, a hot weather disease, is more common on ryegrass. It is generally identified by fungal growth during humid conditions and the matted collapsed appearance of diseased turf.

The appearance of rust and fairy rings can be readily identified. But yellowing of turf in definite areas requires much closer scrutiny. This may be associated with mineral deficiencies, nematodes, yellow tuft, aphids or inadequate root systems on the plant. Soil testing is often needed.

Other problems should not be excluded. Drought stress may appear similar to a disease problem when it starts. Root competition with trees weakens the turf and may resemble a disease or insect problem. Brown spots may be fertilizer, oil or gasoline spill, heat reflection from a muffler or footprints on frozen turf. Erratic patterns in narrow lines are oftendue to mouse damage, but may be vandalism as well. How the turf recovers or a close look at the crowns can determine the cause.

Diagnosing home lawn problems is a definite challenge. It can be frustrating for an irate customer, but rewarding when you find the answer.

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DIFFERENCES IN LAWN RESPONSE - WHY?
Jeff Lefton, Agronomist, Chem-Lawn Corporation
Indianapolis, Indiana

One difficult question to answer deals with two lawns near each other, both with a lawn problem responding differently. The question is asked, "Why doesn't my lawn look as good as my neighbor's?" One approach is to consider realistic possibilities and eliminate them one at a time. Below I have listed several factors to consider when comparing two lawns.

1. Consider a sun lawn vs. a shaded lawn. A shaded lawn will not stress out like a sun lawn.
2. Differences in soil - topsoil vs. subsoil; compacted (traffic) vs. uncompacted soil; natural drainage differences (slope); natural fertility and pH; the variability in soil texture within the lawn and from lawn to lawn; and the differences in soluble salt levels.
3. Differences in grasses - consider the age of the lawn; contamination with Poa trivialis, Poa annua, nimblewill, and bentgrass; poor coloration from improved varieties of Kentucky bluegrass such as Merion or Windsor in early spring and late fall; and a "heading out" problem (seedhead formation) from Kentucky bluegrasses such as Newport.
4. Mowing habits - compare height and frequency of cut; dull vs. sharp mowers; and a "stalking effect" from natural upright growing grasses (annual ryegrass, orchardgrass, etc.).
5. Differences in the nature (thick vs. loose thatch) and the depth of the thatch (greater than 3/4" is a problem).
6. Differences in watering programs - frequency and duration of watering; and a consideration of the natural moisture levels.
7. Consider the application dates and the type of lawn care program:
 - a. When did each lawn start on the lawn care program?
 - b. When were the various rounds applied to each lawn?
 - c. Were the chemicals in any particular round different on either lawn?
 - d. Did either person supplement the regular lawn care program with additional lawn products?
8. The difference could also be explained based on one lawn having a disease or insect problem.

From a customer relations standpoint, it makes sense to prepare yourself to systematically approach lawn problem solving.

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COSTING OF LAWN SERVICES
David Elixman, Ayres Green-Up Service
Indianapolis, Indiana

A. Selling price established by service offered, formula, area, and competition.

1. Program offered - yearly basis per 1000 sq.ft.:

4 lbs. of nitrogen
1 lb. of phosphate
2 lbs. of potassium
plus weed and insect control

Applied in four separate applications throughout the season

2. It is determined selling prices are as follows:

\$20.00 first 5,000 sq.ft. of lawn; \$2.00 per 1,000 sq.ft. thereafter

Eq. 10,000 ft. lawn	1st 5,000 ft.	\$20.00
\$2.00 per M x 5		<u>10.00</u>
Total 10,000 ft.		\$30.00

3. Average lawn 10,000 sq.ft.

4. Truck tank capacity 1,000 gallon

5. Rate of liquid per 1,000 sq.ft. --- 3 gallon per

6. Truck tank square foot coverage --- 333,330 sq.ft.

7. Number of lawns per truck load --- 33

8. 33 lawns @ \$30.00 ea. ---\$990.00 sales per truck

What Makes it Work?

- A. Sales goals on daily basis - by the individual
Weekly basis - by the company
Monthly basis
Follow-up procedure (4.2) days

B. Expenditure budget - set and followed

Note: We must keep in mind that while we are normally working with a fixed amount of receipts (2,000 customers) the expenditures may vary throughout the year. (Eq., overtime, over-usage, low production of individual)

C. Time Table - we must have applied the proper amount of lawns by a specific date

D. Trained personnel

E. Informed customers

F. Sales and company policy

G. Efficient way and control to follow-up complaints

Products to be Used and Cost, 1977 Prices

<u>Material</u>	<u>Comments</u>	<u>Volume Price</u>	<u>Unit Price</u>
Nitrogen	Uran 28-0-0 187 gal.	\$101/ton	.54/gal.
Phosphorus	Poly-N 10-34-0 174 gal.	\$220/ton	1.26/gal.
Potassium	Potash 0-0-62	\$140/ton	.07/lb.
Pre-emergence	75% W.P.	\$3800/ton	1.90/lb.
Herbicide A	49.3%ai (4 lb. ai/gal.)	\$8/gal.	.0625/oz.
Herbicide B	45.0%ai " " " "	\$34/gal.	.27 /oz.
Herbicide C	44.0%ai " " " "	17.50/gal.	.14 /oz.
Insecticide A	41.2%ai " " " "	50.00/gal.	.39 /oz.
Insecticide B	48.0%ai " " " "	24.00/gal.	.19 /oz.

Contents Used

<u>Steps</u>	<u>N - P - K (lbs.)</u>	<u>Herbicide</u>	<u>Insecticide</u>
1	1.5-.5 -1	pre-emerge + A	none
2	1. 0 0	A+B+C	A
3	.5 0	A+B	B
4	1 .5 1	none	none
year	4 1 2		

<u>Material</u>	<u>Per Truck Load</u> <u>Quantity Cost</u>	<u>Step #1</u> <u>Per 1000 sq.ft.</u>		<u>Material</u> <u>Cost</u>	<u>Selling</u> <u>Price</u>
		<u>Quantity</u>	<u>Cost.</u>		
		lbs.	¢	%	%
Nitrogen	140 gal. 75.60	1.26	22.7	20.3	7.6
Phosphorus	42 gal. 52.92	.24	15.8	14.2	5.3
Potassium	533 lbs. 37.33	1.0	11.	10.	3.7
Pre-emerge	100 lbs. 190.00	.23	57.	51.	19.
Herbicide A	2.1 gal. 16.72	8 oz.	05	4.5	1.6
Total*	372.57		\$1.12	100.0%	37.2%

<u>Material</u>	<u>Per Truck Load</u> <u>Quantity Cost</u>	<u>Step #2</u> <u>Per 1000 sq.ft.</u>		<u>Material</u> <u>Cost</u>	<u>Selling</u> <u>Price</u>
		<u>Quantity</u>	<u>Cost</u>		
		lbs.	¢	%	%
Nitrogen	110 gal. 59.40	1.0	.18	34.5	6.0
Herbicide A	1.04 gal. 8.32	4.0 oz	.03	5.0	0.8
Herbicide B	13.3 oz. 3.53	4.0 oz	.01	2.0	0.3
Herbicide C	26.7 oz. 3.66	.8 oz.	.01	2.0	0.3
Insecticide	250 oz. 97.66	3/4 oz.	.29	56.5	9.8
Total*	172.57		.52	100.0%	17.2%

* Water cost not included

<u>Material</u>	<u>Per Truck Load</u>		<u>Step #3</u> <u>Per 1000 sq.ft.</u>		<u>Material</u>	<u>Selling</u>
	<u>Quantity</u>	<u>Cost</u>	<u>Quantity</u>	<u>Cost</u>	<u>Cost</u>	<u>Price</u>
				¢	%	%
Nitrogen	55 gal.	29.70	1/2 lb.	.09	13.0	3.0
Herbicide A	133.3	8.32	4 oz.	.03	4.0	0.8
Herbicide B	13.3	3.53	4 oz.	.01	2.0	0.3
Insecticide	1000 oz.	186.48	3 oz.	.56	81.0	18.6
Total*		\$228.03		.69	100.0	22.7

<u>Material</u>	<u>Per Truck Load</u>		<u>Step #4</u> <u>Per 1000 sq.ft.</u>		<u>Material</u>	<u>Selling</u>
	<u>Quantity</u>	<u>Cost</u>	<u>Quantity</u>	<u>Cost</u>	<u>Cost</u>	<u>Price</u>
				¢	%	%
Nitrogen	90 gal.	\$48.60	.81 lb.	.15	36.	5.
Phosphorus	.42 gal.	52.92	.50 lb.	.16	38	5.3
Potassium	533.3 lb.	37.33	1.0 lb.	.11	26	3.6
Total*		\$138.85		.42	100%	13.9%

* Water cost not included

Per Truck (Two Men Per Truck)

<u>Gross Sale</u>	<u>Less Chemical</u>	<u>Less Fixed Exp.*</u>	<u>Less Labor</u>	<u>Profit</u>
<u>Step #1</u>				
\$990.00	\$372.57	\$405.90	\$99.00	11.8%
(33 lawns @ \$30.	37.2%	41%	10%	
<u>Step #2</u>				
\$990.00	172.57	405.90	99.00	31.8
(33 lawns @ \$30	17.2%	41%	10%	
<u>Step #3</u>				
\$990.00	229.05	405.90	99.00	26.3
(33 lawns @ \$30	22.7%	41%	10%	
<u>Step #4</u>				
\$990.00	138.85	405.90	99.00	34.0%
#33 lawns @ \$30	14.0%	41%	10%	

Fixed Expenses Include: Gasoline, equipment, office supplies, taxes, phone selling expense, accounting, postage, misc., interest, repair, depreciation, hospital, advertising

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FAIRWAYS TOWARDS BENT

Stephen Frazier, Supt., Meridian Hills Country Club
Indianapolis, Indiana

During my first few years at Meridian Hills, we were successful in growing and maintaining bluegrass fairways that were mowed at a reasonably close height of cut. We had several conditions that proved to be quite challenging. These were:

1. Poor internal drainage
2. Thatchy fairways
3. A problem of what to do with a developing disease named Fusarium
4. An arsenic program which was started but which offered problems because there was no good handle on the accumulative effects of previous lead arsenate applications and the current ChipCal program.

The greens committee was very receptive to the tiling program on the basis of shorter time the course was closed to dry out after rains and minimizing loss of revenue from carts not running because of poorly drained turf.

Fusarium roseum wilt at first was not a serious problem. Our frequent aerification program seemed to help lessen disease incidence. Later we started applying wetting agents using rates of 1 oz./M to 3 oz./M at various frequencies in an effort to minimize the wilting effect and spread of Fusarium through better water penetration and usage. In conjunction with aerification and wetting agent preparations, 1991 was applied at various frequencies and rates. This worked for two seasons. Then the cost of fungicide and increased dosage became costly and ineffectual. Syringing techniques were also used.

We have continued to use wetting agents on fairways. During this period of time we continued to use and introduce different varieties of bluegrasses in an attempt to find some disease resistance. There were other implications - Poa annua encroaching in Fusarium wounds and encroachment of some undesirable weeds.

For a number of years our first superintendent sprayed lead arsenate frequently. Particular attention was devoted to the approaches and the effort was directed towards crabgrass. It proved to be impossible to track down any records to determine how much lead arsenate had been applied. Our next superintendent embarked on a sound 'no phosphorus, calcium arsenate' program. He had applied approximately 16 pound/M of ChipCal/acre.

Because of areas of poor drainage and unknown arsenic toxicities and thatch, we decided to soft pedal the ChipCal program and not to pursue it actively. In the first two years of bluegrass management we used Balan. The government helped to make the final decision with the ChipCal. We still have enough for one more application and will make it count.

We were able to correlate to some degree the effectiveness of the arsenic in Dr. Freeborg's tests to determine amounts of available arsenic in the soil.

During the summer of 1973 Fusarium was particularly devastating. During hot weather, even though we had watered the night before, bluegrass in the fairways was damaged, especially where golf cars crossed areas that were stressed during the heat of the day. Consequently, when this turf was weakened, it was very susceptible to disease. This disease incidence followed almost immediately.

In past summers we had experienced the problem with golf cars tracking fairways and the necessity of midday syringings. We observed that frequent patches of bent scattered through fairways were not tracked by the golf cars. Also, the bent was not

under a wilting stress as was the bluegrass. In fact, the patches of bent did not really need to be syringed during midday. Our first six fairways originally seeded to bentgrass in 1956 showed increasing evidence that the bent was growing at the expense of Poa annua and bluegrass.

For many years, bents were included in bluegrass blends. These were supposedly Colonial bents and there are patches of them still in evidence. The Colonials get rather stemmy and off-color in hot weather and are subject to brown patch and drying out. But the persistent residual bents in the fairways were the creeping bents.

In a recent talk at MRTF Conference, one speaker made reference to the situation whereby bentgrass seed, being so small, could be a rider hidden in the glumes of a larger bluegrass seed. Until recently good bluegrass seed could be contaminated and caused this problem. It seemed the more intensively we managed bluegrass, the more prominent the existing bent became.

During a greens committee meeting in August of '73, we again discussed the conversion of bluegrass fairways to bent. We chose Penncross creeping bent. Our general procedure was to aerify first, going over the area two times with a Grasslyn aerifier - 1" open spoons were used. In areas where the turf was exceptionally thin or Poa annua was prominent, seed was broadcast over the area at a very light rate. After the fairway was aerified we used a Mott hammer knife to break up the plugs. The Mott mower was set so that scalping was held to a minimum. After the Mott was used, a chain link fence drag was used over the turf to further spread the soil cores.

The aerifier reacts quite differently when used where there is predominantly bent in comparison to bluegrass turf or weak rooted Poa annua. The open spoon provided the best job whenever it was used. In later renovation where bent was most prominent, springs were installed to keep keep the turf from puffing around the spoon as it was lifted from the turf. If the only operation in renovation was aerifying you could aerify four times in one day and not damage the playing turf. We had a follow-up step of disc seeding immediately after aerifying. This limited the number of times we were able to aerify. We have observed some renovating seeding equipment and felt our McCormick small grain drill could do a comparable job.

The McCormick does require two men to operate; the driver of the vehicle pulling the machine; and the other operating the depth the disc cuts into the turf and raising the disc and stopping the flow of seed. The disc cuts down through the turf and slightly rolls and opens the slit. Seed is then deposited as the sod rolls open. The depth of the disc can be varied according to type of turf, soil conditions and moisture content. Any seed in renovation has to be in intimate contact with the soil to survive.

For the initial seeding with the disc seeder, a 20#/acre rate was used, and the machine was run the length of the fairway. After disc seeding a light roller was used to press the slitted turf down to avoid any wilting that could have occurred. Two weeks later the slits were firmly rooted and the disc seeder was again used applying 20#/acre, but the turf was cut in the opposite direction across the fairways.

We treated collars and approaches differently. Using a Ryan Greensaire, the collar was first aerified and this was extended out to the first fairway sprinkler. After aerifying, seed was broadcast at 1-1/4#/M. The remaining plugs were verticut and the soil was matted in using a Ryan top-dressing drag mat.

From the spring of '60 to '73 the annual fertility program consisted of using 18-5-9 ratio at a rate of 3-1/2 to 4#/N/M/year. A complete fertilizer application was made just two weeks prior to the first renovation.

The following spring we started using a no phosphorus (28-0-14, 2-0-1) fertilizer in an effort to help the accumulated arsenic express itself. From '73 to '76 our total annual nitrogen applied was decreased and varied from 2-1/2 to 3-1/4 #N/M/year.

Light frequent applications were used. From four to six light applications per year were made. Growth has been even and consistent without spurts, color good. We have mowed at least four times per week during these periods.

The first renovation of fairways was started September 14, 1973, and was completed one month later. We were fortunate as the weather cooperated. Seed germinated quickly and the new seedlings developed sufficiently to progress into the winter mature enough to survive until spring.

In the spring of 1974, the bent stayed in the two to four leaf seeding stage for a longer time than expected, due primarily to competition. Throughout most of the summer it was difficult to observe the new bent, unless you got down on your hands and knees. Some time in late August when dew was heavy early in the morning, you could start to see streaks to tell-tale bluegreen Penncross. The same seeding technique as used in the fall of '74 except the seed rate was increased to 30#/acre.

The spring of '75 in the Indianapolis area was cold and wet and it seemed that by the first of April we had solid Poa annua. My spirits hit rock bottom, when I had to face Bill Daniel's turf group with my patch of Poa. One young fellow made my day when he said, "Mr. Frazier, everybody always says how hard it is to keep Poa growing and looking nice; you don't seem to have that problem at all."

Poa annua was flourishing at the expense of the bent and even the bluegrass. Somehow it had to be slowed down. In mid-April we made one light application of Chip-Cal - 80# of material/acre. By the 9th of May you would have guessed it was mid-August. The Poa annua was failing and we faced the stark reality of a lot of brown spots and poor turf for the remainder of the season. We teased and played with the Poa, hoping it would go but also in need of something green and playable until after our July invitational tournament. '75 was going to be a long summer! During late July and early August, Fusarium decided to do its thing, and our hardy bluegrass took on an unhealthy pallor. Throughout this period, I felt it would not have benefitted our total program to aerify or spike to help minimize the Fusarium.

As the Fusarium was working, something else was happening. Small sprigs of bent had competition eliminated and started showing in the Fusarium scars. Early one morning when the dew was particularly heavy, I saw bluish green streaks of Penncross starting to show where the Poa had been failing. This was the first of August, and

the effects of chemicals and weather on the Poa annua had run their course. We didn't syringe during the heat of the day and let the Poa slip more. Evening watering seemed sufficient to maintain the bentgrass. Things didn't seem quite so bad. We didn't lose all of our Poa by any means, and there was a residual amount that carried over, but we had a very significant net gain in our bent population. Interestingly, in August, when the Poa germinated, it was always in a crack or fissure in the thatch or wherever the turf was disturbed. Under most browned out divots in August it seemed that we could find some Poa seedlings sprouting. During some really hot weather, Poa seedlings got up to about 3/8" in height and had the symptoms of arsenic toxicity and drying out from lack of syringing.

That fall of '75 we aerified prior to disc seeding. There were now patches of bent in the fairways that were that solid that we didn't feel it necessary to disc seed. In other areas, a Lely spreader was used to broadcast seed in weak spots in addition to the disc seeding. The response of seeding into freshly aerified turf is very acceptable; the problem, though, is getting enough holes and bringing up enough soil.

One point of interest - the Par 3 fairways were seeded only one time and by the fall of '75, were nearly 90% bentgrass and are now developing thatch. These fairways don't receive cart traffic and are mowed with a light triplex '70 Toro Professional.

The spring of '76 broke early; we were mowing fairways and greens by the last week in February. Once the weather warmed, it continued to stay warm and dry. Bentgrass and bluegrass gained and were very competitive with the Poa annua in early spring. The 1975 season was a teacher. Throughout the summer, we tried to stress the Poa whenever we could. This was mainly with watering practices. Ideally, if the Poa can be stressed, the bent seems to respond, especially when there is a lack of competition.

In various stages of development, the fairways are mottled and patchy. However, when the turf matures to 75-90 percent bent level, the patchy mottled look starts to disappear.

With bentgrass fairways, when rainy weather does plague you, you can go several days without mowing and not be in too much trouble with too heavy a turf to mow. Also, you may be able to cut down one mowing per week.

Seemingly bent does not stress as much as does closely cut bluegrass during the heat of the day.

We are pleased with the response we have seen so far in this renovation program.

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RECLAMATION AND REGULATIONS

David S. Ralston, Agronomist, Environmental Engineering Dept.

AMAX Coal Company, Indianapolis, Indiana

Late last fall when Bill Daniel asked me to be on the program for this year's Conference, I do not think either of us realized the timeliness of the topic. Record cold temperatures this winter throughout the Midwest and East sent energy demands soaring, and fuel bills kept pace. All of us have been both directly and indirectly affected by the severe weather. Rationing of natural gas brought industry to a grinding halt and caused temporary layoffs of well over a million workers. This winter has brought home the fact that America runs on energy, and our modern lifestyle is dependent on having ample energy for domestic and industrial needs.

Gas and oil gradually replaced coal as major fuels for homes and industry because they were cheaper and more convenient. But today, America is faced with an energy dilemma. Our supplies of oil and gas are limited and dwindling. The oil embargo of a few years ago made it clear that we've become greatly dependent on foreign oil supplies. Today, we import more than 40% of the oil we use and the need for imports continues to increase. Natural gas supplies are dwindling; critical shortages are forecast again for next winter.

Americans are having to take a fresh look at our energy resources. Coal will become a more important fuel for the future. There are massive deposits of coal in the United States. In fact, America has half of the free world's recoverable coal reserves - over 200 billion tons. Table 1 shows that the identified bituminous coal reserves in Illinois, Kentucky, Ohio, Indiana, and Michigan amount to over 280 billion tons, or 41% of the total 686 billion tons for the United States. Of the identified 280 billion tons, only 35.5 billion tons is shallow enough to be considered for surface mining, and only 7.1 billion tons is considered economically feasible for surface mining with today's technology and market conditions.

Illinois leads the nation in bituminous coal reserves with over 139 billion tons of identified reserves of which 3.2 billion tons are strippable reserves. A considerable portion of the strippable coal reserves is located under prime farm land. Thus, the major issue facing the coal industry in the Midwest today is, "Can the coal be recovered without sacrificing the agricultural resources?"

Table 1. Bituminous Coal Reserves in Selected Midwestern States, 1 Jan 72

<u>State</u>	<u>Identified Resources</u> ¹ million tons	<u>Remaining Strippable Resources</u> ² million tons	<u>Strippable Reserves</u> ³ million tons
Illinois	139,124	18,845	3,247
Kentucky	64,842	9,355	1,758
Ohio	41,358	5,566	1,033
Indiana	34,573	2,741	1,096
Michigan	205	6	1
Subtotal	280,102 (41%)	35,513 (58%)	7,135 (52%)
Other States	405,931 (59%)	26,313 (42%)	6,462 (48%)
TOTAL U.S.	686,033	62,826	13,597

- ¹ Identified resources: Specific, identified mineral deposits that may or may not be evaluated as to extent and grade, and whose contained minerals may or may not be profitably recoverable with existing technology and economic conditions.
- ² "Remaining strippable resources" means coal still in the ground in beds of at least minimum thickness and under less than maximum over-burden. "Resource" figures do not consider whether the coal can be mined economically. Seam thicknesses are generally at least 28 in. for bituminous coal (12 to 18 in the Midwest) and 60 in. for Texas, the Rocky Mountain, Northern Great Plains and Pacific Coast provinces. Over-burden is limited to 120 ft. in the East, 90-150 ft. in the Midwest and (depending on the coalbed) 50-250 ft. in the rest of the country.
- ³ "Strippable reserves" means that part of the strippable resources which can be economically recovered with existing strip-mining technology. It excludes coal which cannot be mined because of topography, natural and manmade features such as rivers and towns, and other limitations.

SOURCE: Coal Facts 1974-75, National Coal Association, Washington, DC (pp. 74-78)

The wealth and power of this country are based on its soil, water, plants, mineral deposits, and human resources. We need to continue to produce crops and to harvest mineral resources; yet we also need to maintain quality in our standard of living by protecting our environment. We have all seen examples of disregard for the environment when coal was mined. In the 1940's and 1950's, people wanted cheap energy, and reclamation was an afterthought - if at all. Little or no grading was done and spoil heaps were planted to trees. Reclamation laws of the 1960's required some grading, and pasture and hay production became the dominant post-mining land uses for Midwestern operations. The environmental movement of the late 1960's and early 1970's has produced more stringent reclamation regulations, particularly with regard to grading and to compliance with water quality standards. Today's regulations require grading to topography similar to what existed prior to mining, and, in some states, replacing native topsoil and/or suitable rooting medium material for the surface 1 to 4 feet of the reclaimed area.

Let's define reclamation. It is the process of reconvertng mined land to its former or other productive uses. Today this means reclaiming to row crop potential where it existed prior to surface mining. This can only be accomplished through an organized, well-planned approach where everyone involved throughout the process is aware of the desired final product.

The following is a summary of the steps involved in achieving good reclamation at AMAX:

1. Planning - evaluate coal reserve
 - characterize soil and overburden materials
 - review legal requirements
 - make recommendations regarding overburden handling and reclamation objectives

2. Engineering - design mining plan
select equipment
make provisions for achieving reclamation objectives
obtain necessary permits
3. Operations - carry out mining plan for coal production
reclamation grading
4. Reclamation - final grading
apply lime, fertilizer, seed, and mulch (as necessary) - normally
done by Meadowlark Farms
5. Land Management - reclaimed land managed by Meadowlark Farms for agriculture (crop
land or hay and pasture production), woodland, and/or re-
creational development (hunting and fishing, picnicking, and
camping)

Let's focus in on what I consider to be the key element in the whole process, characterization of the soil and overburden materials. Unless we have a thorough knowledge of the materials overlying the coal, the end product is somewhat left to chance and to the limitations of the equipment selected purely on the basis of mining economics. Problem areas can easily result when toxic materials are not selectively buried, problems which are costly to correct. However, by defining the agronomic potential of all overburden and interburden materials during the planning stage, recommendations can be made to management for the best material, or combination of materials, to leave at the surface, and what undesirable or toxic materials should be selectively buried. Equipment can then be selected to achieve the reclamation objectives in the most economical way possible. The age-old saying, "An ounce of prevention is worth a pound of cure" is certainly true for reclamation.

Therefore, for each of our active and prospective mines of AMAX, we evaluate the soils and overburden materials to identify the most suitable agronomic materials for placing on the surface of the reclaimed areas, as well as the less desirable materials which should be buried deep in the cast overburden. Each mine is unique. Depth to coal, type of geologic formations, depth of unconsolidated glacial till material, number of coal seams, interburden materials and thicknesses, and stability of the overburden materials are just some of the variables considered. The physical and chemical properties of native soil materials are compared with properties of the deeper loess and glacial till materials, if present, for determining the material or combination of materials that will provide the most suitable rooting medium for crop production on reclaimed areas.

The rate of weathering of shale and sandstone bedrock materials is also a factor. Soft shale will normally weather to soil material in less than three years, so it should not interfere with future tillage operations. The nutrient content of the shale and the texture of the resulting soil are agronomic properties considered. Hard siltstone, sandstone, and limestone may not weather within our lifetime, so unless these rocks are buried, they will pose continual problems for tillage operations. Reclaimed areas containing such rock are normally used for pasture or hay production rather than for row crop production.

Illinois has recently passed legislation for reclamation of row crop lands (Rule 1104) requiring replacement of between 8" and 18" of darkened surface horizon (topsoil) over a root medium material to a depth of 48" for areas originally having

SCS Class I, II, and IIIw soils. The root medium material can be native subsoil or a mixture of soil and glacial till materials, but it cannot have any rock larger than 10" or any pyritic (acid-producing) materials. An estimated 65% (12,700 acres) of the total 19,600 acres scheduled to be mined in the next twenty years at our Delta, Leahy, and Sun Spot Mines in Illinois will come under Rule 1104 for requirement for row crop reclamation. Scrapers are now being used to move the topsoil around the active pit at all the mines. Where the graded cast overburden placed by the primary dragline or shovel contains rock larger than 10 inches, the full four feet of soil material is handled from native soil areas in front of the highwall to cover the graded cast overburden.

Better methods of selective placement of desirable unconsolidated materials are being evaluated. A small (less than 20 cubic yards) pull-back dragline in the spoil can assist the primary dragline or shovel (normally 50 to 175 cubic yards) in getting the desirable unconsolidated material on the surface of reclaimed areas. Bucketwheel excavators with conveyor belt systems, both around and across the active pit, are being considered. The most effective method can only be achieved when it is an integral part of the total mining plan.

In conclusion, surface mining technology is dynamic. Mining and reclamation methods have changed, are changing, and will continue to change in the years ahead. What was considered unfeasible yesterday is being done routinely today. Prime agricultural soils are being replaced on reclaimed areas, so the coal mining itself is an interim land use. The coal resource is recovered for use in meeting energy needs, and the agricultural resource is being preserved for continued long term productivity.

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PROMOTING AND TEACHING NEW GOLFERS

Don Essig III, The Hoosier Links
New Palestine, Indiana

Why teach? We are all interested in increasing the number of players at our golf courses. One of the best ways to get new players to your course is to instruct them in how to play. Not only will they be happier when they can play better, you also have the chance to teach them about golf course etiquette and golf course care. The player who comes to you for lessons will very often come to you for merchandise and other golfing needs. Often these people will not only come play your course, but will bring others, including outings, leagues, small groups, etc. It should be quite obvious that teaching is profitable for the entire operation of your course.

The golf professional. The individual, or individuals that you have teaching are the key to a successful instruction program. The professional's attitude and golf knowledge, along with a suitable area for teaching, are the main attractions that you can offer the student.

Attitude. The professional must sincerely convey to the student that he likes to teach and that is he interested in the student's game. The professional must sincerely listen to his students' desires and goals. The professional must be honest with his students.

Knowledge. All PGA professionals are not good teachers. The PGA, through the Education Department, has made great strides in improving the teaching knowledge of the members. A good teacher never stops learning. He must continually update his methods and ideas. In selecting a teacher, I would carefully examine his PLAYING and teaching background. It takes experience for one to become a good teacher. Some are more gifted than others.

How important is a professional's teaching responsibility? A recent quote in Golf Business of a statement that Bobby Jones made years ago at a PGA meeting said, "If I had the responsibility to hire a golf pro, his first qualification would be to be an excellent teacher, as he is the only person who can help another enjoy the game more."

Methods of attaching new students. Proper instruction requires that your teaching site is adequate. Too often land is not set aside for a driving range and teaching facility.

The professional's availability is the single most limiting factor. It works both ways. Some professionals are under-available. Teaching is done on a very limited basis only at times when the professional can find nothing else to do. Unfortunately, many of you have heard some professional say he just doesn't want to work that hard. The other extreme is the professional who tries to see how many lessons he can crowd into one day. By the middle of the day this teacher must be mentally exhausted if he is sincerely trying to help the students. Too often this just becomes an exercise in parroting what he started saying early in the day and continues through all his students. Personally, I have found that ten lessons per weekday (five morning, five evening), and four lessons per day on the weekend will enable me to accomplish the other duties I have and to remain alert for the lessons.

Teaching in a series has proven successful in getting people not only started in taking lessons, but also in keeping them coming back for more. Lesson fees vary from one area to another and from one teacher to another. By giving the student a price break for signing up for six lessons, paid in advance, the students will plan their schedules to complete the series and you will see far greater improvement in their golf games.

There are various sources of new students, such as:

Junior golf programs. Every golf course should feel the obligation to have an active, well-planned junior golf program. The program should include both instruction and playing. The new PGA testing program is outstanding and creates great interest in golf for juniors. A successful junior program will develop the most loyal group of golfers you will have.

School golf teams and gym classes. These are excellent sources for new players and for developing the better junior golfer. Free clinics and golf talks are very good ways of attracting them to your golf course. We have found that the junior and senior high school players spend more and are more considerate of the golf course than the college golfer.

College and high school continuing education classes for adults. This has been our best source for group lessons and new golfers. Over 200 adults participated in

classes that I taught in 1976. These courses are conducted both in the classroom and on the practice tee at our course. A high percentage of these students come back for private lessons on a continuing basis. They have also been excellent customers for clubs, shoes, and other golfing needs.

Self-promoted group lessons. Each spring we put up signs in the clubhouse advertising beginning group lessons. The psychology of people starting to play and take lessons in a group is very good. Most new students are very nervous and this 'group therapy' relieves a great deal of the tension. It's comforting to find out that they are not the only ones having trouble hitting a golf ball. One surprising aspect in all of our groups has been the number of men who take lessons.

Clinics, Talks. Every time you have the chance to conduct a golf clinic or to speak to a service club or some other type of gathering you are exposing yourself to many potential lesson takers. After hearing you speak, the golfer will feel that he knows a little more about you and will be more confident in your ability to assist him to play a better game of golf.

Radio, TV, Newspapers. Any time you can appear on radio or TV, or any time you can have an article published in the paper, your exposure is greatly increased. Look at the number of magazine articles that are carried monthly about golf teachers and their ideas. A series of 25-second golf tips run twice daily on our good music FM station gave me more exposure than anything I had done in the past. Not only was I given this air time, but I was paid for doing it.

Word of mouth. This is by far the best source for new students. When your students are happy and tell others that you have helped them improve their golf game, you are well on your way to increasing not only your reputation as a teacher, but your teaching schedule as well.

Conclusions. Teaching golf should be high on the priority list of all golf facilities.

The golf professional's personality (attitude plus knowledge) is the greatest asset in establishing a successful teaching program.

Finally, golfers who return for golf lessons will return to buy merchandise, to play, and will tell others about your golf course.

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SEED AROUND THE WORLD - THE EMPHASIS ON DEVELOPMENT OF NEW VARIETIES

F. B. Ledebor, Lofts Seed, Inc.

Bound Brook, New Jersey

Rapid strides in almost all areas of human endeavor since World War II have brought many changes to most of the western nations. Space exploration, supersonic passenger flights, computer and communication technology, greater affluence for a larger number of people, fewer working hours than ever before, and so on have not left turfgrass culture in the dust. Major improvements have also been wrought here.

In the last three decades modern turfgrass culture came of age. From a practical art it became a science in modern agriculture. When demand was placed on better performance for all types of turf areas because grasses were being used more and more for professional sports, lawns, golf and other forms of recreation, appropriate research programs were initiated by state universities and private enterprise to meet the challenge.

Among the many challenges was the need for improvement of turfgrass varieties. Up to the time that Merion Kentucky bluegrass was brought onto the market, turfgrass seed needs were satisfied largely with commonly occurring types of the various species. Merion changed all that because it proved to be far superior to others.

Turfgrass variety improvement is today being pursued vigorously not only by the United States, but also by many European countries. The Netherlands, for instance, has been a leading force in this area where turfgrass improvement is strongly linked to pasture and forage grasses. Other influential forces have been England, Sweden and Germany. Quite a number of successful turfgrass varieties on the domestic market today originated in Europe.

While the Europeans have relied primarily on selecting and mass screening for superior cultivars, it is not the only method for successful variety improvement. Actual controlled breeding by selectively crossing two or more parents with desirable qualities also has been rather fruitful, as evidenced by the excellent varieties that have been developed by the breeding programs at Pennsylvania State and Rutgers Universities. Several privately funded breeding programs, I am sure, will also make significant contributions in the future. The O. M. Scott & Sons Company already is well represented with its developments in Kentucky bluegrass.

Significant strides have been made in the predominant turfgrass in the U. S., the Kentucky bluegrass. Because of its largely apomictic characteristics of reproduction (seed forms without pollination of the egg), such varieties are quite stable and relatively easy to keep true from year to year. In all other cool season turfgrass species, however, because they are cross-pollinated, the task is more difficult. In order to avoid contamination, all parent material has to be maintained vegetatively until such time that it is needed for seed increase. Since multiple parent clones are often used, these parents have to be kept in proper balance to each other so that the resulting seed represents parent input in desired proportions. This breeding procedure is known as "polycrossing" and results in "synthetic" varieties.

The much improved turf-type perennial ryegrasses are polycrossed synthetic varieties which may incorporate as many as 50 or 60 parental clones. This breeding method assures desired genetic diversity (heterosis), and generally contributes heavily to wide-spread adaptation and reliable performance of these new varieties. They are brought into the marketplace as proprietary types, meaning that they are marketed by organizations with special interests in the varieties. Seed companies, grower associations, or even university alumni associations are examples. Such varieties are being contracted out to seed growers in the Pacific Northwest. In most instances, the entire crop of named varieties is contracted out to be delivered as certified seed only. If growers cannot meet these stringent criteria, their crop can only be sold as a common type often at greatly reduced prices. The emphasis with proprietary varieties, therefore, is definitely on quality production to assure quality and trueness to variety characteristics.

Many named varieties have been produced in Kentucky bluegrasses, perennial ryegrasses and the fine-leaved fescues. Many more will show up in future years, and they will be superior in many respects to those that are available now. A good portion of them will fall by the wayside because of problems of one sort or another.

Economical seed production causes variety attrition more than any other factor. The best turf-type grasses are often very poor seed producers making seed cost too high to gain widespread acceptance. Limited areas of use or adaptation impose similar restrictions which many of the European entries have encountered in the United States. Most of Europe has moderately cool summer weather with many cloudy days, and this is quite a contrast to the long, hot and humid summers in many areas of the U.S.

Seed around the world used to be comprised largely of common types, but modern breeding methods and demands for improved varieties, not only in turf grasses but also in food and fiber crops, have changed the picture quickly. Future variety improvements will continue to be made at a rapid pace as breeders and growers learn to utilize the ability of genetic plant material more and more to its fullest potential.

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SOIL MOISTURE SENSING

W. H. Daniel, Turf Specialist, Dept. of Agronomy
Purdue University, West Lafayette, Indiana

The extensive discussion during this conference of moisture in the soil, in the plant, and in the air is augmented by the current nationwide comments and concerns of the conservation of the limited moisture for 1977. Soil sensing is a tool for achieving maximum water conservation.

Checking for soil moisture content is usually done visually. Plant response such as wilting in spots, exposed slopes, or footprinting may signal that the supply of soil moisture at the root-tips is inadequate.

What other ways can moisture in the soil be sensed and recorded? Four methods to consider are: by the feel of the soil, probing of the soil, suction created, and the electrical conductivity (moisture blocks and naked probes).

1. By the resistance of a probe into the rootzone - will a screwdriver or knife blade probe easily, or is the resistance a clue to dryness?

2. By the feel of the soil - does it mold easily or does it crumble?

3. By the measure of the suction created - the Irrrometer method. The Irrrometer Company has sold over 200,000 units in the western areas for soil sensing. This unit is calibrated to express centibars of tension, 0-100, which is the range that roots readily adsorb moisture from the soil. It is constructed as a water-filled sealed tube, with a dial at the upper end and a porous ceramic cap on the lower end. It is designed to be placed in the soil where the moisture responds to the suction of the soil and roots. The tension is shown on the dial (0-100). Generally, two units are inserted into the soil - one shallow, or in the upper area of the roots, and one deep, at the lower reaches of the roots.

A micro switch can be built into the units which, when the desired setting is reached, (say, 40 millibars suction) will produce an impulse that initiates irrigation. Considerable checking and service of the equipment is required. When air penetrates the porous cap the water level must be recharged.

A new tube designed for installation under mowed turf areas has been produced. It is available in 1977.

4. Measurement of the electrical conductivity of the soil moisture. Either prepared blocks or bare probes can be used in the soil sensing.

a. Moisture sensors using resistance blocks have been made of plaster of Paris, nylon cloth or fiberglass cloth. The amount of moisture adsorbed within the media between the electrodes is registered as resistance on the meter.

The plaster of Paris blocks are economical to construct. Pineapple growers in Hawaii have made and used many of these. When the electrode leads are attached to a small portable meter the moisture available to the plant roots is indicated. The pore space in gypsum blocks is similar to that in silt loam soil. Therefore, the blocks stay too wet when used in sandy soil or pure sand rootzones. The Dormhorst Company currently manufactures a gypsum block and meters.

The nylon block can register at lower moisture tensions than gypsum. The nylon block is durable, but the calibration is difficult. The same is true of fiberglass sensors. The Beckmann Company manufactures a fiberglass block.

b. Recent research efforts at Purdue have been to develop a device with sensitivity to moisture in sand profiles. We have found that a bare probe of stainless steel strap ($1/4\frac{1}{2}$ to 4") can give the sensitivity needed. Each sensor has an individual wire leading to a controller. Our procedure has been to place 3-6 sensors at varying spacings in the upper rootzone. Any two of the sensors are chosen as representative of the available soil moisture. Resistors used in the controller can be changed to correlate the readings with the conductivity of a soil or sand. The controller has an adjustable 0-100 dial, which can be set to close contacts, and thus regulate irrigation. The three on-site adjustments - sensor spacing, resistors in the controller, and settings on the dial - provide the turf manager with the information and flexibility needed. Our success with this process is most encouraging for the sensitivity is excellent.

Many clock controlled irrigation systems have rain cut-offs attached to them. Some of the cut-off controls drain slowly or have a sponge built into them to delay irrigation. But the real question is, 'what is the actual moisture availability in the soil?'

For turf areas having clock controlled irrigation systems it is practical to use one soil sensing controller to interrupt a ground wire to provide control for a series of valves. This could be used for controlled irrigation of all greens, only nine greens, nine fairways or units of certain tees. Thus the clock asks daily, "Is irrigation needed?", and the sensor may say, "Not yet", or "Yes, tonight."

The current water shortage is real, most severe in the west. Soil sensing can provide evidence or justification of the water needed. It can be information used to promote good public relations, as well as reducing stress for the turf manager.

Much has been said about turf being overwatered so that disease is favored, lush growth is encouraged, and roots are shortened due to wetness. Soil sensing is a way of helping to eliminate or control such problems. Soil sensing practice has been slow in being adapted. Now the time of significant use seems much closer.

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WEATHER, WATER IN AIR

W. L. Stirm, Agricultural Meteorologist, National Weather Service
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Water and sunshine are partners with sunshine and soil in the 'big four' for growth.

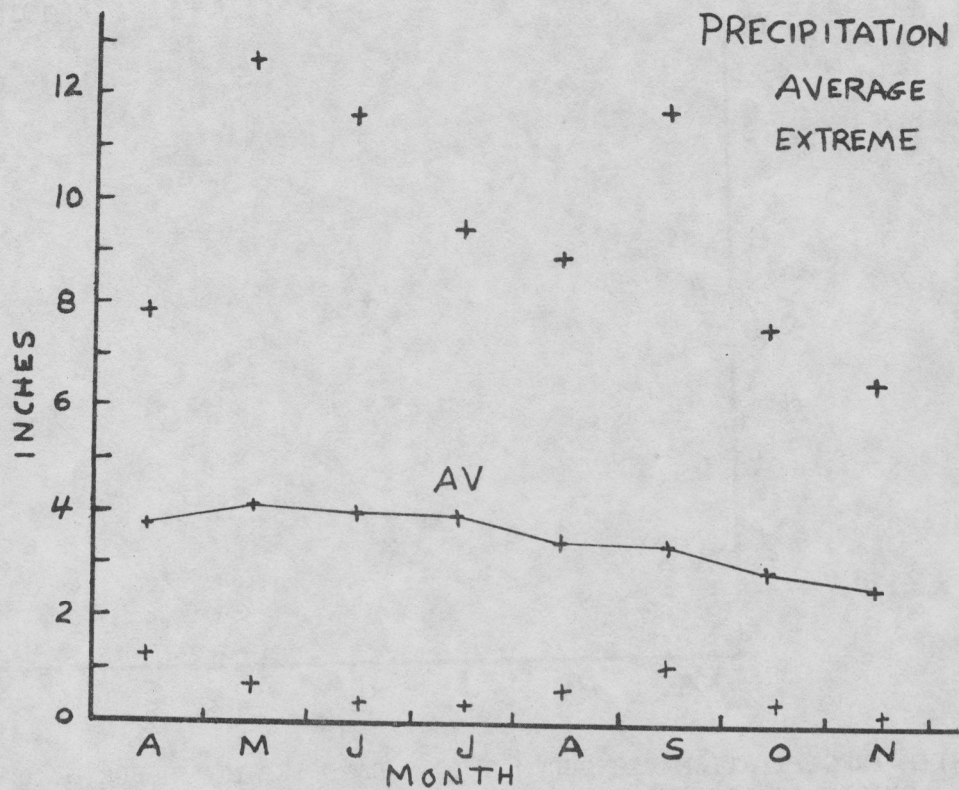
Precipitation in the Midwest ranges from under 25 inches annually in north central states to around 45 inches through the Ohio Valley states. Heaviest monthly amounts occur in May and June and least in winter months. About 60 percent of the annual rainfall occurs during the growing season on average weather years and may be as little as 40 percent on dry years. Wide variation in extremes are noted with amounts in one out of forty years occurrences varying from as little as .50 of an inch in the driest summer month to over 12 inches in the wettest month. The interval between low pressure areas producing precipitation varies from about every 2-1/2 days in April to about 4-1/2 days in late July and August.

Evaporation through the Midwest ranges from around 35 to 40 inches in the Great Lakes region to 45 to 50 inches annually in the other Midwest states. Average daily evaporation amounts vary from around 0.16 of an inch in early April to around 0.26 of an inch in July, but daily amounts can exceed 0.40 of an inch in dry, windy, hot June, July and August days. Wind is an important factor in daily evaporation rates with wind speeds of 20 mph or more increasing the amount by 0.10 inch or more. Similarly, dryness of air will also increase the amount of evaporation. For relative humidity near 100 percent, little or no evaporation occurs, and when humidity is down to 10 or 20 percent, as much as 0.35 to 0.40 of an inch evaporates. Both wind and low humidity should be considered in irrigation during daylight hours.

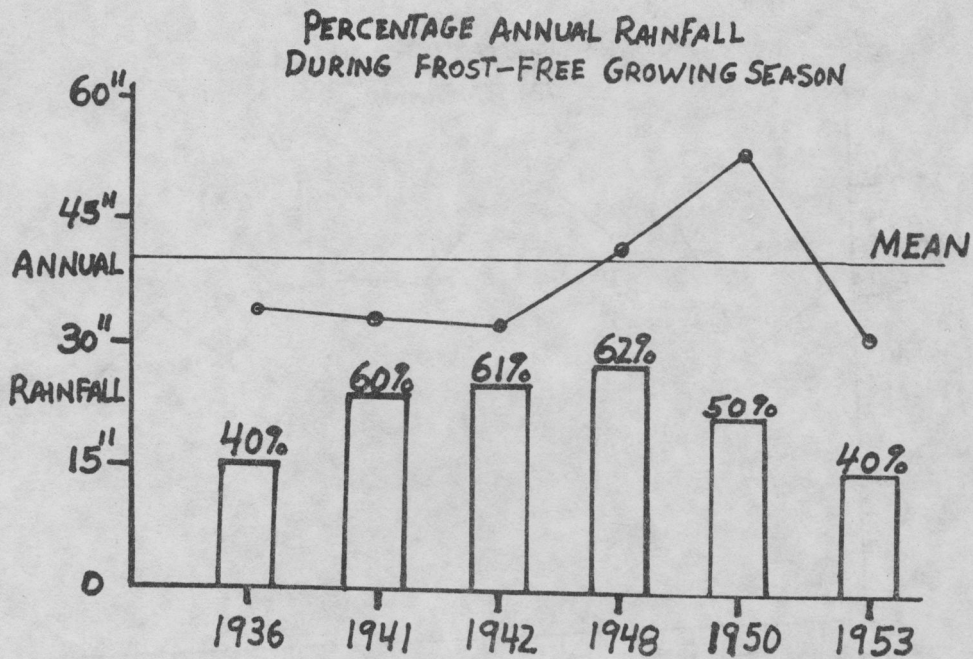
Moisture use by turf in Central Indiana generally exceeds supply with accumulate moisture deficit in the upper foot of soil of near 8 inches for the growth period. Surface temperatures of turf areas is an important factor in moisture lost by transpiration of turfgrass. Surface soil temperatures on a sunny, hot, dry July day may exceed 120° F, particularly if surface foliage has browned from dryness. Rootzone temperatures may exceed the upper growth limit (85-90° F) during such period. Cooling by misting irrigation can be very helpful.

The amount of water received from the atmosphere and the evaporative power of the atmosphere are important factors in turf management.

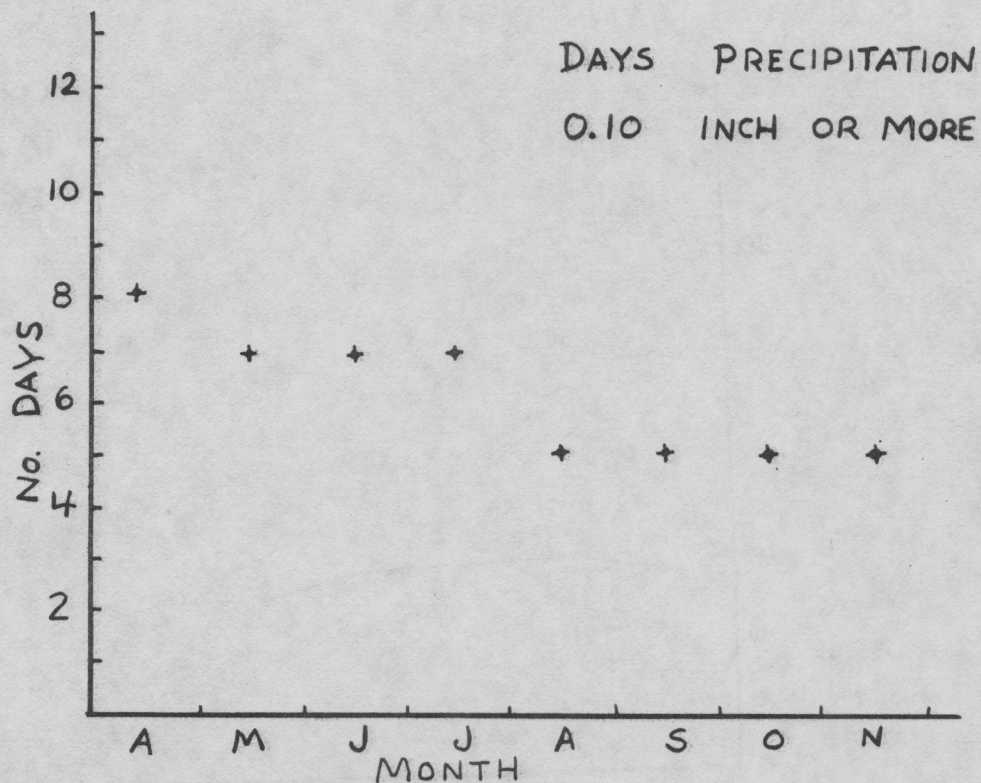
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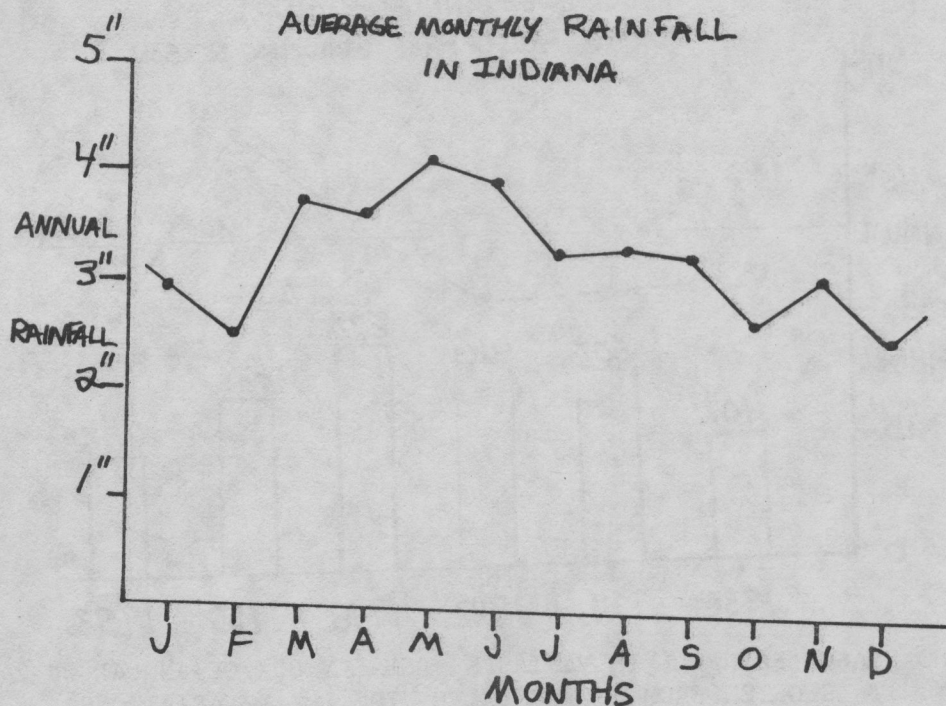
RAINFALL IS SOMETIMES EXTREME AND HAS A WIDE RANGE AT TIMES.



GROWING SEASON RAINFALL IS VARIABLE, USUALLY 60% OF ANNUAL OR 24".
IT IS OFTEN FROM SHOWERS WITH WIDE LOCAL VARIATIONS.



DAYS WITH PRECIPITATION VARY FROM 5 TO 8 DAYS PER MONTH FOR 0.10 INCH AMOUNTS OR MORE. USUALLY 10-12 DAYS PER MONTH OCCUR IF AMOUNTS .01 ARE USED.



INDIANA ANNUAL MONTHLY PRECIPITATION IN ADEQUATE 8 OUT OF 10 YEARS