TURF CONFERENCE PROCEEDINGS

sponsored by the
MIDWEST REGIONAL
TURF FOUNDATION

and

PURDUE UNIVERSITY
West Lafayette, Indiana

March 2-4, 1981

Paul Rieke

PROCEEDINGS OF THE

1981

MIDWEST REGIONAL TURF CONFERENCE

Writings of Bob Dunning are paged 22, 34 and 128. Numerous references to him and his work are included in other talks.

The 68 talks included in these Proceedings are condensations from speakers before sections of the 1981 M.R.T.F. Conference. We appreciated the willingness of the speakers to participate and prepare materials for your reading. A copy of these Proceedings has been mailed to all those attending the 1981 Conference; one person of each member organization within the Midwest Regional Turf Foundation not in attendance at the Conference; and a list of those in educational activities.

Proceedings of each annual Conference have been prepared since 1948. A limited number of 1971, 72, 73, 74, 75, 76, 77, 79, 80 Proceedings are available at $2.00 each, as well as additional copies of these Proceedings. Order from:

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

DEDICATION TO BOB AND INEZ DUNNING

In 1981 the Board of Directors of the Midwest Regional Turf Foundation wishes to recognize Bob and Inez Dunning for their outstanding contributions to the turf industry. The turf management industry has benefitted because of their dedication and their lifelong enthusiasm and support for the many state and local turf field days and conferences. The 1981 theme, "Old Ideas With New Applications", brings to mind some of the many concepts with which Bob worked to develop better turf.

Robert C. Dunning attended Kansas University and Emporia State University. From 1936-1940 hs served as Pro-Superintendent at the Country Club of McAlester,Oklahoma. He was one of the early students (1940) in L. S. Dickinson's Stockbridge School of Turf, Massachusetts University. He studied and traveled with Dr. John Monteith, of the Arlington Turf Gardens, Washington, D.C.

Inez Richards Dunning was of Cherokee Indian heritage. Her father's family was active in the early development of Oklahoma.

During World War II, agronomists with experience in turf and forages joined the battle to improve the surfaces of Air Force flying fields. The dust from new fields caused excessive engine wear and loss of flight time (up to 40 percent) because of reduced visibility.

Dr. John Monteith, former Director of U. S. Golf Association Green Section, was principal agronomist, Engineering Division, U. S. Army Air Force. An Army Air Force citation received 9 October 1945 stated: "...the design criteria and specifications for installing and maintaining turf and other vegetation to control dust and prevent soil erosion contributed to the successful conclusion of the war."

Monteith wrote Dunning on 22 October 45, "...as one of those experts you rightfully share in these commendations with me. Your long practical experience combined with almost endless energy and fine spirit of cooperation were invaluable in the efficient grass establishment program. The development of sprigging and mulching machines from your original plans and under your direction, and the new methods evolved were notable contributions."

A citation dated 18 February 1946 to Robert C. Dunning reads, "...outstanding accomplishments in the control of dust and erosion at war department installations in the Eighth Service Command and for development of a grass sprigging machine."

Dunning worked with Wallace Miller, Burt Musser, Fred Grau, Ike Rabbit, Howard Sprague, J. F. Chandler, Ed Cale, and many more in the projects which included many airfields, such as Matagorda Island Bombing and Gunnery Range, where more than 400 acres of graded, denuded, leveled areas were stabilized with grasses.

Dunning and co-workers designed and developed a sprigging machine which shredded sod and delivered sprigs into rows so that vegetative propagation could occur under limited moisture and fertility. Another machine was built which utilized rolling coulters which crimped straw and hay into the loosened soil, and thereby minimized wind and water erosion. The extensive areas involved and the adversity of the climate and growing conditions magnified the need for successful turfgrass coverings.

In 1947, The Bob Dunning Company, turf specialty, began in the basement of a home. That same year, Bob was instrumental in the establishment of the first Oklahoma turf conference, and became a stauch supporter of the Oklahoma Turfgrass Association.

Dunning participated in an early research study on soils and methods of greens construction. He gave freely of his skills, knowledge and experience to further the growth of "good" turf. He counseled many golf course superintendents, athletic field groundskeepers, and others. The enthusiasm of the Dunnings, and their devoted interest in turf took them to many turf field days and conferences across the country. (Purdue, 1952-1972).

Throughout his career Bob had one major objective - to grow better turfgrass. Soils became one of his major areas of interest. In the early 1950's Bob Dunning explained that in some years as much as one-tenth inch of dust accumulated on watered golf greens; either Texas was moving north or Kansas was going south!

Bob generously shared his ideas by publications released over a period of twenty years. Special issues of Turf Tips concerning athletic fields (1954) and Green Construction (1962) were widely distributed.

During the late 1960's the Dunning Distributorship was terminated. Bob and Inez turned their enthusiasm to designing golf courses. Alvamar Hills was one of their designs which pleased them greatly.

Inez died in September 1977, and Bob Dunning died in November 1979 at age 78.

PRESIDENT'S MESSAGE

John L. Morris, Superintendent, Highland Golf & Country Club
Indianapolis, Indiana

As President of the Midwest Regional Turf Foundation, I welcome you to your 46th Conference. Again this year interest remains high, and this is a tribute to the quality of educational material to be presented this week. The success of this association is due in large part to the services of Dr. William Daniel, Dr. Ray Freeborg, Jo Horn,and Hugh Henry.

I would like to thank the Board of Directors for their ideas and support. The future of M.R.T.F. is indeed bright.

It has been an honor and a privilege to have served as President of Midwest Regional Turf Foundation for the past year. I encourage all of you to seek new members during the coming year.

It is appropriate that we recognize Bob and Inez Dunning for their outstanding contributions to the turf industry.

In 1980 the income from 249 membership dues was $12,970.00. The following listing of memberships by states is one way to thank each and recognize their contribution to the ongoing research and educational program of the Foundation. The total cost of the 1980 turf program is less than $90,000 for all efforts, of which more than 50 percent is from non-tax sources.

1980 MIDWEST REGIONAL TURF FOUNDATION MEMBERSHIP

ILLINOIS -

Aurora Country Club
Bryn Mawr Country Club, Chicago
Carmi Country Club
Central Illinois GCSA
Champaign Co. Forest Preserve, Mahomet
Chicago Heights Country Club
City of Danville, Harrison Park G. C.
Country Club of Peoria
Crystal Lake Country Club
Danville Country Club
Edgebrook Country Club, Sandwich
Edgewood Valley Country Club, LaGrange
Exmoor Country Club, Highland Park
Flossmoor Country Club
Geneva Golf Club
Glen Oak Country Club, Glen Ellyn
Green Acres Country Club, Northbrook
Greider Sod Farm, Carlock
H & E Sod Nursery, Markham
George Haddad, Peotone
Hinsdale Golf Club, Clarendon Hills
Idlewild Country Club, Flossmoor
Illinois Lawn Equipment Co., Orland Park
Inverness Golf Club, Palatine
C. W. Jennings, Western Springs
LaGrange Country Club
Lincolnshire Country Club, Crete
Lockhaven Country Club, Alton
Macomb Country Club
Medinah Country Club
James D. Mello, Downers Grove
Midlothian Country Club
Midwest Assoc. of Golf Course Supts.
Mueller Sod Nursery, Ontarioville
Northmoor Country Club, Highland Park
North Shore Country Club, Glenview
Onwentsia Club, Lake Forest
Robert Parmley, Wheeling
Prestwick Country Club, Frankfort
Rockford Country Club
Roseman Mower Co., Glenview
Seaboard Seed Co., Bristol
Shoreacres, Lake Bluff
Silver Lake Country Club, Orland Park
Eugene Strasma, Decatur
Sunset Ridge Country Club, Northbrook
Thornton's Turf Nursery, Elgin
Timber Trails Country Club, LaGrange
Velsicol Chemical Co., Chicago
Wadsworth Co., Plainfield
Warren's Turf Nursery, Palos Park
Westmoreland Country Club, Wilmette
Woodward Governor Co., Rockford

INDIANA -

Anderson Country Club
Ball State University, Muncie
Randy A. Ballinger, Upland
Beeson Park Golf Course, Winchester
Bd. of Park Commissioners, Fort Wayne
B.P.O.E. #649, Richmond
Broadmoor Country Club, Indianapolis
Burke Mem. Golf Course, Notre Dame
Calumet Golf Club, Gary
Christmas Lake Golf Course, Santa Claus
Clearcrest Country Club, Evansville
Connersville Country Club
Country Club of Indianapolis
Country Club of Terre Haute
Crooked Stick Golf Club, Carmel
Donald A. Cross, Hobart
Culver Military Academy
Duane Dammeyer, Greenwood
Delaware Country Club, Muncie
Randy A. Denney, Warsaw
Desco Chemical Co., Nappanee
Elanco Products Co., Indianapolis
Elcona Country Club, Elkhart
Evansville Country Club
E-Z Lawn Corporation, Richmond
Donald J. Fassnacht, Lafayette
Forest Hills Country Club, Richmond
Forest Park Golf Course, Valparaiso
Dale C. Foster, Fort Wayne
Fort Wayne Country Club
Frankfort Country Club
French Lick Springs Hotel & Country Club
Friendswood Golf Course, Camby
Jon Fuller, Fort Wayne
Gary Country Club
Green Acres Sod Farm, Columbia City
Gritt-Fields, Inc., Brooklyn
Hickory Hills Golf Club, Brownstown
Highland Golf & Country Club, Indianapolis
Hillcrest Country Club, Indianapolis
Hillview Country Club, Franklin
Honeywell Public Golf Course, Wabash
Hoosier Turfgrass Association
Indiana Farm Bureau G. C., Mt. Vernon
Indiana G.C.S.A.
Indiana University Golf Course, Bloomington
Indiana Turf Equipment, Indianapolis
Jansen Landscape Co., Elkhart
Dennis M. Keefe, Muncie
Kenney Machinery Co., Indianapolis
Killbuck Rec. Association, Anderson
Knox Fertilizer & Chemical Co.
Kokomo Country Club

1980 MIDWEST REGIONAL TURF FOUNDATION MEMBERSHIP

INDIANA (continued) -

Lafayette Country Club
LaGrange Country Club
L. C. Lane, Lafayette
Lawn Life, Carmel
Maplecrest Country Club, Goshen
Martinsville Country Club
Mead Johnson Co., Evansville
Meridian Hills Country Club, Indianapolis
Meshingomesia Country Club, Marion
Mutual Security Life Ins. Co., Ft. Wayne
New Albany Country Club
Oak Knoll Golf Course, Crown Point
Old Oakland Golf Club, Indianapolis
Old Orchard Golf Club, Elkhart
Orchard Ridge Country Club, Ft. Wayne
Otter Creek Golf Club, Columbus
Lloyd A. Paul, Roanoke
Pine Woods Golf Club, Spencer
Richard K. Reising, Fort Wayne
Walter E. Reynolds, Cedar Lake
Rolling Hills Country Club, Newburgh
Seymour Elks Club
David Soderquist, Hammond
Speedway 500 Golf Club, Indianapolis
South Bend Country Club
Sullair Corporation, Michigan City
Summertree Golf Course, Crown Point
Summit Power Equip. Dist., Fort Wayne
Sycamore Springs Golf Club, Indianapolis
Tippecanoe Country Club, Monticello
Tippecanoe Lake Country Club, Leesburg
Tri-State G.C.S.A.
USS Agri-Chemicals, Jeffersonville
Valparaiso Golf Club
Washington Country Club
Allen Wehr, Jasper
Western Hills Country Club, Mt. Vernon
Woodland Country Club, Carmel
Woodmar Country Club, Hammond
Youche Country Club, Crown Point
Zollner Golf Course, Angola

KENTUCKY -

Audubon Country Club, Louisville
Big Spring Country Club, Louisville
Bunton Seed Co., Louisville
Harmony Landing Country Club, Goshen
G. W. Hill & Co., Florence
Irrigation Supply Co., Louisville
Kentuckiana G.C.S.A.
Met. Park & Rec. Board, Louisville
Owensboro Country Club
Steve Phillips, Ashland
Standard Country Club, Louisville

MICHIGAN -

Bay City Country Club
Country Club of Detroit
Detroit Country Club
Down River Lawn Service, Trenton
Eugene Johanningsmeier, So. Lyon
McKay Golf & Country Club Prop., Lansing
Maple Lane Golf Club, Sterling Heights
A. J. Miller, Inc., Royal Oak
The Moors Golf Club, Portage
Oakland Hills Country Club, Birmingham
Tuco Div., The Upjohn Co., Kalamazoo
Wilkie Turf Equipment, Pontiac

MISSOURI -

Bellerive Country Club, Creve Coeur
Bogey Hills Golf & Country Club, St. Charles
City of St. Louis Parks Division
Forest Hills Country Club, Chesterfield
Glen Echo Country Club, Normandy
Lakewood Golf Club, Fenton
Mallinckrodt Chemical Co., St. Louis
St. Ann's Golf Club
Westborough Country Club, St. Louis

OHIO -

The Andersons, Maumee
Board of Park Trustees, Springfield
B.P.O.E. Lodge #93, Hamilton
Tom Brehob, Cincinnati
Brown's Run Country Club, Middletown
Camargo Club, Cincinnati
Cemetery of Spring Grove, Cincinnati
Century Toro Distributors, Toledo
Cincinnati Country Club
City of Dayton, Division of Rec.
Columbus Country Club
Country Club, Inc., Pepper Pike
Crest Hills Country Club, Cincinnati
Dayton Power & Light
Edgecreek Golf Club, Van Wert
Edgewood Golf Club, N. Canton
Elyria Country Club
Findlay Country Club
Firestone Country Club, Akron
Terry Frey, Cincinnati
Gate of Heaven Cemetery, Cincinnati
Stephen Gipson, Chesterland
Greater Cincinnati G.C.S.A.
Highland Meadows Golf Club, Sylvania
Arthur Hills, Toledo
Inverness Club, Toledo
Kenwood Country Club, Cincinnati
Robert Kline, Tiffin

1980 MIDWEST REGIONAL TURF FOUNDATION MEMBERSHIP

OHIO (continued) -

Lakeshore Equipment, Elyria
Leisure Lawn, Dayton
Lyon's Den Golf, Canal Fulton
Maketewah Country Club, Cincinnati
Mayfield Country Club, S. Euclid
Miami Valley G.C.S.A.
Moraine Country Club, Dayton
NCR Employees Benefit Association, Dayton
Jack Nicklaus Golf Center, Mason
Northern Ohio G.C.S.A.
Oakwood Club, Cleveland Heights
Piqua Country Club
O. M. Scott & Sons, Marysville
Shawnee Country Club, Lima
Springfield Board of Park Trustees
Springfield Country Club
Tamaron Country Club, Toledo
Tri-County Turf, Maineville
Valley Turf, Valley City
Valleywood Golf Club, Swanton
Walnut Grove Country Club, Dayton
Western Hills Country Club, Cincinnati
Wildwood Golf Club, Middletown
Floyd A. Wiget, New Lebanon

WISCONSIN -

Brynewood Country Club, Milwaukee
Loft-Kellogg Seed Co., Milwaukee
Met. Sewage Comm., Milwaukee
Milwaukee Country Club
North Hills Country Club, Menomonee Falls
Ozaukee Country Club, Mequon
Racine Country Club
Somers Landscaping, Stevens Point
Stevens Point Country Club
Tuckaway Country Club, Franklin
Wisconsin G.C.S.A.

OUTSIDE MIDWEST REGION -

Aquatols Corp. of America, Delair, NJ
James Boyce, Ottawa, Ontario, Canada
Barbara Emerson, Ambler, PA
Jacklin Seed Co., Post Falls, ID
Lebanon Chemical Co., Lebanon, PA
Mock Corp. Pittsburgh, PA
The Toro Co., Minneapolis, MN

PERSONAL GLIMPSES OF BOB DUNNING

Larry Runyon, Superintendent, El Paso Country Club
El Paso, Texas

I have to go way back to tell a few stories about earlier experiences with Bob Dunning. I was a welder, and one morning about 10:00 I shut off my welder and hung up my helmet, and said, "You can take this job and shove it." When I told my wife I had quit my job she said, "What in the world are you going to do? We have about 75¢ in the bank." I told her I was going over to play Coffeeville Country Club, a new course that I had never played. So that afternoon I'm playing with three people that I have known for a few years, and they asked what I am doing for a living. I told them, "As of ten o'clock this morning I am unemployed." One of them said, "We fired our Pro here yesterday. Would you be interested in becoming our new superintendent?" My previous experience on sand greens in Sedan, Kansas, had been to maintain them by applying 25 gallons of used motor oil each spring, so I told them that and that all I'd ever done was drag sand greens. He assured me, "Don't worry; you'll have Bob Dunning to help you."

Some funny things happened. I had been at Coffeeville about three weeks when my father-in-law came to visit and to see his favorite daughter. That evening he was with me while I was removing the sprinkler from the 9th green. However, I continued to hear water running, and I discovered he was urinating on the green! About a week later Bob Dunning came by to see how the greens looked. As we traveled over the course Bob commented that the greens were looking good. I told him I wanted him to see #9 green. When he saw it he said the dead areas looked as if a skunk has been on the green. (He didn't know how close he was!) Bob said to try to give it a shot of PMAS with a little iron, and that should clear it up.

Most of Bob's work was done in Oklahoma. I have his picture taken with Jim Watson in 1952 at an Oklahoma Field Day.

An award was made to Bob: "The War Department expresses its appreciation for patriotic services in a position of trust and responsibility to Robert Dunning for outstanding accomplishments in the control of dust and erosion at War Department installations in the 8th Service Command and for development of a grass sprigging machine. General B. Patterson, Secretary of War, February 6, 1946."

When he was operating the Dunning and Jones business in Tulsa, Bob had what he called the full package deal for golf courses.

One of Bob's worst enemies was artifical turf. Bob met with a group concerned with Arrowhead Stadium in Kansas City as it was being planned. Bob included the following in his book, "I was invited to participate in an all day session trying to convince people that real grass should be used at this stadium complex. There were several outstanding men present - engineers, agronomists, construciton men from all over the United States. The soil being recommended was unstable and could be considered comparable to quick sand, a very high silt content. Discussions had been in progress weeks previous to this meeting, building engineers familiar with this soil will not erect a building without the use of pilings. You can imagine some of the concern and disgust expressed. Neither the agronomist nor the turfgrass man had presented a satisfactory solution, so the artificial turf was chosen in spite of all I could do or say. In fairness to all, I must say that the owners had previously been pretty well sold on artificial turf by the manufacturers."

It was a sad day for me when I removed all the grass from the Kansas City field. It wasn't too long after the artifical turf was in place that the problems began to crop up. I understand George Toma will tell you more about the situation. One machine, Game Saver, was designed to remove the water from the field, but it also removed the paint which was used to mark the field and which cost $5,000. Water standing on the field was one of the things Bob Dunning warned about.

Bob's interest in golf course design continued to develop. He wanted to get away from the saucer effect which predominated in the 1900's and into the 40's and 50's. He did a lot of research, and I helped some. His philosophy was to make his plans clear enough so that a builder could follow. For the elevations he would include the word "crown", low green was indicated with a "L", then as it moved to high, "H", and then on to "HH", which was a bit higher than the high.

Greens built from Bob's plans are located over Kansas. I have played on many of them. His idea was to provide surface drainage in several directions, not just off the front of the green. He wanted to build sand greens that would not need to be replaced after the first or second year. Bob had an opportunity to work with the research that Fred Grau had done on sands and apply it to Oklahoma.

One of Bob's favorite golf courses was Alvamar Hills in Lawrence, Kansas. One can see the Dunning characteristics in those greens. A recent issue of Golf Magazine lists one hundred outstanding golf courses in the United States; this issue also includes fifty outstanding public fee courses. Bob Dunning's Alvamar Hills course is listed as number 11.

WATER USE IN TIME OF CRISIS: GET READY NOW!

Joseph P. Rossillon, Executive Director
Freswater Biological Research Foundation, Navarre, Minnesota

In his book The Poverty of Power, Dr. Barry Commoner describes and discusses the laws of thermodynamics as they relate to energy. The First Law of Thermodynamics can be stated as follows: "Energy can be neither created nor destroyed, only the form can be changed."

The second law of Thermodynamics states: "The Universe is constantly, irreversibly becoming less ordered than it was." As energy is used, changes occur and the changes lead to a less ordered system.

What these two "Laws" suggest to me is: the "quantity" of energy never changes; the "quality" is what suffers. These principles so directly apply to water that with only the changing of a couple words we could have the "Laws of Aquadynamics".

Some of the lessons we learned from dealing with the energy shortage in the last seven or eight years could be of great benefit in planning for water resources in the years to come. If we, as individuals, had better understood our energy resources and energy priorities 18 years ago, the energy use adjustments that have been necessary might have been easier on all of us. The same is true with water. So what are some of the things that we know about water?

Law #1 - "Water can neither be created nor destroyed"

We know that there is only so much water. It is recycled through the hydrologic cycle and we already have all that we're ever going to have on this planet. That amount totals only about 2,000 gallons per day of usable fresh water for every man, woman and child in the world. It is estimated that by 1985, we will be using 2,500 gallons per day, 500 gallons more than our "fair share".

Of the total amount, 50 percent is used by industry, 40 percent by agriculture, and 10 percent by individuals. All of it is used to support our basic way of life.

As our water use demands increase, pressures will mount on rights of ownership, priorities and the need to recycle. Our attitudes and technology should begin to reflect that now.

Law #2 - "Our water is constantly irreversibly becoming less ordered than it was"

We know that water is Mother Nature's sewer system. Everything in nature ends up in water - including us. Like your backyard septic tank, this system works only if kept in balance. And like your septic system, the three ways that get it out of balance are (a) over-load, (b) killing the bacteria, and (c) introducing materials that are "foreign" and aren't degraded by the bacteria. All three of these processes are constantly occurring today in our national freshwater system.

We also know that the pressures placed upon our waters today, as a result of population "pockets" and their water use, exceed the ability of nature to maintain a balance. Most of these imbalances we see and view as "pollution". In nature, all life is part of a process we call the food chain. It is a natural cleansing process. We must become more sensitive to the role that the food chain plays and help it maintain a working balance.

What did we learn from dealing with energy shortages for a decade that could apply to dealing with water in the decade to come? First, we learned that rules for "times of plenty" are different than the rules for "times of shortage". Second, we learned that attitudes of people adjust to those "rules" and to the changes faster than industry is able to adjust. This is one of the explanations why the automobile industry was thrown for such a loss and why Chrysler may never be able to recover. We've always said "if people want it bad enough they'll pay". The third thing we learned was that people will pay, but on their terms not ours. And I think the fourth thing we learned was that the use of "fine tuning" is often better than "brute force" in attempting modification.

Water is going to be the "energy" of the 80's. The energy industry wasn't ready in spite of continued warning. Water-related industries must be. The time to start modifying and preparing for a crisis is before the fact - now. We can't afford to wait until the shortages occur to act because with water we don't have a "Saudi Arabia" to bail us out. It is important for the various industries that rely upon water use for their talents to either begin product modification or behavioral use modification now. A smart coach adjusts his game plan to his talent before the season. Losing coaches adjust their talent to their game plan after the season is underway.

It is important for all of us to realize and remember that potable water, safe drinking water, must always come first. Water needed for other uses, like landscaping, could be used water. Don't "mine" drinking water for non-drinking uses.

If the water use does not require "potable" water, it makes more sense to use dirty water and "help make it clean", than to use clean water and "make it dirty". In a recent case, a Minnesota State Supreme Court ruling established as priorities for water use (1) people, (2) livestock, (3) irrigation. (I don't think "golf" was even included in the list.)

As the pressure for water use increases, the necessity to change our techniques of handling water will also increase. We learned with automobiles that bigger is not necessarily better.

With lawns, "plusher" may not necessarily be better. In relationship to golf courses, we may even have to consider "poorer quality greens and better quality putters".

It must be remembered that water is Mother Natures' septic tank and that a bio/-nutrient balance is always necessary. The maintenance of that balance will require a soft touch. It is too sensitive to be managed with brute force. The over manipulation of that balance will leave water unuseable - a condition categorically as bad as "mining" water.

We, at the Freshwater Foundation and the Gray Freshwater Biological Institute, are initiating a multi-million dollar program to attempt to better understand the relationship of bacteria, principally anarobic, to the aquatic food chain. It is our hope eventually, to develop a stable of bacteria that can be used to degrade some of the toxics and other synthetic bioaccumulants currently building up in the environment that have been developed by man and contribute to the current imbalance in our natural septic system. These toxics, like PCB's are too dangerous to ignore; they make water supplies unuseable; yet, they are in too small a quantity to "harvest" by any current mechanical means. Finding solutions to those types of problems is part of our job.

As part of your job, I suggest you first remember the septic tank rule. The three things that will create imbalance in our water system are (1) overload, (2) killing the bacteria, (3) introducing materials that are foreign or antagonistic to the natural system.

Second, I suggest you use water as a benchmark. In everything we do today, nearly every decision is based, at least in part, upon the energy implications. In the next ten years, decisions will be based upon the water implications. Within the next ten years everyone else will be looking toward better utilization of water - you should begin today.

Third, I suggest to you that if you are involved with water use, that you accept responsibility not only for the quantity but especially the quality of that water that you have used. One thing is certain, you will be held accountable for that water quality - you are the one who will want to use it again.

When the energy crunch arrived, the automobile industry discovered that big cars were "expendable", and industry had then to go to the Federal Government to be "bailed out". When the water crunch comes, green grass will be expendable. Will you be ready? Or will you have to run to the Federal Government, too?

UNITED STATES ENERGY PICTURE - 1980 TO 2000

Wallace E. Tyner, Associate Professor of Agricultural Economics
Purdue University, West Lafayette, Indiana

For the last 100 years cheap energy has been an important fuel of economic development in the United States. It was about 100 years ago that coal replaced wood as the dominant energy source. Coal offered new potential not only as a source of heat but also as a source of coke, tars, fuel gas, and other uses. The increase in use of coal followed a burst of inventions about 1850. Coal was used to make synthetic dyes, steel, glass, and other products. Coal remained the dominant energy source until the early 1940's when oil and natural gas achieved dominance. Although first wood and then coal declined significantly as a precentage of total consumption, they did not decline significantly in the absolute amounts used. Coal in first transitition and oil in the second becamse not only a new source of heat but also an integral ingredient in industrial development. Consumption of new energy source grew very rapidly as it becamse an important fuel for economic growth.

Today, oil and natural gas constitute three-fourths of U. S. energy consumption, but it is pretty clear that oil production in the United States has peaked and is on the decline. The sources of our oil imports have banded together to sharply increase oil prices and control oil supplies. Today the U. S. is importing about one-half of its oil needs,and imports amount to about 2.7 billion barrels per year or $100 billion per year at $37 per barrel. This outflow of dollars puts a strain on our balance of payments. In addition, our national security is dependent on availability of liquid fuels. Because of the balance of payments burden and the perceived threat to national security posed by the high level of imports, the U. S. is seeking means of reducing total oil imports. In our current situation, we face the problem of displacing oil and reducing the rate of growth in total energy consumption.

Options to accomplish these goals include:

- energy conservation
- increasing the domestic oil supply
- converting solid fuels such as coal and oil shale to liquid fuels
- changing energy consumption from liquid to solid fuels such as coal and nuclear
- increasing use of renewable energy sources such as the sun and growing plants

All of these options are aimed at reducing U. S. dependence on foreign sources.

Conservation and Energy Consumption

Forecasting demand for anything twenty years into the future is always difficult, but forecasting energy demand twenty years hence borders on soothsaying. From the 1920's through the 1960's the real price of energy in the U. S. declined, yet the energy/GNP ratio also declined during that period. That is, even with declining energy prices, the use of energy per unit of GNP fell, with GNP growing at 3.1 percent and energy consumption growing at 2.5 percent, or 80 percent as fast. In the 1970's energy prices began rising in real terms, so we would expect the energy/GNP ratio to decline reflecting the higher energy prices.

One major problem in obtaining good long-run projections of energy use is that turn-over of the automobile fleet takes about eight years and housing is replaced in approximate fifty year cycles.

In 1980 we consumed about 80 quads of energy. My own belief is that energy demand in the U. S. will increase 1.0 percent per year. This implies by year 2000 energy consumption of a range of 95-105 quads. This assumes: (1) price induced conservation will occur at increasing rates in the future, (2) auto fuel economy will increase even faster than government standards, and (3) retrofitting to increase conservation.

U. S. Energy Supplies and Consuption

The U. S. has huge amounts of energy reserves and resources relative to current consumption (Table 1). The term resource refers to the amount of the substance expected to be in place regardless of whether or not it has been discovered or recovery would be economic. Reserve is that portion of the identified resource which can be extracted economically. U. S. energy reserves could last from 70 to 170 years, and estimated resources could last from 250 to 300 years assuming energy demand increase at one percent per year, and that the current level of import dependence is maintained.

The extent of energy reserves and resources depends critically upon whether or not the fast breeder nuclear reactor is developed. Uranium reserves and resources are multipled by 60 to 100 times with the breeder reactor. In addition, the U. S. has vast reserves of thorium which can be used in a breeder cycle.

The U. S. energy problem is fundamentally one of a shortage of oil relative to our oil consumption. Half of the U. S. consumption of energy is oil, but oil resources are only about one percent of total resources. The U. S. energy problem is really the national security problem of being dependent on the rest of the world for half its oil needs. The challenge is to find ways to better match our energy use with domestic sources.

TABLE 1 - U. S. ENERGY RESERVES AND RESOURCES

Resource Type	Reserves (quads)	Resources (quads)	1979 Consumption (Percent)
Coal	5747	58614	19
Oil and NGL[a]	212	694	47
Gas	224	706	26
Shale oil	0	6084	0
Unconventional gas	0	336	
Uranium-LWR[b]	257	910	
Uranium-FBR[c]	20510	76200	
Nuclear			4
Other			4
Total-LWR	6440	67344	
Total-FBR	26693	142634	

[a]The oil and NGL resource numbers include enhanced oil recovery

[b]LWR = Light water reactor

[c]FBR = Fast breeder reactor

Note: Current U.S. energy consumption is about 78 quads per year plus 2 quads of wood. A quad is one quadrillion BTUs, 1.055 million terajoules, or approximately one-half million barrels per day of oil.

Potential Energy Sources

Price deregulation is a major stimulus to increasing U. S. reserves of oil and natural gas. However, higher prices alone will not solve the U. S. liquid fuel problem. U. S. oil and gas production in 2000 will very likely be lower than it was in 1979 - even with higher prices.

Domestic gas production in 1979 was about 19 quads. There probably is greater potential for increasing natural gas reserves than oil, because natural gas has been under price regulation since 1954, and little incentive has existed for increased exploration. With higher prices, much more exploration will occur.

Converting Solid Fuels to Liquids - Liquid fuels can be made from coal, oil shale, tar sands, or biomass resources. The U. S. has large resources of both coal and oil shale.

Coal: Synthetic liquid or gas fuels can be produced from coal. Liquid fuels include a crude oil-like product which can be further refined to get petroleum products, gasoline, and methanol. Coal liquids are likely to cost from $40 to $65 per barrel ($1980), and coal synthesis gas will cost between $4 and $6 per million BTU's (1000 cubic feet). Coal liquids plants will require a capital investment of about $2 billion. No coal liquid or gaseous fuels are being produced commercially in the U. S today, but production in 2000 could range between 2 and 5 quads per year.

Oil Shale: The U. S. has vast resources of oil shale, but only a small fraction of the resource in place is likely to be produced because of environmental and social constraints. A 400,000 barrel per day (eight plants) industry could be developed by 1990 without serious difficulties. A one million barrel per day industry, however, would unavoidably violate current environmental air quality standards and cause serious economic and social disruption to the producing areas. Apparently, the environmental, economic, and social systems can accommodate only a certain level of development.

Changing from Liquid to Solid Fuels - Half the oil in the U. S. is used for transportation, and the other half for industrial and home uses. To the extent that solid fuels can substitute for this oil, substantial oil import reductions can be achieved. Fuel oil is used in industrial processes and space heating. It is also used to generate electricity. Coal could be used in idustry and perhaps residential sectors for heat, and coal or nuclear power could be used to displace fuel oil in generating electricity.

Nuclear Power: Nuclear energy is a large question mark for the U. S. The energy potential from nuclear sources is very high, yet so are the perceived social and environmental risks. The estimates for nuclear energy for 2000 are ranged between 12 and 28 quads. Current nuclear power generation is about 3 quads. Even the lowest estimate entails a quadrupling of nuclear power by 2000.

Coal: Interest in the future potential of coal is quite high. One study estimated that coal could provide one-half of the increase in world energy consumption over the next twenty years. U. S. coal production could grow at an average rate of 5 percent per year between now and 2000, which means that 2000 coal production would be 2.5 times the current level. Coal could increase from 19 to as much as 35 percent of total energy consumption by 2000. Coal exports may increase also.

However, the increased use of coal, whether it is burned directly or converted to liquid or gaseous fuels, generates several problems. High levels of coal use may strain capital or equipment markets, cause transportation bottlenecks, and cause social disruptions like the boom town growth in the Western U. S. Environmental problems include land reclamation, the CO_2 (greenhouse) effect, acid rain, air pollution, water pollution, and destruction of scenic beauty. Economically, coal generated electricity compares favorably with oil generated power even when all environmental control costs are included. For example, in Japan where environmental control laws are very strict, imported coal costs about $45/ton and environmental costs add $35/ton for a total of about $80/ton - compared to a cost of about $165/ton for fuel oil power generation. Comparison of coal to nuclear power depends very much on the assumptions. However, coal generated power is as cheap as nuclear power.

Another means of using coal to substitute for liquid fuels is by converting to electric vehicles and trains for motive power. Use of electric vehicles would also bring about substitution of coal or nuclear power for imported oil. Electricity generated from these sources would charge vehicle batteries, thereby displacing gasoline. Electric vehicles are projected to be competitive at gasoline costs of about $2.00 per gallon ($1980).

Renewable Energy Sources

Renewable energy sources include a wide range of sources such as solar, biomass, wind, ocean thermal, and others. Direct solar and biomass are the two most important categories for the near term in the U. S.

Solar - The Harvard study projects solar energy to provide four quads by 1990. Solar energy utilization by 2000 in the CONAES study ranges from 0 to 7.7 quads depending on the assumptions used. Direct use of solar is often more expensive than conventional sources. Without substantial economic incentives, solar energy in the U. S. will remain small over the next twenty years.

Biomass - The biomass energy category includes a wide variety of sources such as wood, forage crops, crop residues, grains, and municipal solid wastes. Wood currently supplies about two quads of energy, primarily in the forest products industry. The OTA biomass report attributes the highest potential within the biomass category to wood followed by forage crops. The most immediate biomass potential is for ethanol for gasohol from grains. By 1990, ethanol capacity is likely to be 2 billion gallons per year of 145,000 barrels per day oil equivalent (about three syn-fuels plants or .3 quads) or higher. Current research results indicate that alcohol production significantly higher than 2-3 billion gallons could cause corn prices to increase substantially.

By the mid-1980's most authorities believe that cellulose conversion technologies will be commercially available to produce ethanol and methanol from crop residues, forage crops, wood, or municipal solid waste. It is too early to tell whether cellulosic biomass will be gassified, directly combusted, or converted to methanol or ethanol. Biomass enery use in 2000 is likely to range between 2 and 6 quads. After an initial surge in alcohol production in the early 1980's, there probably will be greater use of wood, municipal solid waste, and other cellulosic sources in the later 1980's.

How Will the Future Develop?

Over the next five years, the most important changes will be increased conservation and increased ethanol production from grain. A grain alcohol plant can be completed in two years.

From 1990 to 2000, syn-fuels from coal will grow fairly rapidly along with solar, biomass, electric vehicles, and nuclear power. During the next two decades the absolute level of U. S. dependence on foreign oil will decline very little, but the percentage dependence could decline from about 21 percent of total energy today to 14 percent in 2000. Oil and natural gas both decline relatively, and coal and nuclear power both increase. Coal will grow faster than most experts have forecasted and nuclear power will grow slower. Biomass and solar both grow rapidly in percentage terms but still constitute less than 7 percent of total energy consumption in 2000, about the same as nuclear energy.

Another major choice the U. S. must make over the next decade is between the economic potential, environmental disruption, and societal risks associated with coal power and nuclear power. The U. S. will spend the next 5-10 years developing both coal and nuclear power, but during that time she will have to decide how best to handle the uncertainties, risks, and by-products associated with each of these major power sources.

In the energy business, it is true that doomsday prophesies have been with us for hundreds of years. Has the time come for us to believe the prophets of doom, or can we see hope for improvement in the future? In forecasting our nation's energy future there is ample cause for both despair and hope.

ONE YEAR'S EXPERIENCE

Steve Biggers, Assistant Superintendent
Prestwick Country Club, Frankfort, Illinois

My past year at Prestwick Country Club has taught and shown me many different aspects of the working professional. To become a professional a person must refine and sharpen up all the rough edges and become exceptionally skilled in his work. With this goal in mind, three categories of communication, self-position, and management became my main targets.

With these things in mind, I went to Prestwick to begin to grow into the turf industry. I feel lucky to be at Prestwick where Dick Trevarthan, the Superintendent, shows interest in the assistant's program and acknowledges the importance in education of all aspects of management. At the same time he accepts new ideas and methods whether they work or not, enabling me to make decisions on issues of importance. Dick helps keep an optimistic outlook on my future.

This past year perhaps the biggest changes have been through my personal development and communications. Due to such factors as learning responsibility and the psychology involved in worker inter-personal relationships I have maintained the theory of self-assertion and worker equality. Learning to be open and flexible and valuing myself equal to the other workers helps me to develop an adequate repertoire of assertive behavior. This enables me to choose an appropriate response

through self expression and to do things on self initiative, therefore reducing an otherwise tense situation. The whole idea of self-expression without stepping on others and without hurting either yourself or others seems to work rather well.

My experiences as far as communications went this past year have taken me to a different aspect of the business. During the main growing season at Prestwick we take on up to 12 or 13 workers of Hispanic origin. Of these, only three year-round employees can speak English fluently. The rest know a few English words but are essentially 100% Spanish speaking. Not knowing any Spanish posed problems for me. After a period of time learning words and phrases and using interpretations I became adjusted. Through this situation I learned how to teach and educate workers as to their different types of work. My past experiences have shown the importance of educating a person for his or her job. This increases the workers' self-value and decreases tense situations. As long as a worker knows what he is doing and feels its importance, his level of proficiency is increased. If this can be achieved with the total work force, then time, money, and management can be used to their greatest potential.

Since communication with workers is at least 90% of the job I realize that there is also an inner communication to be managed within myself. This is what I call self-position. Knowing who you are and where you stand at all times is very important and is a large factor in being a professional.

My biggest problem when first starting to work at Prestwick was to try to gain the respect of the people with whom I would be working. Being younger, a stranger, and unable to speak the language made it hard. Jimmy Evans, my predecessor,was well like and admired and was missed a great deal. To take his place successfully would take time. To begin with, I tried to put myself on the same level and do the same types of work as the others. Other practices such as alternating work schedules, not taking sides, and some give and take helped immensely. I remembered that a friend had told me a year ago to understand that I was not just a worker anymore but was taking on a position of management and professionalism. Realizing this without losing the working spirit is a good combination.

The total of my work experience boils down to my management capabilities. This year has educated me with the sense of knowing how to maintain an efficient level of management. Knowing and setting up spray and fertilizer programs, work schedules, buying and budgeting, have increased my confidence at work.

I also found that psychological factors play a big role in management. Every golf course has its own different level of management according to status and in each situation there must be pride, patience, optimism, and the ability to take and give constructive criticism. A problem arose with me when I began work at Prestwick which Dick noticed. His constructive criticism enabled me to better my own well being.

This should work both ways. The assistant should be able to give and take from his workers as well as from the superintendent. Being educational in purpose all should benefit. Some workers may take it as hard line criticism and may cause an uneasy situation for everyone, but through assertive actions, if given right to begin with, few problems should arise.

The educational process is continuous. It has a beginning but no ending. In the turf industry this is especially true for we are always looking for more efficient means with which to manage. I have learned and will continue to learn more toward becoming a golf course superintendent.

PIONEERING IN IDEAS CONCERNING TURF

Fred V. Grau
College Park, Maryland

This turns out to be one of the toughest assignments I've had in a long time. The isolated instances I shall relate are not connected nor are they in chronological order. Bill Daniel should have been a major league relief pitcher the way he throws curves.

A pioneering idea that comes readily to mind refers to the sterilization of top-dressing. Marshall Farnham, Philadelphia Country Club, conceived the idea of mixing his screened sandy top-dressing (full of weed seeds) with complete fertilizer and sewage sludge, moistening the material as it was put in a pile. Within a day or two sufficient heat was generated in the pile that all seeds, insects, and disease organisms were killed. Temperatures reached 170° F, well above pasteurization. Oven baking would do the same thing but at greater cost. This process is used today to sterilize products such as Compost Plus, a composted product derived from tree bark and solid wastes from the manufacture of paper. This is working with Nature.

In 1935 I visited a 9-hole golf course near Ridgeway, PA. The greens were badly matted and grainy. The Verticut wouldn't be invented for 11 or 12 years. There was no equipment available to relieve the condition. I asked the greenkeeper to get two heavy, stiff stable brooms. We fastened them together securely and arranged the handles so that a man could pull the dual brooms across the green. The stiff bristles raised the grain so that the greens mowers removed a large part of the matted grass. It was crude, but it worked.

Joe Valentine fitted spring-loaded steel teeth to a frame that was bolted on the fairway mower units. The teeth (adjustable) gently lifted runners of crabgrass, stems of goosegrass and fluffy bent so the mowers cut them off. It was a pioneering idea that was excellent but never made it to the manufacturing stage.

At Hershey Country Club, the superintendent, Jim Morrison, did something about the crabgrass in his fairways. Coulters were put in place of teeth in a rotary hoe with the back row out of register with the front row. The sharp coulters cut the prostrate stems of all plants. A large chain link fence drag pulled over the turf loosened the cut stems which then were chopped to bits with the mowers.

Jim had another pioneering idea. A piece of carpet was attached to the following edge of the foot scraper, a steel doormat used to work in top-dressing. Small stones, gravel and other debris bounced up and was caught on the carpet. On the collar the mat was overturned and the debris was left on the fringe which made mowing the green a lot easier.

Jim Hamner at Memphis Country Club altered a cultipacker by replacing the packers with sharpened steel gin saw blades. These successfully cut the stems of Dallisgrass which reel mowers would not cut. It was a great idea, and it worked.

Sitting on my lawn in College Park one hot July day, I had my sharp knife in hand and idly I drew the knife blade across the flat stems of goosegrass, of which I had lots. By drawing the sharp knife across in two directions, then rubbing with my hand, the goosegrass plant virtually disappeared, leaving only a stub and a small crown. This discovery was related to the Mascaro brothers with whom I was working at the time. Shortly thereafter the Verticut was born, utilizing the sharp-knife principle applied through spinning knife blades. This pioneering idea has revolutionized turfgrass maintenance.

Another great idea was that of cultivating the soil under the turf with minimum disturbance to the use of the turf. This pioneering concept long had been in the making. It blossomed on my desk at Beltsville when Charles Hallowell and the Mascaros drove down from Philadelphia to see me and to talk turf. From a very humble beginning with a band saw driven from the rear wheel of a Model T Ford, the brothers fashioned the spoons which changed and made turfgrass history. Other manufacturers have modified the spoon and utilized coring tubes, but the basic principle operates by letting air, water and nutrients into the soil beneath the wearing surface, thus encouraging deeper, healthier root systems.

The Del Monte rake was a great pioneering idea, developed in California. It served its purpose admirably and was relegated to the scrap heap when the verticut came into general use.

Another idea developed through close observation and a suggestion. Centipede grass always had been planted vegetatively. No one ever had produced seed, yet we knew that it could produce seed. If zoysia could made seed, why not Centipede? We talked it over with Dr. Glenn Burton, who went to work and discovered ways to encourage this excellent lawngrass to produce seed in quantity. Today seed is used to establish lawns of Centipedegrass.

It was a great idea when Dr. Glenn Burton started isolating the finer-leafed selections of bermudagrass when he planted seeds produced from crosses in his search for better forage plants. With encouragement from Dr. Aamodt and me these finer-stemmed types eventually became the Tift series of improved bermudagrasses which revolutionized warm-season turf internationally.

Pioneering has not gone out of style. Witness the advent of electrostatic spray systems on weed and crop plants, now being adapted to turfgrass spraying.

The idea of spraying a mixture of spray lime and powdered ureaform was pioneering in its truest sense. It was a shot in the dark that worked, but it hadn't been tested before.

Sand was scarce and expensive in Western Pennsylvania. The greenkeepers saw huge mountains of grey slag - waste from the steel mills. Grinding and screening developed a gritty product that looked and acted like sand. Many putting greens were built with this type of "sand". Years later soil tests showed a pH value of 7.5-8.0. The slag had, in effect, hardened into a concrete-like mass that needed aerification. Slag is not popular today.

Pioneering in ideas for turfgrass improvement still is in style. Those who practice close observation will continue to create innovations. The industry needs these fresh ideas, especially in view of the restrictions and privations that lie ahead.

OLD AND NEW GRASSES

Wayne W. Huffine, Professor of Agronomy
Oklahoma State University, Stillwater, Oklahoma

When we think of something being "old", we immediately think of something or someone far advanced in years or life. Yet, with our turfgrasses, most of the varieties in use today are less than 25 years old, some are less than five.

Of the old Kentucky bluegrass varieties, we would list Merion (released in 1947) as the one that provided the impetus for the development of other superior strains and varieties for close cut turf purposes. Among the newer varieties of Kentucky bluegrass that possess the characteristics which make them more suitable for close cut fairways than common Kentucky bluegrass, we would find Adelphi, Baron, Birka, Bonnieblue, Brunswick, Cheri, Fylking, Galaxy, Glade, Majestic, Nugget, Pennstar, RAM I, Sydsport, Touchdown, Victa, and Warren's A-20.

In the southern warm-humid region and over much of the transition zone, bermudagrass reigns supreme. The elder of the turf-type bermudagrasses is the variety U-3. It was selected in the early 1930's, and distributed by the USGA Green Section in 1946-47. This variety of bermudagrass was the forerunner of other turf-type bermudas that have been developed. The variety U-3 bermuda did for the warm-season grasses about the same thing Merion bluegrass did for the cool-season group. Newer varieties of bermudagrass include among others Everglades, Ormond, Royal Cape, Sunturf, Texturf 1F, Texturf 10, Tifdwarf, Tiffine, Tifgreen, Tiflawn, Tifway, and Tufcote. The newest release (1980) is Vamont, from Virginia.

Old varieties of creeping bentgrass would include among others Arlington, Cohansey, Collins, Congressional, Metropolitan, Seaside, Toronto, and Washington. Of the newer varieties Emerald, Evansville, Penncross, and Penneagle would be included.

Meyer, Emerald, and Zoysia matrella were released in the early 1950's, whereas Midwest was released in 1963. The loss of bermudagrass in the winter of 1978-79 in the transition zone particularly has stimulated additional interest in the more cold-hardy zoysiagrasses.

The older perennial ryegrass varieties which were popular during the 1960's, namely NK-100, Linn and Palo, have been largely replaced by the newer turf-type, fine-leaved ryegrass varieties Manhattan and Pennfine. Newer varieties are now available in the group Yorktown, Yorktown II, Diplomat, Derby, Omega, and Citation.

THE TURF CARE INDUSTRY AS I SEE IT

Gene Johanningsmeier
Turfgrass, Inc., South Lyon, Michigan

Old Ideas with New Applications, the theme of this year's conference, is really dealing with changes we make to adjust and to adapt to the present and the future. Change is the universal law of nature. The poet Freeman said:

"I resisted change with all my will,
Cried out to life, 'Pass by and leave me still.'
But I have found as I trudged time's track
That all my wishing will not hold life back.
All finite things must go their finite way;
I cannot bid the merest moment, 'Stay.'
So finding that I have no power to change
Change, I have changed myself. And this is strange
I have found out when I let change come,
The very change that I was fleeing from
Has often held the good I had prayed for,
And I was not the less for change, but more,
Once I accepted life and was not loath
To change, I found change was the seed of growth."

I would like to summarize Dr. Roger Blackwell's keynote address at the Ohio Turf Conference, entitled "Changing Life Styles". As a background to why we change, Dr. Blackwell and his colleagues are engaged in the finite art of lifestyle forecasting. Life styles are changing because the technology and value components of our culture are changing. Values and lifestyles are learned,styled and individualized from individual interactions with value transmitting institutions such as the family, the church, the school. They are also influenced by key experiences of the individual during his or her lifetime. No one can deny changes we have seen from family influence. There has been a growth of pre-schools, rising divorce rates, working wives and weekend fathers, so that collectively, these changes have resulted in less parent-child interaction, and the family has become a less important transmitter of values. We have also seen a declining influence of the institutional church, because the trends in membership and attendance have been downward. The ability of the church to instill conventional or past vales has declined, particularly among the younger people.

Next let us look at schools. The education children receive today has changed measurably as a result of the socio-economic profile of the teachers and the new teaching techniques that they use. Schools have become more important transmitters of values, but the values they teach differ from those of the past.

Young people finishing school today are no longer willing to lead unexamined lives. All aspects of any given operation will be questioned and challenged by these people as they become employees or golfers. Much has been said about the environmental forces and experiences that people in the generation of our parents experienced, such as the Great Depression, and World War II, and has been constantly changing with each generation. We have experienced the Nuclear Age, the civil rights movement, poverty amidst abundance, space exploration, the communications revolution, Kent State, Watergate, and Bloody Wednesday. The next generation has been referred to as the "Me" generation. They have grown up with affluence and personal peace. They have a desire for self-fulfillment and security. As we look back from one generation to another, we can see that changes in lifestyle are logical consequences of the changing environment. We have a continuing change from the Puritan work ethic to the new work ethic; a living to work versus working to live. Along with this change we have the following changes from postponed gratification toward instant gratification, from reluctance to use credit to credit as an accepted way of life. The new theology of pleasure, making things fun, relieving

boredom, a growing interest in life simplification via more time in labor-saving products and services, changing sexual attitudes and behavior, changing sex roles, the feminist movement and the emerging men's and children's liberation movements. Changing attitudes toward the role and importance of children and senior citizens, from elder/maturity/seniority toward younger appearance, state of mind, creativity and adaptability orientation with increasing concern about physical appearance, health and longevity. The trend is away from passive acceptance of traditional ideas toward introsepction and self examination, in search for a new set of values. We see an increasing desire for novelty, change, and escape to deal with the perceived boredom and frustrations of life. We see a growing rejection of artificial forms of behavior, dress, product ingredient, etc., toward naturalism, thinking, acting, dressing in comfortable casual ways, interest in natural ingredients, etc. We see a growing interest in selected forms of creativity that permit self expression, enhance identity, and dignity and/or save money. We see the emergence of fear and intensified interest in personal safety and well being as a dominant concern. We see a change from domestic orientation to selective national orientation, from behavior homogenity to eclecticism. We have the emerging conservation ethic, from gasoline to energy to waste awareness; from self reliance toward institutional reliance. There has been an erosion of public confidence in institutions, both government and business. Consumers and the consumerism movement have been growing in importance causing an emergence of a new balance of power. There has been an acceleration and proliferation of price value consciousness as a consequence of inflation. These are changes in our society that affect turfgrass management and the game of golf.

There is only one small society within our country that probably is not affected by all these changes, that being the Amish community. The changes in the role of the family, the role of the church, and the role of the school has not really changed in their society for the past several decades.

One of the sessions at the recent GCSAA meetings in Anaheim was conducted by the U. S. Golf Association Green Section. The theme for that session was, Meeting Our Challenges for the 80's. Since the Green Section is a leader in the golf industry, I would think that many of the topics discussed will become accepted practices in the future. Many resort facilities demonstrate a trend today toward multiple courses, particularly in the Sun Belt, because the customer is a guest for three or four days. That is the only time the conditions of the golf course matter to him. Robert Mitchell has attended many Midwest Turf Conferences in the past, and is Superintendent at The Greenbriar, White Sulfur Springs, Virginia. In his presentation entitled, "Quality Playing Conditions Every Day", he suggested that greens putting speed should be between 8 and 8½ feet, using the stempmeter. The only way it is possible for resort areas to provide top quality playing conditions every day is by having multiple courses so one course can be closed one day each week for major maintenance. There are some economies possible where multiple courses are maintained by having crew members who are highly proficient in one area or another, such as drainage, irrigation, mechanics, or spraymen, because they can do their special thing on all courses. Bob has a crew of 29, plus one foreman for each of the four golf courses. He has a union; therefore the workers must be classified as to whether they are tractor drivers, greensmen, workers of the general crew, or special crew.

It seems to me the move to unionize golf course workers is at a standstill, probably due to high unemployment with an abundance of people who would be happy to have a job without paying union dues for the privilege of working.

The president of the American Society of Golf Course Architects, Mr. Richard D. Phelps, from Evergreen, Colorado, talked about designing golf challenges for economy and maintenance. He said because of costs, he sees a trend back to the old style construction, using natural terrain and reducing mowing areas. He suggested that mowing could be reduced 35 percent just by not mowing tees, greens and fairway bunkers into the fairway, but rather mowing them out of the fairway. He said it doesn't all have to be green.

The new Industrial Hills Complex where the GCSAA tournament was held is a fine example. Most of the roughs and areas out of play were planted to wild flowers and ground cover that required minimal to no irrigation and virtually zero maintenance. Industry Hills also demonstrated the trend toward multiple courses. Mr. Phelps also advocated using sand for bunkers that do not have to be raked with power equipment every day. Sand bunkers must be properly drained, and if raked properly will be smooth. Continued education of the golfer to smooth traps would eliminate the necessity for power raking every day.

Another trend that I think we can expect to see is reduced watering because conservation of water is crucial to many areas of the country. Mel Lucas, from New York, indicated a strong warning had been published in the New York Times, January 15, this year, stating that if water was not conserved voluntarily, that area could experience calamity in June, July, August or September. He also indicated that one-half of the world could exist on what the other half wastes. He recommended keeping golf courses as dry as possible and not to irrigate for growth. He cited one experience where water usage increased tremendously when a new irrigation system was installed in 1955, with a usage rate approaching 55 million gallons per year. They how have the use rate down to 12 million gallons per year. Not only does that conserve substantial quantities of water, but also represents a savings of $12,900. The net effect of cutting costs in areas of water conservation and energy conservation will make it possible to maintain quality playing conditions with less increase in budgets.

C. William Black, Superintendent at Congressional Country Club in Bethesda, Maryland, talked about budgets. He said there is no problem budgeting for quality playing conditions if the budget is realistic. He suggested emphasis in condition of the playing surface rather than manicuring an expanse for appearance. He also advocated the use of less water and indicated that bounce and roll should come back into the game. Too much of the game has been played in the air. Properly played shots would be rewarded if less water is used. He advocated fairways lightly fed, closely mowed, and watered sparingly. Because of high cost of new equipment, we are seeing more and more golf courses making extensive repairs to maintain old equipment in top notch condition. Richard E. Eichner, of Los Angeles Country Club, talked about proper equipment for maintaining quality turf. He emphasized C-A-R-E. C is for correct equipment selection. This includes determining capacity and whether it is more efficient to ride or walk. A is for adequate operator training. Many pieces of equipment are underutilized because the operator hasn't been adequately trained to get the most out of them. R is for regular equipment servicing. Most manufacturers provide a schedule for changing oil, lubricating various points and suggestions for other preventive maintenance. E stands for extra attention to details, such as being particularly observant of bolts or screws starting to loosen and tightening them, and reporting any unusual sound from the machine.

Golf courses that consistently provide quality turf have proper equipment, not by accident, but by wise planning and purchasing, have the employees properly trained to use the equipment most efficiently, and keep it well serviced.

The country is experiencing a population shift to warm climates. There are 2,000 golf courses in the Southeast, and more are being built all the time. Overseeding for winter play on these golf courses is increasing because players coming down from the north will go past a resort that does not overseed to play at one that does, simply because they like green greens.

Regardless of what happens in the next decade, we can rest assured there will be some changes made.

Editor's Note:

Bob Dunning built a "sand" green in 1936, prior to his attending Dickenson's Turf School.

Oklahoma State University's Research Project 669 supported Dr. Garman's studies on sandy soils.

Dunning was a leader in the promotion of sand rootzones. From 1947 his writings were consistent in support of the use of coarse and medium size sands for soil mixes. He was one of the pioneers in proposing the use of sand and peat (no soil) as a rootzone for golf greens. The current use of washed, uniformly fine sand with 15% or less organic matter in the surface area is based on early work and observations of Bob Dunning.

A demonstration golf green with a perched-water-table-intimate-mixture rootzone was constructed in 1958 by Ferguson and Holmes as the U.S.G.A. Green Section expanded research.

The following are excerpts from The Green Construction (undated) and Basic Concepts of Green Construction by Bob Dunning, the latter presented at G.C.S.A.A. meetings in 1962:

With rising labor costs, increased play and player-labor interference it is necessary for all courses to scrutinize operations. New construction methods, mechanization and automation will go far in solving these problems. These improved methods will add greatly to the importance of the golf course superintendent's position when backed by a system of cost analysis and budgeting.

Green Construction - Superlative Surface and Internal Drainage are Necessary

Base - The base of the green may be constructed of any soil at hand and shall be compacted and watered to prevent shrinkage.

Percentage of Slope for Putting Surface - A high percentage of the putting surface should be suitable for cup cutting or pin position. There should be a minimum grade of not less than 1% and maximum slope of 3%. The slope should not cause the ball to gain momentum after being stroked. Necessary undulations of the edges should not exceed 10% slope.

Multiple Distinct Cup Setting Areas - These cup setting or pin position areas in each putting surface shall be divided by gently sloping undulations. The pin position should require strategic play as well as protecting putting surface from excessive wear.

The trend is that the pin position be targets for the low handicap player and the whole green may be used for the average player.

Division of Drainage Areas On Greens - Mounds at the perimeter of the putting surface may be used to divide drainage areas for surface runoff, orientation and character, and add to, and blend with the surrounding terrain.

Grading Shoulders and Aprons of Greens - All areas surrounding the green including the shoulders and mounds should be graded to be conducive to maintenance with gang type mowers or multiple reel power mowers. There should be room for the machinery to operate and be maneuverable between traps or bunkers and the putting surface proper. The maximum percent of grade on shoulders or areas surrounding the greens should be no more than 30%.

Grading Base, Finished Surface of Green Appears in Base of Green - All undulations are included in the base of the green or sub-grade and there shall be no pockets where water stands. A green should be constructed so that surface runoff is in several directions, never all off the front of the green.

Drainage - For the ultimate in putting green construction, drainage must be considered in five phases: 1) surface, 2) internal, 3) lateral, 4) air, 5) diffusion. For the best in green construction there should be a system of tile with protected inlets and outlets. Tile should be placed at least 24 inches below the finished surface of the green on a properly prepared grade and bedded into two inches of gravel. Tile should be placed so water will not have to travel more than ten feet below.

There shall be left a space 1/16 inch between the tile joints to facilitate the entrance of water. The joints shall be properly protected with a small piece of tar or waterproof paper to prevent materials from dropping into tile. The trenches shall be backfilled with gravel to the surface. The base should then be covered with 4-6 inches of fine gravel. This is then covered with the prepared, laboratory approved, topsoil mix to a 10-12 inch depth.

The installation of tile affects drainage in three phases: internal, lateral, and by diffusion, allowing the interchange of atmospheric and soil gases, helping to prevent an overabundance of carbon dioxide and to prevent the forming of carbonic and other organic acids which are toxic to vegetation.

The margin of error allowable in sandy mixtures is very small. A mixture using five parts sand,one part soil, with 15% peat may be totally unsatisfactory and near concrete in consistency, whereas six parts sand may be near perfect, friable, and providing excellent drainage.

Principles of Contouring Greens

The fundamentals of green contouring should be natural contour and water flow. It is by the use of mounds at the perimeter of the putting surface that the continuous straight lines are broken by curves and indentations which are desirable and have eye appeal. At the same time they divide the outer putting surface making segments of multiple pin positions.

A natural contouring is not glaring, but easy on the eye. It has a soothing effect rather than one of irritation.

Mounds at the perimeter of the green may be used as sand traps, bunkers and grassy hollows. The effect is to gently divide the different cup cutting areas or pin positions. The predominance and greater mound effect is given to the outside away from the green making an irregular outline for orientation and to blend into the surrounding terrain. Sand traps when used should be placed higher in the mounds than the surrounding terrain so they can be observed from a distance and emphasize orientation. Surface water should not enter traps.

Other uses of these areas are to protect pin positions, to direct the line of play authoritatively.

Soil Mixing for Greens

These turfgrass areas require specialized standards of maintenance and soil requirements. Soils with a high silt and clay content may be satisfactory for turfgrass in non-use areas as granules or crumb structure will develop, creating porosity of different sizes, but under heavy traffic this type of mix has shown its limitations.

Through research and observation in the past few years the so-called "sandy mixtures" have come into use.

A mechanical analysis of the basic soil to be used is helpful. If one has had long experience in choosing soil this may be done with some degree of accuracy. The minimum content of silt is desirable as it adds nothing to the structure and has little or no colloidal value. It is difficult to hold in place and may cause layering that will impede or obstruct drainage.

Choosing the correct sand is important. We hear sand described in every kind of manner: No. 4, No. 6, No. 8, sharp sand, coarse sand, buckshot and torpedo. If too much coarse sand or fine gravel is used in the mixture a hard non-resilient surface may be created. Another factor against excessive quantities of fine gravel or coarse sand is that there are simply not enough particles to break up the soil mass. From 4% to 6% clay in a mixture is adequate. Good results have been observed with smaller amounts.

Example No. 1 Basic Soil:

48% silt and clay = 4.8% of 10%
52% sand = 5.2%

Required:

	Volume %		Volume %
8 parts sand	80 + 5.2	=	85.2
1 part soil	10 + 4.8	=	4.8
1 part peat	10		10.0
10 parts			100 %

Clays are chemically active. They vary in physical characteristics, colloidal properties and exchange capacity.

Tests should be made on the final mixture, including rapidity of drainage, moisture holding capacity, before and after compaction. A good rough test is to form mud pies and allow them to dry. Those that hold teogether but will crumble readily are usually found to be good putting green soils. They will approach 80% sand when 15% peat is used. Laboratory tests are superior.

Peat should not be used in excessive amounts - 10-15% by volume is best. Peat is used for its moisture and nutrient holding capacity and its intermixture with the clay fraction. This colloidal material gives adequate nutrient and water holding capacity or permeability. Organic matter is the main source of energy for soil microorganisms, and its presence favors soil organisms and their activity. The peat will weaken the soil mass, leading to better soil structure by bacterial slime, aiding in flocculation and granulation, thereby favorably affecting the moisture and nutrient holding ability of the soil, at the same time giving crumb structure, friability, better permanent structure and drainage. Its ability to expand and contract also has a bearing on this.

Composting of soil mixtures will produce a more natural soil. An ideal situation is to find a natural soil with the desirable characteristics of properly graduated sand, with adequate clay content and only requiring peat to be added for organic matter. When one is this fortunate, a near perfect green soil is produced.

Advantages of Sandy Mixture

Physical - The texture, structure and porosity of the soil influences the absorption and infiltration rate. It also governs the water holding capacity.

Percolation - The movement of moisture through the soil is affected by the physical properties. Oxygen is carried into the soil, promoting root development. Roots will move to areas where there is sufficient water, oxygen, and nutrients. The proper physical condition of the soil affecting percolation will prevent putrification, the accumulation of toxic gases,by diffusing oxygen into the non-capillary pore space and promoting drainage. This aids in the prevention of root disease. Such soils resist compaction.

A properly graduated sandy soil with 4-6% of clay and 10-15% peat is a permeable soil, one which furnishes enough available moisture to sustain plant life. A sandy soil of this type is not a droughty soil. The permanent wilt point is much lower in sand soils and requires less moisture than soils of a more plastic nature. However, large quantities of water can be applied without the soil becoming too wet. A green never needs to be closed because of excessive moisture.

Soils with the above characteristics create beneficial microorganisms and bacterial action. The advantages of a sandy mixture can be lost if a mat of thatch is allowed to accumulate. The proper sandy mixture is conducive to produing good turfgrass and may offset lack of attention to some management factors.

OLD IDEAS AND NEW ROOTZONES

Marvin H. Ferguson, Golf Course Architect
Bryan, Texas

It is a privilege to participate in this conference. The fact that the memory of Bob and Inez Dunning will he honored by these Proceedings adds to our appreiation of the program.

I met Bob and Inez Dunning on June 7, 1940, at the old Arlington Turf Gardens. It was the second day of my employment by the USGA Green Section, and Bob and Inez were on their way back to Oklahoma. Bob had just finished Professor Dickinson's Turf Course at Massachusetts.

In a friendship spanning forty years, I came to know Bob as a person who was dedicated to his profession and his avocation (which were the same) in an unusual degree. For her part, Inez apparently dedicated her entire life to helping Bob pursue his interests. She was a constant companion and helper. It is doubtful if Inez ever realized the extent and value of her contributions through her support of Bob.

Bob contributed to our knowledge and our appreciation of turfgrass management in many ways. He used a great deal of his own money and time in pursuit of turf research, he was exceptionally generous with his time in consulting with golf course superintendents, and his interest in the search for new and better methods was a constant spur to those who were engaged in turfgrass research at institutions throughout the country.

A great many people contribute to the body of knowledge that we enjoy and are never aware of the extent of their contributions. While Bob Dunning is an exceptional example, there are others like him who have contributed.

One of the special problems to which Bob devoted a great deal of time is the matter of soils for putting greens. His efforts paralleled those of some others in this area. The development of the concept of putting green construction which came to be known as the USGA specifications grew out of the combination of many little pieces of knowledge. The conversations with people with similar interests and the sharing of hypotheses were very important to the development of the concept.

The first serious efforts to determine optimum physical characteristics of soils for putting greens were undertaken by the USGA Green Section in 1947. Through arrangements with Saratoga Laboratories of Saratoga, New York, studies were made of the textural composition of "good" and "bad" greens from numerous golf courses. Ample wind movement and freedom from shade identified the good greens. Unfortunately, the studies provided few clues as to why one green supported better turf than another, especially concerning rootzones.

In 1951, the author had the opportunity of working with a group of civil engineers engaged in paving work, and became adquainted with some of the criteria upon which they judged the suitability of base material for the support pf pavement. Their aim was density and stability. The aim in a putting green soil is to achieve a degree of stability but certainly not density. One of the measurements used by the engineer is called the plasticity index. Obviously, plasticity of base material is inimical to support of pavement. Charts are available which indicate the amount of granular aggregate material necessary to stabilize soils of any given plasticity index. It occurred to us that a similar chart might be constructed which would show the percentage of a given soil which could be used if sand and organic matter were of a specified type.

In 1953, Raymond Kunze embarked upon a period of graduate study at Texas A&M and he chose this subject for his thesis work. As might be expected, the problem turned out to be more complex than it appeared.

At the outset, Kunze collected cores from putting greens, determined density, made textural analyses and recompacted the material to its original density. Kunze studied the particle sizes of sands and their influence on turf growth and compactibility. He found that sand particles of fairly uniform size in the range of .5 mm to .1 mm were preferable, but usually too expensive to be practical. Concrete sand or mason's sand was not ideal, but it did serve the purpose satisfactorily.

Kunze also worked with different types of clay. He found that much more kaolinite clay could be used than montmorillonite. Montmorillonite is a highly plastic clay that tends to envelope and cement the sand particles.

A great many mixtures were made up and studied with respect to their ability to support growth under conditions of close mowing and compaction. One interesting observation was that the mixtures containing the least sand and the most soil supported the most vigorous turf at the outset. However, as compaction was imposed, the response became completely reversed, and those mixtures containing the greatest amount of sand and least soil were most vigorous.

In 1956, Leon Howard began work toward the Master's degree and he continued Kunze's work. Howard used many different soils and sands and compared these in field plots and in the laboratory. He found that variations in sand or in soil could be tolerated so long as the mixture produced some common measurable physical qualities in the end product. He found that in general after compaction, the noncapillary pore space should amount to 12% to 18% of the volume. Capillary pore space should range between 18%-27%. Hydraulic conductivity, according to Howard, should range between .5 and 1.5 inches per hour. (Note: In the two decades since this work was done, experience has indicated that relatively more noncapillary pore space is preferable and that much higher permeability rates--over 5 inches--may be preferred.)

In the meantime, other workers had contributed to the literature, and attempts were made to incorporate these findings into the work Kunze and Howard had done. Garman, working in Oklahoma, had observed that about 20% of peat by volume, was the maximum desirable amount. Davis at Purdue and Lunt at UCLA had found that most compaction occurred very near the surface of the soil. Lunt had tried building some greens, using a pure fine sand about four inches thick over the existing soil. Such greens were satisfactory, but watering had to be done very carefully.

At about this time, Reese Coltrane, superintendent of Lakewood Country Club in New Orleans, built a green using a porous soil mixture on a base of muck from Lake Pontchartrain. The green was almost impossible to keep because of the fact that the muck pulled moisture from the porous soil mixture very rapidly. Obviously, some way of interrupting this capillary attraction was necessary.

We also learned at some point during this period that Willie Tucker, who was one of the pioneer golf architects in America, used a layer of gravel and manure at a depth of about 9 or 10 inches in greens he built at the University of New Mexico in Albuquerque. We assumed the gravel was for drainage but could not understand the purpose of the manure until Mr. Tucker told us that the layers were not necessarily for drainage. They simply broke up the capillary pathway whereby salts from the caliche subsoil crept to the surface. The manure layer above the gravel was Mr. Tucker's way of preventing soil particles from migrating downward and filling the spaces between gravel particles.

We had long been aware of the detrimental effects of texturally different layers near the soil surface and it had become apparent from the observations cited that layers could be made to serve useful purposes if they were placed deeper in the soil profile. This thinking was reinforced when Charles Wilson brought to our attention some of the demonstrations of Walter Gardner at Washington State University. Gardner had shown in a dramatic way, the effect of layering upon water movement through the soil.

The many bits of information from various sources finally began to permit their fitting together into a concept of putting green construction. In 1957 and 1958, Leon Howard rebuilt the greens at Texarkana Country Club using the method we had devised. In 1958, he rebuilt the greens at Albuquerque Country Club. None of these greens have experienced serious trouble.

In 1960, we felt we had enough information to publish an article entitled "Specifications for A Method of Putting Green Construction." The method is described in detail in the September 1960 issue of the USGA Journal and Turf Management. An article outling progress and redefining these specificaitons appeared in the USGA Green Section Record in November 1965.

My purpose in reciting the steps involved in the development of a concept which led to these specifications is to emphasize the importance of exchanging information. A bit of information that you gain from one of your colleagues may be the missing link which will permit you to tie other facts together in a coherent concept.

Some of the people like Bob Dunning add to our knowledge in such large measure that we can recognize the value of their contribution and we can give them credit. Others contribute impressions and ideas that we do not recognize immediately as being applicable to our work. It is unfortunate that we are sometimes not able to identify the source of some of the bits of knowledge we use. Many contributors are never aware that they have supplied a useful thought.

Thank you for allowing me this opportunity to pay tribute to the memory of an old friend, and to acknowledge the help that he gave to me and to many of our colleagues. Thank you also for allowing me to emhapsize again the importance of exchanging information.

RESEARCH REVIEW OF SAND

J. R. Watson, Vice President, Agronomist
The Toro Company, Minneapolis, Minnesota

A research review of sand as a seedbed or rootzone medium closely parallels the growth and development of the turfgrass industry and its role in the expansion of outdoor recreational activity, especially golf, and in more recent times, athletic fields. Sand is the most widely used soil textural class for construction and maintenance of turfgrass facilities, especially those areas like golf greens that receive intensive usage. Also, it is the most important because of its relationship to soil stability and to the soil air-water relationships.

Most early golf links in Scotland, England and The Netherlands were laid out along coastal areas. One may assume therefore that the dominant soil textural class was sand, or at the least, sandy loam. As the popularity of the game, and the number of courses increased, non-coastal areas came into play, especially in the U.S. Non-coastal sites more often than not were predominantly clay, clay loam, silt loam - non-sandy, but, understandably, little thought was given to soil modification. In fact, in many areas local sedimentary peat - black dirt, muck and similar - were often added if the soil for greens (or athletic fields) proved to be too "sandy", However, as traffic or play increased, alert practitioners seeking to prevent or to avoid severe turf loss in times of stress, noted the relationship between soil texture, soil compaction, water logging of soil and similar problems. The need to research soil and soil related problems became apparent, and help was sought from a number of sources - the land grant colleges, the U.S.D.A. and the U.S.G.A. Green Section.

The Green Section played a key role in early research efforts. John Monteith, Fanny Fern Davis and Fred Grau were among the early directors responsible for conducting and supporting turfgrass research. In the late forties and early fifties, Grau granted USGA Green Section fellowships to a number of graduate students (among them Daniel, Harper, Nutter, Watson) to study soil and soil related problems. Within the ensuing decade, Marvin Ferguson, as Director of Research for the Green Section, gave support and direction to studies which culminated in the publication of the "Green Section Specifications for Building Putting Greens". Research contributions from work conducted by Garman, R. Davis, Kuntze and Howard, among others, provided basic information for these specifications. Garman helped to establish parameters for the organic matter fraction

(20 percent or less). Howard and Kuntze developed infiltration rates (1+1/2 inch per hour) and porosity levels after compaction for putting green mixtures (30 to 35 percent total porosity, 12-18 percent non-capillary and 18-22 percent capillary pores). In addition to the 80-90 percent of sand found to be preferred for a seedbed mixture, a layer of coarse sand was used immediately below the mix to create a perched or false water table. (This is no longer called for in recent modifications of the Green Section specifications.)

During this same period (50's) and beyond, a number of other research workers were studying "sand". Among them: Lunt, Keen, Bingaman, Duich, Daniel, Ward, Horne, Madison, Schmidt, W. Davis, and, more recently, Brown, Blake, Duble and others have continued to establish criteria for qualifying sand as a medium for turfgrass growth. Also, the Green Section continued to support many of these as well as other projects.

Duich and associates established threshold values necessary in mixtures to ensure a bridging of coarse particles; confirmed that compaction occurs mostly in the top one inch and rarely exceeds a three inch depth - similar to the results obtained by Alderfer and Robinson working with heavily grazed pasture soils. Keen confirmed the importance of medium sand (0.25 or 0.50 mm) and also the importance of high percentages (85-90) of sand in the mixture. Madison and W. Davis delineated preferred particle sizes for construction and for topdressing - medium sand.

Concurrent with the work directed specifically toward golf greens, other investigators were studying soil problems of athletic fields. In this group one may expand the above list to include European investigators working almost exclusively on sports turf - athletic fields. Skirde and associates in Germany; Petersen in Denmark; Adams in Wales; Jansen and Langvad in Sweden; and Daniel, Bingaman, Freeborg and Robey at Purdue were devoting most of their efforts toward development of rootzones for athletic fields.

Their studies and observations dealt with the role of sand as a factor in infiltration rates, percolation rates, surface stability, and other pertinent soil physical properties. Their findings further confirmed the importance of sand, and demonstrated that in the correct amounts of the proper size, it performed in a manner similar to that found for putting greens.

While the above list of research workers is far from complete, it does serve to point out the wide range of studies devoted to sand as a stabilizing factor in intensively used turfgrass areas.

But this is only part of the story, for during this same period, others involved with golf course design and construction were forging ahead in the practical application and use of sand as a rootzone medium for intensively used turfgrass areas. Included in the group of golf course architects were Evans, Plummer, Jones and Dunning. Sand modified with only 10-12 percent peat as a putting green mix was frequently questioned from an agronomic standpoint - sometimes with justification, sometimes not, depending on how well the grass grew and survived under conditions of intensive play and climatic or man-made environmental stress.

These and others who pioneered the use of sand, often with little, if any, research data upon which to base their decision for use, must be recognized for their contribution. For as Oliver Wendell Holmes once said, "Many ideas grow better when transplanted into a mind other than where it originated."

Gradually, the fund of knowledge accumulated from research and from field use continued to a better understanding of the causes for success and failure with sand. Based on knowledge of its performance in golf greens and in athletic fields it is now being used as the base for turfed race tracks (horses). Davis and Madison of California have been the primary proponents of this approach.

The story of review of sand would be incomplete without brief mention of two other areas.

The first, topressing with sand. Since Madison's report on sand as a top-dressing material at the GCSAA conference in Portland, Oregon, much the same thing is happening as occurred when sand was first proposed as a medium for turf-grass growth. A number of golf course superintendents have adopted the practice, others are opposed to its use. There has been success and failure. From all reports, more success than failure! Research programs have been initiated, but more time is needed.

Secondly, there is a need to determine why the practice of using high sand contents for intensively used areas has not been more widely adopted. For the most part, failures can now be explained. Yet many still do not use the material. And, in some cases, northern climes, there may be justification;for all the answers are not clearly evident. Perhaps it will fall upon some of you in this room to continue that research.

Yet I am of the opinion that the problem of acceptance perhaps relates to other areas - economics, availability of the right type of sand, lack of understanding of the importance of mineral origin, relationships of particle size and distribution.

What concerns me most, is that the problem may be one of communications - failure or inability to communicate the basic concepts to those responsible for making the decision pertaining to seedbed mixes.

Editor's Note:

Bob Dunning in the 1950's proposed coarser sands for rootzones, as he wanted to dilute silt and clay. In the 1980's Daniel proposes sand as the rootzone, with just organic matter additions. Note the comparisons:

Comparison of sand	Size mm	mesh, Tyler	Dunning, 50's	Daniel, 80's
very coarse	1.0	on 18	8-14 %	0 %
coarse	.5-1.0	on 35	37-47	0
medium	.25-.5	on 60	36-41	24
fine	.12-.25	on 120	0-5	70
very fine	.05-.12	on 270	0	5
pan	pass	270	0	1
			100	100

EVALUATION OF SANDS FOR ROOTZONES

W. H. Daniel, Turf Research
Department of Agronomy, Purdue University, W. Lafayette, Indiana

Sands are being used extensively in the construction and management of rootzones for growing turf. Seven important considerations for choosing a rootzone sand are:

1. the finer fraction - 10%
2. the coarsest fraction - 10%
3. uniformity
4. pH - less than 8.0
5. less than 1% silt and clay
6. continued availability
7. reasonably priced source

1. The finest 10 percent of the sand particles predominates. The finer particles settle between larger fractions. As little as 5 percent silt and clay, or as much as 25 percent of very fine sands, actually determine this predominance. These fine particles:

   a. determine the pore space - 26-48 percent
   b. control the rate and extent of capillary action
   c. permit increased rootzone moisture capacity
   d. increase surface stability
   e. improve ease of managing turf

2. The coarsest 10 percent particles:

   a. form a filter for the narrow openings of the plastic drain tile
   b. tend to reduce moisture retention
   c. tend to provide a less stable surface
   d. appear more obvious
   e. may cause dry spots if concentrated
   f. may adversely affect equipment and putting surface
   g. occupies space

3. Uniform particle sand is preferred. Perfectly uniform particles provide 48 percent pore space. Naturally occurring sands seldom provide uniform texture, but a "good" (chart, Turf 1-75) dune (wind sorted) sand may provide 40-44 percent pore space. Many dune sands provide only 35-40 percent. Washed "pit" sands provide 26-35 percent pore space since all particle sizes are generally included. When all sizes of sand, plus silt and clay particles, are combined, the pore space can be reduced to 18 percent.

The quality needed for cement production is the opposite of that best suited for turf production. Mortar and asphalt production is a primary use of the combined particles sizes. The variety of particle sizes provides increased density and requires less cement or adhesive.

A set of 14 graduated sieves are used to separate and measure sand particles. The range of available sands has been documented in the samples tested in our laboratory.

Table 1 - Sizes of Particles at the Finer 10 Percent Level (Turf 1-75)

size at 10% mm	Frequency %	
-0.9	8	hold more moisture
-0.12	8	
-0.16	15	
-0.18	15	
-0.20	13	
-0.22	17	hold less moisture (tend to be drouthy)
-0.24	15	
+0.24	8	
	100	

For the finer 10 percent the particle size averages 0.19 millimeters and ranges from 0.08 to 0.27 mm. Of all sands tested, 75 percent of the samples measured between 0.15 and .24 mm for the 10 percent level.

Of the samples tested, 53 percent had less than 10 percent particles coarser than 0.05 mm. Another 17 percent had less than 20 percent coarser than 0.5 mm.

Table 2 - Percent of 170 Sand Samples Tested

Samples		
below 0.5 mm %	less than .5 mm %	Quality for rootzones
40	100-95	very good
13	-90	
17	-80	good
11	-70	poor
9	-60	
7	-50	very poor
2	-40	good trap sands
1	-30	
100		

Commonly, turfgrass surfaces develop an accumulation of thatch and dust. A program of frequent, light sand applications as topdressing can result in a continued uniform predominance of sand.

4. pH of sand tested. Tests show dune sands generally are near neutral, neither acid nor alkaline. Sand from pits formed by stream deposits in the Midwest tend to be calcareous. A pH range of 7.6 to 8.6 has been measured in most samples. The addition of sulfur plus ample phosphorus, potassium and iron may be needed to encourage maximum turfgrass growth on sands with a high pH.

5. Washed sand usually contains less than 1 percent silt and clay. A simple test to determine the amount of silt and clay in a sand sample: dilute a five inch column of fresh sand with two parts water, shake vigorously, let stand for 24 hours. The silt and clay present will form a surface coating, which in a "good" sand should be barely discernable. Pit or unwashed sands vary a great deal, but may be suitable for use as a rootzone medium.

6. Availability. Investigate all sand sources to determine the best available, uniform sand at reasonable cost. Large sand companies are equipped to prepare in one day all the sand needed for the turf areas in a metropolitan district for one year. Turf managers are encouraged to work together to create bulk orders so as to obtain a preferred supply.

Plans for a sand topdressing program should include adequate equipment. The repeated procedure should be an efficient operation. The sand storage area should provide for an ample, dry supply. The area should be readily available for truck delivery and machine hauling.

We at Purdue are encouraged to find adequate availability of quality sands. Currently we have record of 170 samples. Turf managers desiring an analysis of a sand may send one pint or one pound of sand for each area to be tested.

Ship to: Dr. W. H. Daniel
Turf Research
Department of Agronomy
Purdue University
West Lafayette, IN 47907

Editor's Note:

The Oklahoma "Dust Bowl" years of the 1930's made a strong impression on R. C. Dunning. He wrote of the "normal" accumulation of dust on irrigated golf greens in an article entitled, "Where Do Fines Come From?"

"Despite all the research and proven techniques available on how to build and maintain a golf green, a major problem has been virtually ignored. We call it 'fines'."

"What are 'fines'? Simply very small particles of silt or clay. These fines are everywhere. Leave your car parked almost anywhere for two days, observe the film that accumulates on the shiny surface. Those are fines."

"Walk through the dry grass, such as the rough on your golf course, with freshly shined shoes and watch the gloss disappear. The cause is fines, which also filter through your socks and leave dirty ankles after a round of golf."

"With these examples, it can be easily seen how a putting green is exposed day after day, season after season. Even in properly constructed greens, fines accumulate at the surface... The tiniest particles are air-borne most of the time. But they are constantly settling. This problem is particularly bad in drier, western climates."

"Golfers track fines onto the green. Irrigation water carries a certain amount of material not quite fully dissolved. During construction, fines are blown, dragged or tracked onto and into the seedbed. The wet turf surface attracts and traps the fines from the air. As the fines accumulate so does organic matter including humus. These become a sticky sealant at the surface that holds out oxygen,decreases absorption, infiltration and percolation of water and creates a climate for fungi diseases. In conjunction with mat and thatch, this condition is serious. Lack of air decreases decomposition and increases putrification."

"When fines accumulate over coarser material the capillary action is upward. Water is held in this material rather than draining through. The result is undesirably wet surface."

"Some other troubles caused by fines are: reduction of root length, accumulation of salts, localized dry spots, crusty surfaces..."

"The solution to this problem depends on how much and for how long the material has accumulated, and how serious the condition of the turf has become. The most drastic correction method is to rebuild the green, especially if the basic soil mixture is poor..."

"In older greens with good soil but a choked off surface, aerification and proper topdressing will provide a cure. The aerifying holes must be filled to the top with a sandy mixture."

"For new greens, the maintenance program must include light topdressings of materials with occasional disc spiking and verticutting."

"To determine if the surface is sealed, rub a little material from the root level between your thumb and forefinger. It has no structure and will feel almost like glue."

"It is important to keep the surface of the rootzone open."

Editor's note:

Tom Mascaro has been in the turf business since 1936. He holds twelve patents on turfgrass products. He has acquired more than 70,000 slides, and edited the GCSAA photo quiz for 21 years.

COMPACTION AND ITS REDUCTION

Tom Mascaro, President
Turf Fibre Products, North Miami, Florida

See what being in the turf business will do to you - puts you in a wheel chair (Fred Grau) and requires help such as canes (Tom). It is a pleasure to be here again. I didn't bring all 70,000 slides but did bring a few to share of the early days about soil compaction and how it forms and some of the work that was done years ago and is still good today. The basic principles never change.

When turf dies you wonder what happened. Certainly there are many factors that make grass disappear, and compaction is one. Compaction is formed in many different ways. Most of us don't realize what is underneath the turf and seldom take time to investigate the soils and the effect they have upon the surface. To find what is underneath one of the best tools is the shovel; just dig a hole and look.

Soils can be described through two categories, texture and structure. By texture we mean what it is composed of, sand, silt and clay. Most of us don't realize the great and subtle differences that occur even on one golf course. Se we are dealing with many variables in soils.

Structure is how the particles are put together. We have limited control over structure and tend to live with it in large areas as is. We know that many clays are plate-like in character, and a combination of traffic and water causes the particles to slide together to form a brick. We see this frequently in turfgrass areas.

Dr. Alderfer said many years ago, "Roots do not grow in the soil, they grow in the spaces within the soil. If there are no spaces, there are no roots." No two objects can occupy the same space at the same time. We like to think of a soil being in good tilth with plenty of air space, so we have 55 percent solids and 20 percent air space and 25 percent for water. Water being a lubricant, it can favor compaction. Compaction doesn't necessarily come from weight but from the puddling action. As kids, when we made a mud pie we didn't mix soil and water and beat it to death, but we patted it, patted it many times, and this is what we do to soils. Just stroking a wet soil with a chicken feather can seal it. We do this with maintenance equipment, the rolling action of the wheel and the rolling action of the human foot. The soil is gradually being puddled and compacted near the surface. The work that Jim Watson did at Penn. State, and that of others, demonstrated that the most compaction occurs in the first inch,

The best thing to do with a compacted soil is to plow it up and start over with a good management program. What a plow really does is to pick up the soil, turn it over, and relocate it gently. It opens and subdivides the soil so the needed air spaces result. In agriculture this improved condition lasts about a year and then reverts back to compacted or sealed soil.

We also tend to forget the number of living microorganisms in the soil. In one acre, between four to six thousand pounds of living creatures need air to breathe - just as you and I. They may not exist in a compacted soil.

We tend to forget that the root system of the plant is as important as the top. We know the root system takes in oxygen and gives off carbon dioxide which requires ventilation of the soil. Compaction plays a big part in the way those gases move. Roots grow quickly in soil where there are spaces. The root system in open soils can move down within two weeks.

The other thing we tend to forget is what grass does for us. The soils, of the Midwest especially, were built from grass. We can stabilize a rather poor soil by growing grass. Alderfer demonstrated this by using two beakers with a screen halfway down, and used clumps of grass from different plots - one where the grass had been growing for one year, and the other from a barren plot. He

dropped these into a beaker at the same time. The soil without grass almost exploded, lacked any stability, and within five minutes had completely flaked off. The sample with grass roots was stable. He said that soil is inert, nothing but mineral matter. The only way it is made dynamic is in the presence of organic matter, which we can grow as grass roots. So, producing grass roots is one way of overcoming compaction.

Another good piece of work was done thirty years ago by Dr. Merkle. He was attempting to demonstrate the effect of lime and fertilizer and how roots can develop. He used pots of sterile sand and added calcium to the top, nothing to the bottom, and the root concentrated in the lime area. When he added fertilizer and lime together, the root concentration developed there. From this developed the original thinking of the relationship between pH and roots. He also experimented with only lime at the bottom and fertilizer throughout. The roots grew better in the lime area.

Fertilizer applied to compacted areas produces surface roots. There is little reason for them to grow elsewhere. Roots will develop where the conditions are best.

Some of the early work of aerification has been documented by research. Dr. Engel (New Jersey) used plots on a plain clay soil. He did nothing to the center for three years. He verticut the left portion three times a year, and he applied extra lime, nitrogen and topdressing to improve the soil on the right portion. To overcome compaction we need to promote the cycle so the roots can do the work.

Renovation by aerification can be done with proper equipment. The soil is picked up and moved ahead, a modified way of plowing turfgrass areas without taking them out of play. In the early days compaction was so serious we moved a three gang aerifier over greens as well as fairways and tees. Now we have improved ways of doing a nice neat job. We bring up 8-10 tons of soil per acre which acts as a topdressing to help level the playing surface. When the effects on the turf show above each hole, this indicates the area needs a lot of loosening.

We are never judged by the green turf we grow, but by the brown turf we produce. Golf cars have been a great culprit on golf courses. We can do a pretty good job except where traffic concentrates. In research at Tifton, Georgia, thirty passes a day for two months wore the best bermudagrass out. Vehicles with big tires are not good for turf. Much damage occurs where the soil becomes compacted. The golf car is airborne when it leaves the end of the asphalt cartpath. Adding more asphalt has not been the answer unless the paths go all around the course. We have looked into many different ways to overcome this problem where the real wear occurs. In earlier days, the old cobblestones provided some structure to support the load. In Germany they took the curse out of concrete by molding it into little squares which allow grass to grow through to make it attractive and to provide some green color.

We photographed the loss of turf caused by compaction of the perimeter of this green. As the weather changed, the Poa annua appeared. Poa annua thrives on compacted soil because it is a shallow rooted plant.

Architects design buildings with walkways for esthetic value, not for practical reasons, and as a result, people don't use them. They make their own paths. Parking lots are built, but people tend to park where it is more convenient. Athletic fields are built and people use them for practice areas. Shifting concentrated traffic to other locations to protect an area is great, but if this is not possible, then aerification is certainly one approach to renovation or renewing soil structure.

We are now doing research with materials that add structure to the root system, hoping to aleviate compaction. At New Mexico State, Enkamat, a woven plastic material, was placed directly on the bermudagrass surface and covered with one-half inch of topmix. It worked fine. This material has been used successfully in Europe for the past twelve years. We have high hopes for it in our country. Current research will produce other products which will do similar jobs. Research hasn't ended. I feel we are just beginning.

Above all else it is important to remember in dealing with compaction there is no substitute for good management. Getting rid of compaction is one problem; however, good management programs must be continued or the problems recur.

Editor's Note:

A severe and persistent damage to one strain of C-15 at many courses, C-19 at one site and Nimisilia at one site occurred in 1973 and 1980. Some of the following talks describe the damage. It was so severe that rebuilding and replacement of greens and grass occurred at three courses.

(In Chapter 16 of Turf Managers' Handbook by Daniel and Freeborg, ten ways to build rootzones are described. The editor has identified these numerically at the titles as an aid to readers.)

WHAT'S THE DISEASE?

Charles Lawson, Superintendent
Indiana University Golf Courses, Bloomington, Indiana

Our greens consist of C-1 and C-19 on the front side and Pennlu on the back nine. Since all my disease problems were on the C-1/C-19 greens, this report will be on the program we followed to keep these greens playable and also to introduce new bent strains through aerification, seeding, and topdressing.

The first attack of the mystery fungus occurred on May 25, 1980, to our #6 green. The C-19 strain had a yellowish brown cast with irregular dark streaks. No apparent damage was noticed on the C-1 strain. We immediately treated with Koban at 6 oz./1000 square feet. This treatment arrested the fungus. The next attack occurred on June 8 on all C-1/C-19 greens. The same pattern as before was noticed, with the exception of fewer dark streaks where resodding had been done. All elevations of the greens were attacked, but only the C-19 strain was affected. The turf in and around aerifier holes was healthy, but a noticeable amount of turf between the holes began dying. We were treating with Koban every five days and also using a contact fungicide every six to seven days.

I called Dr. Daniel on June 14, and on June 16 he came to observe the affected greens. The pattern was the same on all greens. The old C-19 plants were dying between aerifier holes, but putting out new tillers. The C-1 strain was healthy. His recommendation was to continue our fungicide program with aerification, overseeding, and topdressing.

By the first of July the new tillers and seedlings were filling in and the recovery looked promising. Some seedlings were lost due to the 90-plus degree termperatures during late July and August. Five greens had almost completely recovered by September first, and the other four showed remarkable improvement.

The greens were aerified four times and seeded with Penncross six times at one-two pounds per green. We also topdressed lightly every ten to fourteen days.

In late October and November we again noticed a loss of some turf. Small areas of turf appeared stunted and yellow with some plants dying. The plants lacked vigor, and roots were short and knotty.

Soil samples were taken in late November. No bacteria was found in the soil at this time. No nutrient was needed, as analysis was satisfactory; however the pH range was 7.2 to 7.4. We plan to take a nematode test in May.

At the present time all but parts of two greens have completely recovered, but it was a very long summer!

DISEASE TROUBLE AND RECONSTRUCTION (System 3 or 5)

Dale Foster, Superintendent, Pine Valley C. C., Fort Wayne, Indiana

and

Duane Dammeyer, Owner, Quality Golf Construction Co., Greenwood, Indiana

Our problem at Pine Valley Country Club was severe disease trouble on Toronto C-15 bentgrass. It started in August, 1979, when we had the first infestation of red leaf spot ? or crown rot ? or cool weather Pythium ? or ?? It recurred on May 22, 1980, and persisted every week thereafter. The answers to the questions concerning this disease problem were as numerous as the agronomists and plant pathologists we questioned. However, with the help of Dr. Daniel from Purdue University, we did get the best results when we started using a control for cool weather Pythium. That control was Koban sprayed at half rates twice a week plus another fungicide to protect from other diseases. That meant we were spraying greens three times a week. Unfortunately, by the time we found a control for this disease the damage to the C-15 was severe. We had less than 20 percent turf on several greens.

We could have continued to use chemicals and overseeding and maintained grass, but with the Poa annua and other weeds that had invaded the damaged areas on the greens we would not have had a quality putting surface. In addition, we had a severe thatch problem in the greens, and a drainage problem in the sand traps.

I had several meetings with my Greens Committee to discuss this problem and recommendation for its solution. The recommendation was to rebuild all eighteen greens and to build or rebuild twenty sand traps. This recommendation was approved by the board of directors. Duane Dammeyer, of Quality Golf Construction Company, was hired to do the rebuilding, with September 2 as the starting date.

Dammeyer Comments:

The situation at Pine Valley was both typical and unique, for many golf courses have similar problems in one form or another.

Pine Valley had a fairly good high sand topmix which made it easy to blend the new with the old. This allowed us to go through our program of reconstruction with proficiency and speed. It took eleven working days to complete the major rebuilding.

One very important aspect was having professional people do the project. What was done at Pine Valley is what I call "perfect coordination in labor skills". With Dale Foster and his crew and my crew doing the necessary steps in a sequence there was a saving in time and, especially, money. On construciton or renovation projects you have the equipment operator operate and use his skills in the molding of the project. Then you have the other people to do the prep work and the clean up, just as you do in regular maintenance. Let's face facts; you don't need your high dollar people to pick up loose sod or re-set sprinklers. However, you do need them in shaping and grading.

Foster (continued)

We started by stripping the old sod off the green. We set the sod cutter as deep as it would go, 1.5 inches. This would remove most of the thatch. What was left was scraped up in a pile with our box scraper and hauled away. Then Duane started making the corrections in the surface drainage and recontouring the greens. Fine sand was spread over the green and raked to a uniform depth of three inches and then roto-tilled in four directrions to a depth of six inches with a Howard Rotovator. After raking with a power rake and rolling to make a firm seed bed, we seeded with one pound per 1000 square feet of Penncross creeping bentgrass. A hydroseeder was used to spray 80 pounds of mulch and 13-25-12 fertilizer at .5 pounds of nitrogen per 1000 square feet.

Penncross creeping bentgrass was used as a replacement grass because of its observed freedom from the disease we had.

At the same time Duane was correcting the surface drainage and recontouring the greens, he was digging and shaping the sand traps. My crew would then put in the tile and sand,and sod or seed the dirt areas around the traps.

Our arrangement with Duane was that he would rebuild the greens, do the dirt work on the sand traps, supply the sand, seed, fertilizer and mulch for the greens only,for a flat fee of $26,500.00. In addition to this, we spent another $4,230.00 for sand, tile, seed, and the rental of a trencher. At this time we have spent $30,730.00 to rebuild eighteen greens and twenty sand traps, with a possible expenditure of another $300-500.00 this spring for sod, seed, and sand. This averages about $1,800.00 per trap and green for reconstruction.

We started the rebuilding project on September 2 and finished the greens on September 26. We rebuilt all eighteen greens in eleven working days, excluding rain days. I feel this method of reconstruction was the most effective way for us to rebuild our greens because we not only eliminated the disease ridden, weed infested grass on our greens, but it also gave us the opportunity to remove the thatch, improve the surface drainage, and recontour some of our greens to make them more interesting and challenging to play.

Given the opportunity to rebuild greens in the future, this is the method I would choose.

RESODDING EIGHTEEN GREENS (System 3)

Julius Albaugh, Superintendent
Westmoreland Country Club, Wilmette, Illinois

I would like to begin with a brief history of Toronto creeping bentgrass (C-15) in the Midwest. Westmoreland Country Club was one of the few golf courses across the country to have one of the USGA experimental putting plots, established sometime in the late 30's. These early plots contained twelve varieties of creeping bentgrasses, stolonzied into pie-shaped portions on a circular green. In 1943 an evaluation was made, and C-15 was chosen to be the new grass for the greens at Westmoreland. In the fall of 1943 stolons were taken from the experimental plot, and our ninth green became the first C-15 green in the Midwest. That same year stolons were used to establish a sod nursery on the grounds of Westmoreland. This nursery would become the source of the sod used to convert the other seventeen greens to C-15 over the next ten years. Over the years, our ninth green has been the source of much of the C-15 sold in the Midwest. (Ben Warren started C-15 at three different farms with sprigs from our ninth green.) The popularity of C-15 grew from the reputation of the greens at Westmoreland because for thirty-four years we had some of the most uniform, true, fast, and beautiful greens in the Midwest.

Over the years there have been reports of problems with C-15, mostly with a disease called red leaf spot, but at Westmoreland we seemed somehow not to be affected until June 22, 1979. Our problem started on only one green, our 11th. I first diagnosed the disease as Helminthosporium, melting-out type of disease based on the visual symptoms, and accordingly applied a fungicide. Within three days the green seemed to worsen, and the next green mowed with the same mower started showing the same symptoms. I sought help from a friend who felt our problem was red leaf spot and began spraying with Daconil 2787, but, in our case, we received only a three-day control. At least we felt we were getting control because the reddish cast would go away, only to reappear again in four days.

Over the next twelve months I watched more greens become affected after each cool wet period followed by any kind of stress. I discussed the problem with turf specialists and plant pathologists, and made numerous fungicide applications, based on the many theories I received. I had disease samples sent for laboratory analysis, soil tests were taken, nematode assays run, and I continued to experiment with anything that sounded half-way reasonable. I spent many hours on my hands and knees with a pocket knife and hand lens looking for a possible clue. I invited fellow superintendents to give their reasons and to compare records. I went over my reocrds for hours looking for a possible

change in management, a cultural change, or a product change that could in any way lead to a solution to the problem. Nevertheless, we eventually had eighteen greens completely denuded by the "C-15 Problem".

Special Treatments Given To Try To Solve C-15 Problem:

A. Cultural Practices

1. Isolate problem greens; mow problem greens with separate greensmower
2. Removal of dew before mowing
3. Raise height of cut
4. Skip green mowings
5. Aerify, topdress, overseed
6. Syringe

B. Chemical Applications per 1,000 square feet

1. Daconil 2787 Flowable, 12 app., 8-12 oz., often 3 to 4 days apart
2. Mercury treatments, CaloClor or PMAS, 1/2 to 1 oz., 10 app.
3. Chipco 26019, 2 app., fall-spring, red leaf spot preventative, 3-4 oz.
4. Tersan 1991, 1,8 oz. Stripe Smut app.

C. Fertility Applications

1. Experiments with high phosphorus fertilizers
2. Experiments with higher nitrogen rates
3. Experiments with 92% wettable sulfur to lower pH

D. Laboratory Analyses

1. Soil test
2. Plant disease culture test
3. Nematode assay

I can't overemphasize the importance of keeping the club officials and membership aware of one's plight with such a problem. I kept them informed by means of a monthly grounds and greens report, by attending board of directors meetings, and by being available in the locker room or on the first tee to answer the many questions of the concerned membership. Probably one of the most helpful items to many of the Chicago area superintendents with the C-15 problem was the publicity in the local newspapers. Since Butler National had the problem, and they were to host the Western Open, the C-15 problem was most certainly a news item. This sort of convinved the individual club members that the problem was indeed widespread.

I think the turning point as to when we would stop trying to control the problem and seriously start planning for a permanent solution was reached in July of 1980. After a meeting at Butler National with several superintendents and experts in the turfgrass field, and the Midwest AGCS meeting a few weeks later, it became quite evident that a solution to the problem was months, possibly years, away. The Westmoreland Pro, Vern Fraser, and I were asked to attend the board of directors meeting on July 2; the major topic, What are we going to do about our declining greens?

Our experience at Westmoreland had indicated that whatever the problem, it seemed to affect only C-15 creeping bentgrass, Westmoreland strain. I had enlarged two of our greens in 1972, and for some reason had used C-15 from H & E Sod Nursery. These enlarged portions of the greens showed no signs of the problem. Also, other varieties of bentgrass in our greens, and Poa annua, except for a purple cast, seemed to be unaffected. From this observation we concluded that the problem was more involved with the grass than the soil, and leaned towards a new grass, rather than to completely rebuilding greens.

Several of our board members had played the eighth green at Bob O' Link, the only Penneagle green in our area, and liked it. We discussed seeding vs. sodding. I felt that seeded greens would provide a more even putting surface sooner, but we had a factor of time of establishment to consider. To seed meant that we would have to have the seed in the ground no later than mid-September in order to assure a playable putting surface by the next May. This meant going to temporary greens in mid-August. With club championship golf events, scheduled outside events, and a certain reduction in income for both the club and the Pro, there was no way we could start the project in August. Resodding the greens was our way out. I had in back of my mind a plan to resurface six to nine greens a year in a two to three year program, and even to completely rebuild up to fourteen greens because the grounds and green committee had in mind major recontouring.

The unanimous opinion was to resod all eighteen greens starting on September 18, 1980. I was told to reserve sod and to arrange a meeting with a golf course architect regarding recontouring several of our greens. Eventually the plan to recontour greens was dropped with the exception of enlarging the collars on two greens.

During July and August I had further soil tests taken and worked on the procedure for our fall project. Soil fumigation was an absolute must and would start us out with the cleanest possible slate next to completely rebuilding the greens with new soil. We started on September 18 with our worst six greens, and completed them on September 30, 1980. The remaining twelve greens were completed on October 27.

Step by step procedure:

1. Aerify over the existing sod. To double aerify open soil disturbed the contour.
2. Use our newly purchased 18-inch sod cutter to cut the old sod and thatch layer.
3. Pick up the old sod and clean surface. All hand work.
4. Aerify the bare soil.
5. Fumigate with methyl bromide - chloropicrin mixture. Greens were covered with plastic before fumigation, edges sealed with sand from a nearby trap. Covers left on for 48 to 72 hours because of colder fall temperatures.
6. Covers removed. Air for 72 hours.
7. 1/4 inch of 1-1-1 topdressing added.
8. Topdressing double verticut into soil.
9. 13-25-12 starter fertilizer added, 8 pounds fertilizer per 1000 square feet.
10. Leveled with Sand Pro and dragmat.

11. Surface rolled with power tennis court roller.

12. New Penneagle sod laid.

13. Sod fertilizer with 13-25-12 starter fertilizer, 4 pounds fertilizer per 1000 square feet.

14. Sod watered heavily, soaked.

15. While greens were in soaked condition they were rolled with the tennis court roller filled with water, over 3/4 inch plywood.

16. Cleary's Turf-Gro, a liquid humus concentrate applied. One gallon per 1000 square feet rate used, watered in, to aid rooting.

17. Sod kept wet until rooted.

18. After two weeks rolled with walking greensmower with wheels in basket.

19. First mowing of new sod - 1/2 inch cut used.

20. Topdressed twice before soil froze in late November.

21. We expect to open about May 1.

Expenditures for resodding 18 greens:

Topsoil - 165 cu. yds. to enlarge collars	$ 1,225
Rooting material - 50 gal. Cleary's Turf-Gro	300
Fertilizer - 1 ton of 13-25-12	420
Topdressing - 56 cu. yds. 1-1-1, Frenzer	980
Soil fumigation - Hendrix & Dail, Inc.	5,500
Sod - 8,450 sq.yds. Penneagle, Warren's	18,000
Plywood - 18 sheets 3/4 inch, 4 x 8 ft., CDX	330
Bluegrass sod - 375 sq. yds. for banks	400
Labor - 11 men, 1,228 man hours	6,000
	$33,155

$436. per 1000 square feet

$ 4.00 per square yard

REGRASSING OF SEVENTEEN GREENS (System 5, Maintenance)

Oscar L. Miles, Superintendent
Butler National Golf Club, Oak Brook, Illinois

Fumigation and Penneagle:

1980			
8	American Airlines (soil test sample flight)		$ 81.
8	Texas Agr. Exp. Station - soil test		60.
9	Brookside Laboratory fees		160.
7	Healy & Associates - experimentation		866.
9	Professional Turf Specialties - soil set		4,998.
8	Hendrix & Dail - Fumigation		5,793.
8	Sod removal labor		8,368.
9	Gardevator reseeding		1,300.
9	Dr. J. M. Duich - planning, consultation, supervising regrassing project		7,018
10	Vaughan Seed Co. - plastic for greens 1, 5, 13 & 15		574.
10	Lakeshore Sand Co. - topdressing		480.
10	Henry Fremzier - mix sand & peat (65-35) 48 yds.		480.
10	Paul Schmidt Trucking - haul sand		306.
8	Bob Williams - consultations		600.
10	H & E Sod Nursery		2,098.
8	Elmhurst Sand Co. - to fill aerifier holes (43 tons)		372.
10	Frenzer 64-35 mix - winter & spring topdressing		1,500.
	Clear plastic vented cover for No. 1 green		574.
		$ 35,632.	

Rebuilding #8 green and home putting green:

8	Oak Brook Landscape		41,000
9	Grounds department - labor for rolling, grading, seeding, raking & mulching		500.
		$ 41,500.	

Renovation and regrassing of fairways to Penneagle:

9	BoJo Supply - Aqua Gro and RoundUp		1,941.
9	Art Clesen - fertilizer		2,690.
9	Illinois Lawn Equipment - new equipment		4,686.
9	Paarlberg - fertilizer		4,457.
9	Vaughan Seed Co.		1,325.
10	Martin Implement - tractor rental		688.
10	Estimated additional labor costs of grounds for months of August through October		5,000.
		$ 19,787.	
	Total	$103,634.	

INSTALLING AND UPGRADING A PURR-WICK (System 9)

Lee Redman, Superintendent
Bellerive Country Club, St. Louis, Missouri

We decided on a rebuilding of No. 12 green. It was surrounded by trees, but the land adjacent to the green does not belong to the club. This rebuilding was done in October 1979. We had 300 tons of sand brought in and stockpiled near the green. The course had been designed by Robert Trent Jones and had been well accepted so our aim was to improve vertical drainage and reduce some contours. The green was built twenty years ago. The gravel base had no outflow and excess wetness persisted as indicated by gray-black soil and a gray area in the topmix about four inches below the surface. The soil mix varied over the green, and poor root aeration was common.

We staked the perimeter, marked our fill and cut areas. We rented equipment to do the major earth removal. We raised the front apron and edge of the green about 18 inches and hauled the remaining unwanted soil away. Because of the encroaching vigorous bermudagrass we stripped a few feet around the green and later replaced those areas with zoysia. A swale above the green was deepened to better divert the water coming from above the green. We agreed on a 14-inch depth of Mississippi River sand. We established the 14-inch high baffles with wood stakes, using a 1 x 4" board along the top. The Purr-Wick plan was for six compartments using five internal dividers. We made the outer berm at least 16 inches high and smoothed the subgrade to contour. Our total slopes from front to back was three feet so each unit allowed six inches change in surface.

We laid the 4 mil plastic barrier and glued the 40 foot sheet together. Drain tubes were laid level along each divider and extended to drain pits. Possibly the biggest problem in building our Purr-Wick was getting the sand piled evenly on both sides of the divider. This requires extra hand work and close supervision.

A front end loader was used to fill tiers, but then hand work was required to finish placement of the sand. We brought in 200 tons of sand onto the front and, using a track piece of equipment, pushed sand across the green. We used the tractor equipment to establish the edges and to clean up. Our exit drains were run to boxes, which were established on grade. The seal for going through the plastic used two plexiglass flanges with two inch holes cut in them. These fitted onto a male and female two-inch PVC coupler. Soft caulking was applied to sides of the plexiglass, then the coupler was hand screwed for a tight seal.

The narrow slitted plastic tubing was not available so we substituted the larger slitted pipe and wrapped it with fiberglass cloth which was taped at intervals. We had some experience using that material in sand traps with good results.

Risers were cut and loosely sealed so each can be modified as needed. After the sand was on the green we exposed each internal divider and cut the plastic and removed each board and the support stakes, thus leaving two pieces of plastic, side by side, vertically. We applied fertilizer and a one-inch layer, or 75 cubic feet of sphagnum peat moss which was fluffy and could be mixed in with sand trap rakes.

We seeded 1.5 pounds per 100 square feet of Penncross and packed all with the sand pro wheels to help stabilize the seed. Two weeks following seeding we could see greener areas across the green which were determined to be areas just above the line of the internal dividers. We mowed after four weeks, and two months later were into the winter with five inches of roots.

In the spring of 1980 the area pattern was less distinct but unequal water retention was evident. After rains the upper four tiers would lose reserve water (in risers) within 24 hours, but the two lowest tiers would waste water for 48 hours. Anaerobic conditions were evident in lower tiers so the lower risers were removed. The siphoning of water through the sand, over the plastic dividers, was severe and undesirable. In October, Dr. Daniel recommended that we expose the buried vertical plastic dividers and extend additional plastic to the surface. In early November a wedge of sod and topmix was lifted vertically by two men using straight shovels and working opposite each other. The plastic dividers were found from two to eight inches below the surface. A vertical strip was inserted bewteen the existing dividers and extended to the surface (along one wall), then the sod wedge was replaced in exact order and tamped. The excess plastic was cut even with the turf surface. It required three men two days to extend the five internal dividers and some perimeter edges to the turf surface. Our tests last fall showed water retention in all six compartments. The ultimate is equal water retention and evapotranspiration, thus the least irrigation and management tedium.

Our material cost for complete removal of the green rootzone and replacement used 500 tons of sand which was $6.00 per ton delivered. Our total cost was less than $9,000.00 for replacement of the green.

Editor's Note:

All Purr-Wicks should have internal vertical dividers extended to the surface.

In new construction, the dividers are continuous grade stakes for the final grade. At the 1981 Turf Conference, Larry Runyon of El Paso Country Club, Texas, (who built 50 Purr-Wicks while in Kansas City) thought of and expressed a new idea on internal dividers. He suggested shaping the subgrade and outer berm as before, then laying the plastic barrier over the bottom and extended up the outer berm. Fill all sand to grade, add enrichment, and make final topmix to final grade. Then, survey the surface along six-inch contours, shovel the topmix to one side, then lay extra strips of plastic and shovel a column of sand onto it. Expose the bottom barrier, lay in a strip of plastic, lay a soft caulk line and tape lower edge to cleaned bottom barrier for seal. Place drain tube along bottom barrier and replace sand with packing and finally the topmix to grade. Water settle the entire area, trim vertical plastic along the surface and plant. This permits all tedious work to be done from the surface down and allows faster installation. Try it!

CONSTRUCTION OF THE USGA GREEN BY THE SUPERINTENDENT (System 5)

Louis E. Miller, Louisville Country Club
Louisville, Kentucky

Of the many various methods of construction used to build a putting green, the USGA method is probably the most accepted as being the "successful" way to properly construct a green. The method of layering has been refined and tested for a number of years, and if all of the proper steps are followed in the right sequence, then a correctly built green with many years of service should result

If you are considering rebuilding one green or your entire course, then the first step is to acquire the services of a competent golf course architect. I have seen too many greens that have been designed by the superintendent or the greens committee that have been disasters. In our particular case, we secured the services of David Pfaff, whose work was quite reputable. His design kept the existing character of the course, yet gave an innovative flare to the new greens to be built. His job was finished when the blueprints were finally approved.

A committee was established consisting of the superintendent, golf pro, and two members of the greens committee. Once the board of directors had approved the construction of three of the greens it was the job of the committee to work with and approve the design of the architect. This project was to be done over a period of six years, by doing three greens each year.

As soon as the board approved the project we began mixing our topmix. In wanting to stay away from any soil at all, we sent samples of the sand and peat to Texas A&M for analysis. Their recommendation was to use eighty percent of the sand, which was classified as a medium wash, and twenty percent of the Milburn peat. This material had a percolation rate of 7.4 inches per hour. We mixed off-site, starting in June, using two front end loaders and a Lindig soil shredder. We found that two men could mix about one hundred tons in a six hour day. The high sand content made it necessary to clean and change the oil on the breathers and crankcases of all equipment used each day. We were able to mix two thousand tons in about one month's time.

Our target day for construction was set for the day after Labor Day. Arrangements had been made three months in advance for a track type high lift and a backhoe. A rule of thumb here is that you can budget about three days for the high lift and one day for the backhoe per green if the operators have done this type of work before.

The sod was removed from the green the morning that the construction was started and used to establish a temporary putting green. This lessened the shock to the membership and gave them a satisfactory surface to putt on during the construction.

As to the staking and gradework, this should be handled by the superintendent. Using a transit properly is part of his professional requirements. The two main stakes to be considered throughout the construction are the center stake and the backsight stake which is established in the center of the fairway. The backsight stake is absolutely essential in that it allows the green to be properly oriented with the fairway. If a cut or fill is required then the center stake and four others will suffice until a rough grade is reached. The green can then be staked on sixteen points with the proper grade marked on each stake. This just speeds things up for the operator.

The base grade of the new green should roughly conform to the finish grade, except that it will be eighteen inches deeper. Once the base grade is established, the next step is to install the tile lines. In our case the design of the tile system varied with each green, with a minimum spacing of twelve feet and a maximum of twenty. The main thing to keep in mind is that they all have the proper fall. We used four inch ADS plastic perforated tile with a half inch gravel to bed and cover the pipe. During the tiling phase of the greens, I would move to the next green site with the heavy equipment and my assistant would take over the installation of the tile. This necessitates the use of two transits or at least one transit and a level. A transit with a plumb line and full vertical adjustment on the instrument will be required for the stake work on the green. A level will suffice for checking the grade work on the tile installation. The soil taken from the tile trenches can be slightly mounded between the lines and rolled with a power roller. This speeds up the flow of the water to the tile lines while draining. Once the lines are installed, a series of grade stakes can be driven into the base grade. Ten to twelve stakes will be enough. Come up four inches from the base grade, and using a felt tip marker, draw a line around the stake. This will be the four inch grade for the gravel bed. Come up two more inches and draw another line of another color and this will act as the grade line for the two inch buffer layer of coarse sand between the gravel bed and the final mix. Come up twelve more inches and draw another line which will be a "rough" final grade line for the green mix iteself. These lines speed up the filling process.

The gravel bed can be spread by one operator using a tractor with a blade or grader box and a laborer to hand rake the tight spots next to the edge and around the stakes. The gravel can be trucked right to the green.

The coarse sand blanket can be spread in the same manner as the gravel blanket. A spot check from time to time by the superintendent helps insure the quality. A sandtrap rake is an ideal tool to level the sand blanket, especially when working around the grade stakes.

By this time the work force and the entire project is going to be spread pretty far. The superintendent and heavy equipment will be working on the last green or the third green, depending upon how many you plan on doing. The tiling crew, run by the assistant, should be working on the second green, and the operator and laborer spreading the gravel and coarse sand will be working on the first green. Once you get spread out like this, there is a tendency to pick a couple of the men from your regular crew to help with the construction. Don't make the mistake of letting the routine maintenance on the course go simply for the sake of the construction. You still have a primary obligation to provide as good a condition as possible to the membership. If this declines, then you open yourself and everyone involved to criticism. If you need a couple of extra men, then hire them. You should have added at least a ten percent contingency fund to the total construction budget anyway. Things such as old water lines, and tile lines, along with existing irrigation lines and wires will have to be contended with. One good bite with a backhoe into a couple of dozen irrigation wires can put havoc into your day. It is the quality of a good supervisor to be able to handle these contingencies as efficiently as possible.

The irrigation to the green can be installed by a crew of three men in a day. The size and amount of pipe, heads, valves and swingjoints can be ordered well in advance. The most important part is the proper spacing of the irrigation heads. Your might want to consider using some part circle sprinklers, especially around

the sandtraps, because the USGA green does require more water than one of a heavy clay construction, and there is no need to water the sand traps. A small, wheel-type trencher with a thirty-six inch boom and a four inch cutting width will be sufficient. The back-filling can be done easily with a tractor and a blade. Once the heads are in, it is a good idea to stake them. We found that we can work the irrigation in with the tiling. Here again it strings the work out even more, so you find yourself constantly checking on the progress or lack of it. We are fortunate that we have a two-way radio system on several pieces of equipment, and a lot of small problems can be handled over the radio.

The backhoe can start putting in the sandtraps when the highlift has just about finished the earthwork on the second green. If the trap is extremely large, then the highlift can help in the excavation. The finish work can be left to the backhoe. After staking the traps we have found that if sections of irrigation hose are laid around the stakes then it gives the exact design of the trap with all of the curves,and makes it easier on the backhoe operator. The type of backhoe used has an added attachment called an "Adjust-A-Bucket". This is a smooth bucket attachment with an extra hydraulic cylinder that permits the bucket to swing one hundred and eighty degrees horizontally, and the operator can follow the design of the trap, curves and all. A good operator can also drain the bottom the trap into one area. A tile line should be installed from the trap and then joined into the main tile line exiting from the green. If the trap is above the green, then the tile from the trap can be tied into the tile system of the green. When exiting the green with the main tile line, try and get it away from the green as far as possible.

Filling the green is probably the largest single phase of the operation. Here is when you get on the phone and use the "beg, borrow, and steal" method and round up four or five dump trucks from nearby courses. All of the clubs in our area have been most generous, and often send an operator for a day or two. Two front end loaders can keep the trucks filled, especially after they get spread out traveling from the mix area to the green site. A small track type of highlift is ideal for handling the mix and spreading it onto the new greens. We usually rent a Case 350 for this job, and it handles the material well, and also does an excellent job of compacting. Once we get some fill on the green, the dump trucks drive onto the fill area and dump. We never have had any problem with compaction with the trucks on the green. With any kind of luck you can fill two greens in an eight hour day. Remember those grade stakes that you put in earlier? Once you have reached grade line on them they can be pulled. It will be necessary to have a transit set up to check the final contours on the green, and you can expect to take about four hours per green putting in the final contours using the track type highlift and a tractor with a grade box. Once the contours have been established, then get the committee together to make sure that everybody involved agrees with the final shape of the greens.

The next step is to incorporate the starter fertilizer and seed the putting surface. We used Penncross bent at two pounds per thousand. The seed was weighed out and applied in three directions to insure good coverage. We have had our best results with lightly raking the surface after seeding, and then rolling it. The green and sandtraps are then rimmed with two widths of sod. This helps to define both and helps keep the proper design.

All that remains now is to grade the banks and surrounding area and prepare the final seed bed. Add the starter fertilizer and the seed and mulch everything except the putting surface. The only thing left to do now is turn on the water. If you have any kind of favorable fall weather at all, then you can expect to see germination in five to seven days. We hold off on putting the white sand in the traps until some time during the winter.

The next step is to straighten up any ruts or damage caused by the trucks during the construction, and believe me, you will have some. Some time with a disc and a rake and some seed and mulch, and the problem is solved.

We have been involved with constructing the perched intimate-mix type of green for three years, and are more than satisfied with the results. If you plan this type of construction as far in advance as possible, it will eliminate a lot of problems. It can be done smoothly and rapidly. The last four greens that we built took twenty-two working days from start to finish, which averages out to five and one-half days per green at a cost of $1.29 per square foot. This cost figure includes everything down to the white sand in the traps.

If you are going to take the time to build a green, then do it right the first time.

THIN LAYER ROOTZONES (System 7a)

Donald J. Fassnacht, Superintendent
Elks Country Club, Lafayette, Indiana

One fast method for reconstruction of a golf green is the "Thin Layer Rootzone" soil structure. During the summer of 1980 severe weather conditions of high temperature and humidity took their toll on the Lafayette Elks No. 10 green. The soil composition of this green was a heavily compacted clay soil, having poor aeration and porosity. It was also located in an area where there was very little air movement. The triplex grass mowers added more compaction and specific wear patterns to the already compacted soil. As a consequence, steep slopes, poor drainage, and diseases inevitably cause the green to die out during the hot summer months of July and August.

A superintendent facing this situation has three options. The first is to completely ignore the problem at hand, which would result in many complaints from the golfers. The second is the possibility of adapting management practices to reduce or stabilize the problems which exist. The third option is complete renovation.

When a decision to renovate has been made, one must choose the proper method of renovation which fits the character of the course and your budget and the feasibility of doing the renovation during the available time period. In building or reconstructing a green, there are several different methods from which to choose, such as a Purr-Wick System, a perched water table, or a layered rootzone. The circumstances involved in the decision that was made by the Elks Country Club were typical of most private golf courses in the United States. Renovation of the No. 10 green must be done within a budget of $4,400.00, and in the time period from late fall to the next spring, when the green must be ready for play.

The layered rootzone concept seemed to be the most logical solution. This rootzone is created with a mixture of sand and peat over a layer of clean sand which in turn is over a contoured subgrade. Good drainage as well as a fast and economical installation are the chief advantages of this system.

The thin layered rootzone system consists of three parts that have specific roles which enable the system to produce the desired rootzone characteristic. The first part is the drainage system which consists of two-inch narrow slitted plastic drain tile placed in the contours of the subgrade to expedite the removal of excess water. The quick movement of water out of the base of this rootzone will promote good aeration and increase activity of aerobic organisms, which make more nutrients available. Good drainage also allows for better greenup of the turf in the spring because drier soils warm up faster than wet soils. Good drainage also helps reduce disease problems.

The second part of this system is a layer of clean sand placed over the drain tiles spread to a uniform depth of three inches over the subgrade. The type of sand we used was the #3 masonry sand from a local distributor. It is desirable that the sand be of uniform particle size. This allows for constant water retention throughout the sand layer; it also allows for better root penetration for the turfgrass plants. It reduces compaction and increase aeration porosity for nutrient and water exchanges. The sand with its large pore space is also able to handle the irrigation requirements by providing adequate percolation of the water from the surface of the green, thus eliminating water pockets on the green.

The third part of the system is the topmix which is comprised of a selected sand and peat mixture that will give a suitable rooting medium for the turfgrass plants. Adding a mixture of 75% sand and 25% peat will achieve an infiltration and percolation capacity of four to six inches per hour. Generally a three to ten inch per hour rate is considered adequate. The addition of the peat will aid in the nutrient and water retention. The peat also adds resiliency and structure to this top layer of soil.

It was for the previously mentioned reasons that the Lafayette Elks Board of Directors decided to approve the renovation of the number 10 green according to the design and proposal submitted to them by Dr. Daniel and myself. It was approved on October 17, 1980, and we started the reconstruction on October 20.

The construction procedure called for five days to complete the project. On the first day the revised outline of the green was marked by paint and was followed by the removal of one strip of sod around the entire reconstruction area. The four sprinklers were moved and equalized around the enlarged green. We also removed some of the good sod and expanded the eleventh green. The entire area was rotivated and disced four times. On the second day a grader blade on our tractor and our sand pro was used to grade the existing topmix to the new elevations. The sand and peat were hauled into the parking lot where it was mixed 75% sand and 25% peat. On the third day the green was trenched (five lines), the drains placed, and the layer of clean sand was hauled in and graded to provide a uniform three-inch layer. On the fourth day the topmix was hauled in, leveled and graded to the final elevations with our sand pro. The depth of the topmix ranged from three to five inches. Also on the fourth day we built a small sand trap to the right of the green. On the fifth day, October 24, we put the final grade on the green, and then seeded with Penncross seed.

We finished seeding just as it began to rain, and that shower provided an inch of rain with no washing of any soil, so the project was off to a good start. On the next day we covered the green with clear palstic in which we had punched holes with a Greensaire. With the help of the plastic,we saw seedlings emerging after nine days (November 2), and three weeks after planting we had a nice cover.

Overall, we used 200 tons of sand, 40 cubic yards of peat, 1,000 feet of two inch slitted plastic drain tile, 20 pounds of Penncross grassseed. These materials cost us approximately $2,400.00. The heavy equipment and operators used were: a highlift, a dump truck, and a crawler grader. The cost, approximately $2,000.00. Therefore, the total cost of the project, excluding labor, was $4,400.00. There was a total of 160 manhours used to build the green. The cost of this labor was $960.00, giving a total cost to rebuild No. 10 green - $5,360.00.

On February 13, 1981, after having some unseasonably warm temperatures, we removed the plastic covering from the green. The overall view of the green was good. There was a uniform cover of grass. There were also several patches of disease which seemed to be snow mold. We sprayed the green with Tersan SP which stopped the spread of the disease. We replaced the cover for a few days, then we removed it, and mowed.

Overall, the project went very smoothly.. We hope to reopen the green before June.

VERTICAL DRAINAGE IMPROVEMENT (System 2)

Steve Nichter, Superintendent
Greenhurst Country Club, Auburn, Indiana

We have seven greens on our golf course where surface pockets collected excess water during heavy rains and restricted surface run-off. A high content of clay in the topmix and subsoil restricted water percolation, leaving us with poor turf quality.

After inspecting our problem greens, Dr. Daniel recommended the following: Tile the pocket areas with two-inch narrow slitted drain pipe and begin removing cores when aerifying, followed by heavy topdressing with No. 17 mason sand.

The tiling process was as follows: A transit was used to determine the direction the tile should run, taking into consideration all the pocket areas. Paint was then used to make the tile run. The afternoon prior to trenching a strip of sod was removed for each drain. The next morning, as we trenched, the soil was removed with scoop shovels and trucksters. Two inch narrow slitted rain pipe was laid, and again a transit was set up to confirm a uniform grade. The trench was then filled with No. 17 mason sand, the same material we are using for topdressing. The trench was soaked thoroughly to settle the sand completely. Low areas were filled and excess sand was removed. We soaked the trench a second time before replacing the sod.

Since we had no existing tile in the area to drain into, we dug a hole 3' x 4' and ran the tile into it. The hole was filled with stone, and a layer of plastic was placed between the stone and the top soil. We felt the plastic would help prevent soil leaching into the stone.

After three weeks we aerified, removing the cores and filled the holes with No. 17 mason sand. This improved water penetration considerably.

Breakdown of cost per green:

Trencher - one day rental	$ 60.00
250 ft. of tile @ 25¢/ft.	62.50
5 tons No. 17 mason sand @ $5.00/ton	25.00
Labor, 3 men, 12 hr. ea. @ $4.45/hr.	120.60
	$268.10

Editor's Note:

The Cambridge System (Cambridge Soil Services of America, Glencoe, Alabama) of vertical drainage is worthy of mentioning after vertical trenching has been installed.

A machine is available to make slits nine inches deep and one-half inch wide and to fill each with sand. A second machine makes grooves four inches deep and one-quarter inch wide, and fills these with sand. The machines vibrate as they travel, and get best results when dried sand is available. Continued core aerifying and sand topdressing are also encouraged.

SAND TOPDRESSING UP-DATE

Marvin Laird, Superintendent
Lincoln Greens Golf Course, Springfield, Illinois

Our course is approximately twenty-five years old, and the greens are a mixture of soil, sand, and peat. Depending on the weather, we have from 43,000 to 50,000 rounds of golf per year.

Our reason for going to a sand topdressing program was to try to eliminate the problems of hard greens that didn't take water well, and didn't hold up very well under high traffic and hot weather.

Beginning in June 1978, our initial heavy sanding was as follows: we aerified the greens with a Greensaire equipped with 5/8 spoons. The plugs were raked and loaded by hand and removed. We applied the sand with a Cushman truckster with a mounted drag belt type topdressing machine. We applied 100 tons of sand on twenty greens when we started the program. As soon as the sand was applied we started brushing it in with a Toro Sand Pro with a Jake Green mower bush mounted on the back. We brushed the sand until it was dry. At this time the holes were about half filled. We then tried to use a power sweep to rake the rest of the sand in, but this didn't work at all. The next step was to try to wash the sand in with a water hose. That didn't work either.

We then started brushing the sand in with hand push brooms. It was a lot of work, but the results were good. With six to eight men we could only complete about three greens per day. The temperature was over 90 degrees every day we worked on the project, and we had no damage or wilt from the heat.

Since that time our light topdressing program is as follows: We apply about 200 pounds of sand per 1000 square feet approximately every three weeks, depending on how fast the greens are growing. We apply the sand with a Lely spreader equipped with a Mass Feed Ring set wide open, and turf tires, and pulled with a Cushman truckster. One problem is that the sand will not slide down inside the spreader, and someone must ride the spreader and keep poking the sand down to keep it spreading. The amount of sand applied and the sand spread pattern can be changed by the speed. Usually about four passes over a 6000 square foot green is enough. The sand needs about one half hour to dry and then we brush it in with the Sand Pro and the brush. As soon as the sand is brushed in there is little sign of any sand, and it doesn't interfere with play.

The program began in 1978. As 1981 begins the sand topdressing program has worked for us even better than we hoped. Our greens seem to be in much better condition.

Another sand project (System 7a):

In June of '78 we constructed a practice green by removing the sod from an area and putting sand about six inches thick, and then sodding the green with C-7 Cohansey bentgrass. For about three weeks the green seemed too mushy, but then firmed up, and has been in good shape since. It doesn't require as much water as the other greens.

Deep Sand Green - Bunn Park Golf Course, Springfield, Illinois, (System 7a)
Ron Miller, Superintendent

Bunn Park Golf Course had a green that had been rebuilt about five years ago. It was constructed from black gumbo, sand and peat. It was so hard a Ryan aerifier would not penetrate the green without extra weight on the machine.

In October of 1980, Ron removed the sod from the green, used an end loader and dump truck and removed approximately one foot of soil from the green and replaced it with one foot of fine sand. He relaid the sod, and two weeks later reopened the green for play. Early results were very encouraging.

NEMATODES, UGH!

Orville Dicks, Quincy, Illinois

My comments today will hopefully be a warning to you about a creature you may look for in coming years. This creature creates headaches. The GCSAA pesticide manual describes the nematode as a small thread-like animal which averages about 1/25th of an inch in size, and normally lives in the soil. They live as both parasite and non-parasite on plants. The plant parasitic nematode feeds primarily on the root system of the plant, using a specialized mouth part called stylet to penetrate the root cells. They secrete a digestive enzyme into the plant. Then the nematode withdraws the partially digested cell content. If a large number of nematodes is feeding on the root system in a small area, the function of that root can be completely destroyed. The apparent symptoms of nematodes are similar in appearance to that of drought symptoms. The plant affected by nematodes loses its ability to take up water and nutrients. The plant color changes from a dark to a light green, and it dies.

This description is more than adequate, for most of you have not been bothered by the organism. During the summer of 1980 we experienced record highs in temperatures, prolonged periods of drought, and sustained periods of unbearable humidity. Accompanying these extremes were Pythium, dollar spot, Helminthosporium fusarium, and the new disease seen in the Chicago area on C-15. Some had the added good fortune of being introduced to the mystical nematode.

Geographically, Quincy is located in west-central Illinois on the bluffs overlooking the Mississippi Rover. We are more than one hundred miles north of St. Louis, but our temperature and humidity levels are comparable. At the end of June our temperatures typically range from 70° at night to 90° during the day and the humidity ranges from 50 to 75%. During the first week in July, we experienced a warming trend in both day and night temperatures. Then the hot spell started when the temperature reached 105° the first week in July. For the next twenty days the afternoon temperatures ranged from 98-108 degrees. Nighttime temperatures offered little relief as they averaged 80 degrees. Humidity levels remained at 70-90 percent.

The first areas to show stress were those around greens. The symptoms included dark spotting of the spike marks in the early morning, progressing to a yellowing by mid-afternoon, and to a withering and dead condition by late afternoon. To contol this we initiated a program of early morning hand watering of these seemingly localized dry areas. In accordance with the weather conditions, we intensified our fungicide program, reduced night watering to a minimum, increased afternoon syringing, raised the height of cut of the mowers, and reduced frequency of mowing. During the week of July 7-14 several greens became affected. The areas on the green first affected showed symptoms between old aerifier holes. As these areas yellowed, withered and died, they expanded and coalesced into large areas of dead turf. Plant and soil samples from the affected areas were sent to the University of Illinois Plant Disease Clinic. The University specialist diagnosed the problem as Pythium on July 16, based on weather conditions, physical symptoms he had seen, and the massive turf loss in such a short period. During the next two weeks all greens were affected, and the ultimate result was dead turf. Test results of July 23 determined there was no plant disease in the plugs they tested. Further tests showed those samples had high nematode counts with levels ranging from 200 to 500. Researchers indicate that an excess of 25 per 100 cc of soil merit chemical treatment.

Five days later the nematicide, Nemicure 15G, was applied, and the results were almost immediate. Three days later symptoms of stress on the remaining turf disappeared. The final result from this encounter with nematodes was the loss of fourteen greens, a massive fall regrassing program, and the dismissal of this certified golf course superintendent, who has come a long way in his knowledge of diseases, insects and other organisms. The nematode organism is not new to science, but little is known of it as related to the turfgrass plant.

WATER SUPPLIES AND MANAGEMENT

Oscar Miles, Superintendent
Butler National Golf Course, Oak Brook, Illinois

We have been hearing a lot about putting water on the golf course. My concern is the quality of water we are using as it is related to the situation we had last fall after we had seeded the greens. We realized after watering we could see a yellowing of the turf and a limp condition of the grass. After it had rained, however, there was a dramatic improvement in color and turgidity of the plant. In an effort to determine the cause of our problem, we had the soils of both greens and tees tested to see if there was an imbalance. Then we began to study the water.

We have a report from our water commission on the ppm of magnesium sulfate, common salts, the chlorides, and boron. Findings from our local Brookside Laboratory were compared with the findings of a testing company in Chicago for content of calcium, magnesium, sodium iron, boron and sulfates, chlorides, carbonates, pH and conductivity. To determine the pounds of minerals applied per acre, for one acre foot of water, multiply the ppm by 2.7. For one inch of water the factor is near 0.22.

The water management staff at Purdue University helped me to evaluate our water supply. Water quality is judged on hardness and other factors. First we checked to see what silt factors were involved, particularly if the water source is lake or creek. Another area is industrial waste or chemicals from manufacturing plants. Our Salt Creek water quality is poor. It contains some bacteria, not at harmful levels, but it is high in salts. The hazardous part of the salts is the sodium. Our well pumps 135 ppm salt into our irrigation supply lake. Annually we use 22 inches of irrigation on fairways. Salinity is judged by electrical conductivity and rates from 1 - low, to 4 - high. The particular water we have is classified as C3S1. C-3,a high salinity water is not recommended for soils with restricted drainage. S-1 rated water is not a serious problem, but the salinity condition could be serious. Even with adequate drainage, special management for salinity control may be required. Salt tolerant plants should be chosen.

We are trying to determine how Penneagle bentgrass, which we have just planted, will react to the water with high salt content. We are alert to study our total management program and learn how best to use this available water until a different source is available.

We have two sources of surface water available to us. Teel Lake, on the adjacent property, is a good, low conductivity source of water. That is the area where McDonald is going to build a new lodge and hamburger university. They are planning to put in two large lagoons where our maintenance shop now is - potentially a new source of water for us.

We took plugs from the center of a Penneagle green, began to water three plugs with each of four sources of available water. We learned the nitrate level from one water source actually increased the vigor of the grass, but when we added fertilizer we found that was the first area of grass to die. This was an informative study.

Our fertilizer program will include some applications of gypsum because it has soluble calcium which will help to replace the harmful sodium that is in our soil. We will also add light applications of sulfur to reduce the pH. In our water management, we must maintain adequate moisture levels at all times which may require some hand watering. We should use fertilizers that have a low salt index. We are going to measure moisture retention. We will continue to take soil samples to determine the electrical conductivity. It may be necessary to flood the green periodically to reduce the salts. We need to know the bentgrass tolerance to salts. The answer may be to change our water source.

WATER SUPPLIES AND MANAGEMENT, ADDITIONAL COMMENTS

William Lindley, Consulting Engineer
Hinsdale, Illinois

My special interest is surface water drainage and storm water management. This prepared tape refers to urbanization, but it can be applicable to your golf course facility. Most golf courses are located in relatively highly urbanized areas. Many golf courses are located in areas that could be considered flood plains. Storm water on a golf course should be managed as if it were an urban development. We want to have the benefits of surface water. We have all heard that rain water is more beneficial to house plants than well water. That is because the rain water carries very little mineral content. Surface runoff from storms accumulates in the streams and lakes. This provides a suitable source of water for your golf course irrigation system.

However, there are also some problems because in an urban area, the quality of water is not high. The two streams that Oscar mentioned, one of which drains a 24 square mile area that includes three sewage treatment facilities that discharge effluent into the stream. Above that are communities with roadways that produce heavy metal discharge. One of the chief offenders of stream pollution comes from home water softeners. The soft water systems are designed to remove the salts from the home system, and it is then discharged into the streams, resulting in high concentrations of unwanted material.

The ability of the land to absorb and channel rain water harmlessly into our streams and rivers is nature's regulator against disaster. In recent years, nature is having to contend with new and powerful forces in its hydraulic cycles, forces that can change a thundershower here into a flash flood a few miles away. In the old days, muddy streets were a nuisance, and we waited for the moisture to evaporate. That problem was solved by paved streets and storm sewers, large systems of pipes under the ground, to carry the rain water away to some distant place. By the time of the housing boom after World War II, many areas had regulations requiring storm sewers, based on the assumption that now we must not leave rain water standing. It was very expensive. It took us years to notice that we had created a new set of problems. Nature had allowed this water to soak back into the earth, but we were hurrying it away. In many places the water table began to drop sharply. The results have been massive uncontrolled erosion, carrying away valuable topsoil and leaving the earth bare. But the worst problems occur miles away. Rain falls on the communities upstream, the water is collected and developed into a flood. Floods cost us hundreds of lives and billions of dollars in property damage each year. Many of these floods are our own doing.

Here is a study that provides a new and better approach. The basic idea is simply this. Before construction, find out how fast water flows off the site of a new housing development. After construction, water should flow off the site at the same rate, not faster. The site is first analyzed and data gathered: How much rain falls here? What is a typical storm? What is the worst storm that can be expected? And most important, How does water flow off the site? through what channels, and where does it go? The entire development plan is then influenced by this information. The designer tries to preserve the natural terrain as he decides where streets and homesites will be placed. The natural flow of water will be changed as little as possible. The plan must allow for the rare severe storm, as well as the frequent minor ones. He must consider how his plan will fit into the basic plan of the wide region. Sedimentation and drainage ponds are created to collect water runoff during construction. Some of the ponds will later be filled in, but others will become permanent features. In the finished development, many details contribute to the slowing down of the water runoff during and after a rain. The goal has been to avoid the idea of 'hurry and get rid of it'. When water stands on home lots and open spaces for a while it soaks into the earth, helps to irrigate the grass and plants, and seeps down into the water table. Building roofs can be built to pond water temporarily, letting the roof become part of the overall drainage scheme. Parking lots can be built with a gentle slope where water can pond inta little used area for a time after a rain and then drain slowly. In a well planned system, much of the water flows downhill in much the same pattern it always has, but now the paths are built in permanently. Along the way more seepage takes place. Drainage ponds or lakes add to the natural beauty of the development which serve other functions as irrigation, sedimentation, and infiltration to the water table. This new approach to storm water management offers a bright outlook to each of the people it affects. For the developer it means substantial savings over the costs of a traditional expensive storm water system. This is in part offset by higher design costs, but there is still a significant difference that can be passed on to the home owner. There will be some ponding on a lot after a rain, but this can mean less effort and expense in watering the lawn.

For the engineer, it means the acceptance of new ideas, and using a new, more up-to-date method. For the greater community, especially those areas downstream, this approach offers very significant benefits; less erosion, an improved water table, and most important of all, no increase in the hazards of flooding. For years we have been building whole new communities to meet the demands for new homes. We realize now that we have paved miles of earth unnecessarily, earth that water could once soak into. We have designed large and costly storm water systems to get rid of that water as fast as possible. Now we realize what problems that has caused. It has been harmful to the ecology, eroding land, silting rivers, and lowering the water table. It has led to recurring floods. The time has come for a new approach, one that cooperates with nature.

It is possible to construct a golf course to serve as part of that flow control project. One of the major drawbacks is the difficulty in growing grass in such areas. No one wants to have the responsibility for flood control on his project. There are successful projects on golf courses,with holding or regulatory ponds designed for collecting runoff or irrigation water. It is a critical matter as to where you place these reservoir facilities. You must have upstream water shed so you will have sufficient water to fill the reservoirs, adequate for irrigation demands when it isn't raining. Cart paths can be designed to help in regulating the flow of water across the course. Modified rip rap can be used to slow down the speed of water movement. Uncontrolled flow of water is damaging; massive erosion can occur in a short period if fast flowing water is left unchecked.

OLD AND NEW FUNGICIDES, TANK MIXES

Paul Sartoretto
W. A. Cleary Corporation, Somerset, New Jersey

The theme of this conference is "Old Ideas with New Applications" as exemplified by Bob Dunning, whose memory we are honoring. I knew Bob and his wife Inez personally and intimately. Let me way a word of praise for Inez, a loving wife who adored and admired Bob, and, having a fair amount of wealth, put it all on the line for Bob to pursue his interest in the turf management industry.

Monetarily, Bob put a lot more into this industry than he ever took out. His was a labor of love with only the satisfaction that golf course superintendents and lawn care people profited in wisdom and knowledge for having been associated with him.

One would find Bob and Inez consistently at turfgrass conferences from Oklahoma, to Purdue, to Michigan State, to Penn State, to Rutgers, and even Rhode Island, year after year.

Bob was quick to pick up new ideas, new chemicals, and new pieces of machinery and immediately implement them through Oklahoma. Within a few short years of becoming a distributor of W. A. Cleary, he became the second largest distributor in the entire United States.

I can remember his concern for the Oklahoma superintendents who had a chronic problem of silver crabgrass on their greens, and how he had picked up Dr. Ralph Engel's work at Rutgers one year showing preemergent control of silver crabgrass with granular chlordane. That's how fast he operated. Every single new product that looked promising was in the hand of Oklahoma superintendents before it appeared anywhere else in the country. That's how up-to-date he was on every aspect of research going on in the nation. It was indeed a pleasure to work with that man.

Back in the late 40's and early 50's, turfgrass research and development was just coming of age. The new insecticides were DDT, Lindane, Heptachlor, Chlordane. The new herbicides were 2,4-D, 2,4,5-T, DSMA, and the arsenates. Mallinckrodt had its reliable Calachlor and Cadminate; Cleary had its PMAS, and duPont had its reliable organo mercury and also Thiram. The mercurials were the best fungicides ever developed, but because of their solubility we soon found out they were hot to use and quickly dissipated, and mixing them with Thiram at lower rates enabled us to get safety and a few more days of protection.

What followed was a new breed of fungicides - mixtures. DuPont came out with Tersan OM, a mixture of mercury and thiram; Cleary followed with Thimer, a mixture of PMAS and Thiram; and Mallinckrodt produced Kromad, a mixture of Cadmium and Thiram. However, the smart, knowledgable superintendent saved money by tank mixing his own mercury or cadmium and thiram. Thus, the art of tank mixing was born.

TUCO was quick to recognize that their soluble actidione was also fugitive and short lived, formulating actidione plus PCNB and actidione plus Thiram to round out their line of fungicides. What followed in the next five years was the introduction into turf of farm chemicals such as Dyrene, Maneb-Zineb, and Daconil 2787, all of which were insoluble, wettable contact fungicides. It became evident to those of us experienced in the art of tank mixing that now we didn't have to rely solely on Thiram as the other ingredient in the spray tank to mix with the soluble fungicide. We could use a variety of mixtures.

I formulated two rules for tank mixing that are chemically sound:

Rule 1: Any number of insolubles can be tank mixed without incurring phytotoxicity. Isn't it logical to assume that if a chemical is insoluble it cannot burn the grass? The rule works.

Rule 2: Use only one soluble at a time at the recommended rate. But, if two solubles are used, cut the rate of each in half. Or, if three solubles are used, cut the rates by thirds. These solubles can be used with any number of insolubles. Applying these two rules, the permutations and combinations are limitless.

The next breakthrough was the introduction of systemic fungicides such as 1991, 3336,and Fungo. They performed fantastically well for the first few years, and then resistant strains of fungi began to appear. But I had seen resistant strains develop before with cadmium and other organic fungicides as well as chlorinated hydrocarbon insecticides. Immediately I began to advocate tank mixing the systemics and not to rely solely on their single performance. A specific example: for dollarspot I have found that by mixing cadmium and a systemic, the cadmium will control the systemic resistant strain, and the systemic will control the cadmium resistant strain so that the mixture gives excellent control.

There are some new excellent fungicides coming to the forefront: RP26019, Bayleton, Ridimil, and Previcure. But I'm warning you that there are signs of resistant strains developing even among these new wonder fungicides. Please heed my advice; don't use them singly, but tank mix them in order to avoid the development of resistant strains.

You are aware that success comes from tank mixing post-emergence herbicides such as 2,4-D, MCPP, and Dicamba. You can buy the readymade mixture in the form of Trexsan or Trimec, or you can tank mix any two or three by using Rule 2. Mix any two solubles by cutting the rates in half or mix any three solubles by cutting the rates by thirds. At the University of Maryland, Dr. Doernoeden has achieved great success in substituting MCPA for 2,4-D in mixtures with MCPP and Dicamba. This work is in anticipation of a ban on 2,4-D, and it also fortifies the success of following Rule 2. Dr. Doernoeden concludes with this statement: "Single herbicides do not provide the effective level of broad spectrum weed control that is achieved through combining herbicides."

When thiophospate and carbamate insecticides were developed and implemented, EPA seized the opportunity to ban all chlorinated hydrocarbon insecticides. But now we are encountering severe resistant strains from the use of these easily biodegradable insecticides. Some recent work by Dr. Roscoe Randall at the University of Illinois has revealed the startling fact that mixtures of these insecticides are working fantastically well. He used a full rate of Dursban with only moderate insect control, and a full rate of Sevin gave only modest control, whereas a mixture of a half rate of Dursban and a half rate of Sevin gave excellent control.

Do you need further proof that tank mixing pesticides does provide better control and does result in a synergistic effect?

NEW FUNGICIDES, 1980

Donald H. Scott, Department of Botany & Plant Pathology
Purdue University, West Lafayette, Indiana

One of the most common or important diseases in the bluegrass lawn is the Helminthosporium, melting out, leafspot complex. The leafspot phase of the disease is relatively innocuous and doesn't cause many problems, but as the melting out stage occurs, close observation is required. A reddish cast is characteristic of this phase, with dark purple to black lesions on the leaves. At times they become tan in the center, but with a dark border.

In early spring or late fall, especially if we have cool wet conditions, stripe smut can be identified by yellow patches of turf with black stripes running lengthwise of the leaves. The spore of the fungus is the black powdery masses.

Dollarspot rarely causes problems in bluegrass, fescue or ryegrass lawns. It does appear occasionally. The lesions are typical, going across the leaf blade, with a dark border at either end.

When talking about lawn grass diseases we must include Fusarium blight. This is a hot soil, dry weather disease, resulting from stress. We are looking for a frog eye pattern in healthy grass in the center surrounded by dead ring. It can be detected by the serpentine pattern. In the Midwest we are talking primarily about a crown root rot problem with the Fusarium blight.

In the past couple of years we have had a problem evident in early spring and occasionally in late fall that has been misdiagnosed as Fusarium blight. That is rhizoctonia, brownpatch. This appears similar to Fusarium blight, with small circular areas, serpentine patterns. Look for the frog eye pattern. If this occurs early in spring or in late fall it is not Fusarium blight.

Red thread is another disease that shows up as small pockets, more commonly found in fescue than in bluegrass. This disease occurs during hot moist weather. Close observation indicates a fine red thread at the tip of the grass blade, thus the name.

Pythium is rarely a problem unless the area has just been overseeded with ryegrass. In hot humid weather, seedlings or mature ryegrass may show spots or sustain severe damage when well fertilized. Protective fungicide applications can prevent damage.

Now for some of the fungicides that you are or will be hearing about. Chipco 26091 has been on the market for a couple of years. Bayleton is now labeled but is limited in availability. Previcure and Ridimil, by Ciba Geigy, are new for Pythium control. A warning related to the use of most of these is the development of resistant strains of fungi.

Another fungicide is Vanguard, not labeled as yet, but should be in the hear future. Voloman is another that we'll talk more about later. BP3424, duPont's new chemical is still experimental. Lilly's 222, known as Lubrian, is not yet labeled for release.

Chipco 26019 looks very promising in the golf course industry. The common name for the product is Actidione. This is a 50% wettable powder. It is not a systemic, but a contact fungicide. It is very effective on dollarspot, brownpatch, Helminthosporium, and red leafspot (disease of bentgrass).

The compound Baylaton comes as a 25% wettable powder. Our tests with this indicate excellent results with dollarspot on bentgrass. This is a systemic compound effective against dollarspot, red thread, strip smut, brownpatch, rust, and it gives some control of Fusarium blight. This product is labeled and should be available in limited supply.

Previcure is a water soluble systemic designed for control of Pythium. As far as I know, it is the only water soluble systemic available. We experimented with this material a few years ago, and found it to be a potential preventer of Pythium. It needs to be applied prior to the appearance of the disease.

Ceba Geigy compound Ridimil is very expensive because of the great demand in the tobacco industry. It comes as both a 50% wettable powder and 2% E.C. It is a systemic, and is very effective in control of Pythium.

As with other products when used by themselves, the grasses quickly develop resistant strains of fungi. Ridimil has been used in the wheat fields of Europe for several years, but is now being taken off the market because of the resistant fungi strains that have developed. It is recommended when using Subdue to use it as a mixture with other products. Another Ciba Geigy product is Vanguard. You will see it listed as CGA64251. This is a systemic effective on dollarspot, brownpatch, Fusarium, strip smut, red thread, and with some control of Helminthosporium and snowmold.

TURF DISEASES VS CULTURAL PRACTICES

Bill Lyons, Lyons' Den Golf Course
Canal Fulton, Ohio

If there is any one turfgrass disease that will turn a young turn manager's hair white overnight, it has to be Pythium. It will damage both roots and leaves. Losses are fast, and as much as fifty percent of the turf has been lost in one hour.

The Turf Manager's pH Scale (compiled by Lyons) shows the turf disease harboring range to be pH 4.0 to pH 6.5 in both soil and thatch. We have observed pH much above 7.0 in the first inch of our Ohio sand greens, yet the thin layer of thatch growing thereon was pH 5.5. Some fungicides and fertilizers are making the thatch more acid, but there is a lot more acid rain filtering through the thatch than either of the above.

Each rainfall and snow were measured and tested at Lyons' Den Golf during 1980 for both acidity (pH) and nitrate nitrogen. Only once did we receive a neutral rain (pH 7.0). The spring rain testing pH 3.8 made all vegetation look sick on farms, lawns and gardens. Nitrate nitrogen tests showed low to medium in most tests but higher in rain from thunderstorms or snow.

"Most fungi, including those responsible for turfgrass diseases are favored by high acidity." say Dr. William Daniel and Dr. Ray Freeborg in their Turf Managers' Handbook. And further, "It has been reported that turfgrasses grown on soils with near neutral pH (7.0) are less susceptible to red thread, brownpatch and Pythium."

When fungicides were not available, the late Paul Truckenbrod, Sunny Brook Golf, Kent, Ohio, dusted his greens with hydrated lime late in the evening. He would then wash it off in the morning, and was successful in controlling many hot weather diseases.

Paul Williams, Agronomist, Grounds Manager, College of Wooster, Wooster, Ohio, observed that areas limed the previous fall had minimum Pythium. In their stadium turf where Pythium was a problem he found the nematode county very high. He sprayed with a nematacide and reduced the severity of Pythium. He also adds, "When I see crabgrass in our athletic fields I lime. Seems like the lower the pH, the more crabgrass."

Dr. Fred V. Grau reports, "In the late 50's the greens on an Omaha course were declining from a leafspot attack during extremely hot weather. One pound of spray lime (300 mesh) and two pounds of Powder Blue (UF) in five gallons of water per 1000 square feet checked the disease and allowed the grass to recover in spite of continued heat. There is no magic about it, but it worked then, and it works today." Lyons note: Very cheap, too.

One one course sprayed greens had no Pythium. Unsprayed ones were severely damaged.

Dan Getz, Superintendent at Fe' View Country Club, Orrville, Ohio, tested his greens with a small pH computer. Both thatch and soil read below pH 6.0. He applied 25 pounds of superfine dolomite lime per 1000 square feet. No Pythium in 1980 even though the greens are built on tight soil and many are shaded and have poor air drainage.

One superintendent applies ten pounds of superfine dolomite lime per 10,000 square feet to his fairways four time a year. A drop type spreader that will lay the lime on as uniform as paint on a wall is required for best results. He never gave acid rain a thought until we discussed it. He has no problem with Japanese beetles.

Half a fairway was limed at Lyons' Den in fall of 1979. It had a history of much disease. In 1980 this half was quite clean, yet the other half had occasional outbreaks. The adjacent fairway was limed, 2 tons per acre, acceptable turf all summer. There was a noticeable line at the edge of the fairway. The rough was clobbered with disease. The pH in that area was 5.5.

For a test in 1980 we treated parts of a few greens with 25 pounds of lime per 1000 square feet. There was a noticeable difference all season in those areas.

I am not recommending the elimination of fungicides from a turf management program. But all cultural practices have to be checked to see why the outbreak of disease.

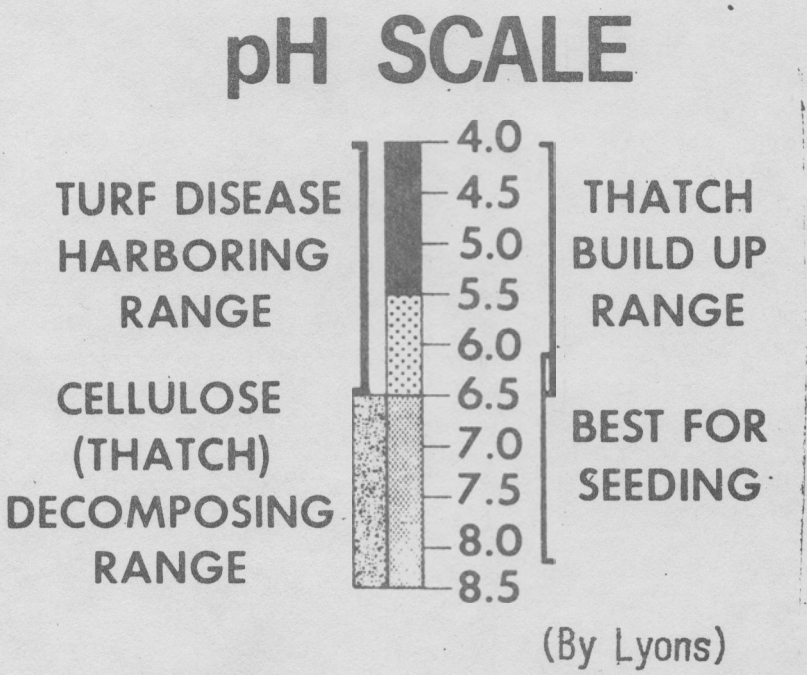
Has there been too much nitrogen without an equal amount of potassium sulfate? In the early 1940's, the late Dr. George N. Hoffer, Mid-Continent Director of the American Potash Institute, furnished the writer a quantity of potash which we applied in solution with N and P. When we kept the potash level in the juice of the clippings up to 2000 parts per million, we had less disease and a tougher, better wearing turf.

What about chlorosis? No problem. We find chelated iron usable when soil temperature is below 65°. After that, as soil temperatures go up we switch to 6 ounces of iron sulfate, along with 1/4 pound of urea (45% N) in not more than five gallons of water per 1000 square feet. Both chemicals feed through the leaves.

One of the side effects of liming is the control of Jap beetles. Our program for 1981 calls for aerifying all fairways by June 10. Soon after that we will apply 100 pounds of pulverized dolomite lime per 1000 square feet. Perhaps timing is important. The adult beetles emerge in late June. The lime may act as a deterrant to the female laying eggs in the limed area, or if she does it may kill the hatching larva. But we were successful once on nine and one half fairways.

About 1977 we had a fairway that was horrible, to say the least. The more tender loving care (TLC fertilizer) we gave it, the worse it got. Thatch was 1-1/2 inches deep. The pH in that thatch was as low as we could test, about 4.0. So our program (cultural) was to aerify four or more times over. Apply 100 pounds of superfine lime per 1000 square feet. Seed with only one pound of Manhattan rye per 1000, and ten pounds of 15-15-15 fertilizer. As soon as aerifier cores would crumble with finger pressure, we crumbled them with a Scotch harrow, smooth side down. Then watered and kept damp for ten days. The thatch layer was down to one-half inch by October 1st, and completely gone the following April. We do not use fungicides on fairways. We prefer this treatment when trouble strikes.

We never heard, in forty years of attending turf conferences, of anyone testing the pH of the thatch. So we developed a simple method of doing it, now sold as a Thatch Test Kit, Soil Lab., Purdue University.



THE EARLY YEARS OF ZOYSIA

Fred V. Grau
College Park, Maryland

My first look at zoysiagrass turf was in July 1931. I had graduated from the University of Nebraska in June, spent a month at the Midwest Turf Gardens in Chicago, then came to Washington, D.C., to assist with publication of the Bulletin and with research at the Arlington Turf Gardens. In one corner of the research area there were two 4' x 4' plots of zoysiagrass. One was Z. matrella from the Phillipines. The other was coarse Z. japonica. For the most part they were considered botanical curiosities with little practical value for lawn and golf course turf.

These grasses had to be established with sprigs. Seed was gathered in the Orient by hand stripping. It was of low quality and often heavily infested with ergot, a fungus disease. The prospects of poor seed, limited availability, uncertain germination plus the necessity of sprigging and slow establishment made the zoysiagrass a poor choice for almost any kind of use.

In 1933, when the Great Depression turned the economy around, interest in turf dropped virtually to zero. Everyone in the Green Section was dismissed (no money). I had finished my Master's degree and had started my PhD work on Maryland pastures. From 1933 to 1945, when I came to Beltsville as Director of the USGA Green Section, I hadn't given zoysiagrass a thought. But, someone in the USDA had been planting seeds of zoysia and making individual seedling selections. They had been established in small plots at the Arlington Turf Gardens. When the Pentagon was being built all that turf work had to go. Sods of all grasses were moved to Beltsville under the supervision of Dr. O. S. Aamodt, USDA. Thus it was that, in August 1945, I was priviliged to assume leadership in the development of the Beltsville Turf Gardens. There I saw, for the first time, the 4' x 4' plots of 150 Kentucky bluegrass selections, and 80 or more similar plots of zoysiagrass selections. What a challenge! Day after day I would do nothing but walk up and down those rows of plots wondering what could possibly be done with what was there. Time and close observation furnished the key.

During the summer of 1946, pronounced differences among the zoysiagrasses became apparent. Some developed rust. Their numbers were deleted on the chart. Others with undesirable characteristics also were deleted. The grass in one plot was so vigorous that the runners grew across a hard-packed dirt roadway on which our service vehicles traveled daily. That selection was considered too aggressive and potentially dangerous for turf use, especially on lawns and golf courses. Had we been oriented toward sports fields at that time we might have had a candidate for some of the Bowl arenas.

Evaluation of the zoysia selections was being made simultaneously with choosing the best bluegrass cultivar. Little by little it became apparent that the Z-52 zoysia selection was remarkably similar to the B-27 selection of Kentucky bluegrass. The similarity of these two grasses, one a warm-season grass, the other a cool-season grass, was emphasized by the differences at different seasons. B-27 was at its peak when Z-52 was dormant. When B-27 languished in the heat and humidity of Washington summers, Z-52 was at its best. Finally it occurred to me to try growing the two together to see if year-round turf could be achieved. The world learned

that we were successful. A sod of the Combination was exhibited at the Sixth International Grasslands Congress at Penn State in 1952. The August 1953 issue of the National Geographic magazine carried the story and a full page color picture. In 1950, the Z-52 selection of zoysiagrass was named 'Meyer' by the joint USDA/USGAGS committee on nomenclature. It honored the name of Frank N. Meyer, a USDA plant explorer who, in 1907, gathered seeds of zoysia in the Orient and sent them to the U. S. At the same time, B-27 Kentucky bluegrass was named 'Merion' after Merion Golf Club where the selection was found by Joe Valentine, golf course superintendent.

The use of Meyer zoysia for lawns began with my own lawn in College Park, Maryland. Here, too, began the practice of plugging to plant new areas. From this humble beginning there developed an industry that soon spread across the country, devoted mainly to lawns in the "transition belt".

In 1950, our Green Section staff arranged a joint venture with the Mid-Atlantic Association of Golf Course Superintendents. At the Fairfax Country Club in Virginia we planted an entire fairway to zoysia. An aerifier with one-inch spoons was used to create planting holes for sprigs and plugs. Bill Glover was the superintendent. He had seen the value of a warm-season grass for providing excellent playing turf during the height of the season when bluegrass-fescue turf was at its lowest ebb. He and I had started a patch of U-3 bermudagrass on a fairway which had done extremely well. For a time it looked as though U-3 would the the warm-season grass for the Mid-Atlantic area, but it was not to be. A severe winter and cold spring knocked U-3 out of the picture while Meyer zoysia was unharmed. That was a turning point of major proportions.

The Z-73 selection of zoysia was one that seemed to me to have great potential. It was faster growing than Z-52, had a pleasing texture, and was more open, which seemed to promise better compatibility with a cool-season grass for year-round green turf. One day we noticed that seedheads were forming so stopped mowing and let the seed develop. We calculated that the seed yield was on the order of 1800 pounds to the acre. We germinated these seeds and produced many flats of seedlings in the greenhouse. Seedlings and seed were shipped to cooperating universities and golf clubs in the U. S. Part of the zoysia research at Purdue had its origin in these shipments.

In 1953, Bob Shields, superintendent at Woodmont Country Club near Rockville, Maryland, gave me the chance to plant a fairway to U-3 sprigs. Here and there I inserted a seedling or a sprig of zoysia. The fairway filled and was a standout. When the U-3 died in the cold winter, the areas of zoysia stood out glaringly - not hurt at all. That helped to give zoysia for fairways a boost.

The front lawn at the Plant Industry Station at Beltsville, Maryland, was replanted to Alta fescue in 1947. I wanted Kentucky 31, but there was not enough seed available. In 1952 it was clear that Alta would not be satisfactory. We used a John Deere Transplantrol to plant two-inch plugs of Meyer zoysia on the 17 acres without irrigation. The operation was successful. This gave encouragement to golf courses which then began to consider zoysia for fairways. Today we know that many golf clubs are enjoying zoysia fairways with lowered maintenance costs.

The zoysia story would not be complete without telling of the Meyer zoysia putting greens at the Naval Ordnance Lab on New Hampshire Avenue near Washington, D.C. They were established in 1950. A few years ago, Ed Ault, golf course architect, was retained to relocate some greens. He asked, "What grass do you want on the new greens/" The answer came without hesitation, "Zoysia, of course!" So, for thirty years this course has enjoyed low-cost golf with a grass that never had been used that way before.

We have not even begun to use zoysiagrass to its full potential. New selections and new sod sources will expand its use. A drive through residential areas in Washington, D.C., in the winter shows how the homeowner has accepted this grass with its color that changes with the seasons. Meyer was the first, but is not necessarily the best.

Postscript -

With the help of Dr. Jack Murray, USDA, Beltsville, early records show that the first introduction of zoysia seed was made by Fairchild in 1902 and 1903, seeds gathered in Japan.

Frank N. Meyer sent two introductions from China in 1907.

Seeds were sent from Yokohama in 1910.

Cuttings (rhizomes) came from China in 1914.

Maiden sent seed from Australia in 1916.

J. C. Knottinberger sent material from Java in 1916.

J. B. R. Norton gathered seed in Japan in 1919 and also sent rhizomes. He was my Botany professor when I started my graduate work at University of Maryland. I lived in the head house of his greenhouse and kept his plants watered.

After a lapse of ten years, D. Morse sent vegetative cuttings and seed from Tokyo.

In 1930, 15 or 20 small seed lots came in from Japan.

In 1934, from Korea came 100 pounds of seed and 16 pounds of seed from (Chugay) Japan. In the same year hand-harvested seed arrived from S. Manchuria.

Small lots came from Japan in 1938, from Puerto Rico (seed) in 1946, and sprigs from Korea and Japan in 1950 and 1953. Nigeria yielded several vegetative selections in 1955. In 1966, vegetative Z. matrella came from Formosa. The last known introduction came from China in 1967.

The disposition and use of all these different introductions is not known. Many records are lost or missing. One lot of seed was loaded with ergot. A seed importing firm in New York sold zoysia seed that germinated 8-10 percent. I processed a lot of this seed by running it through an Eddy-Grant huller-scarifier at our Grasslyn plant near State College, Pennsylvania. Germination of the naked seed ran about 80 percent, but half the weight was lost (hulls).

BENTGRASS OVERSEEDING

Steve Frazier, Superintendent
Meridian Hills Country Club, Indianapolis, Indiana

I believe this is the twenty-second Midwest Regional Turf Conference I have attended. John Morris has done an outstanding job leading the organization this past season, and I congratulate my dear old friend who is taking the leadership next year. Gene Johanningsmeier is a hard worker and a good friend of Midwest Regional Turf.

We are now starting our eighth season of converting bluegrass-Poa fairways to bentgrass. Our original estimate of five years to convert to bentgrass was not realistic. Seeding into existing turf, weather, and techniques did not cooperate. We are looking at still another year or two before we are 90 to 100 percent bent. However, I have never regretted the decision of going to bent, nor had second thoughts about the program.

If thatch and soil drainage are problems, Roundup is not the answer. Roundup is the answer for getting rid of unwanted grass. Bent is not a panacea, but bent can get the job done if soil drainage and thatch are controlled. Over the past two years we have used Roundup in solid Poa annua areas with good results. This year, even after a horrendous summer with Pythium, we used Roundup and overseeding only on five approaches where we had an abundance of Poa that still hung on, or some remnants of an old ryegrass seeding.

We have an older membership so we extended eight fairways into the rough closer to the tee to accommodate the shorter hitters. We used Roundup very successfully in this situation. One thing should be pointed out - we are going to have to improve techniques if we are to use Roundup where there is existing bent. We did not have a successful renovation and seed germination using Roundup in areas where there were existing Colonials and creeping bentgrasses.

Over the past two years we have learned something about seeding rates. High seeding rates are not necessary for successful renovation with bent. If you use a disc seeder or thatcher type seeder and are seeding into turf killed with Roundup, five to seven pounds per acre of bent is sufficient. This should be followed by cross discing; the recommendation is 45° angles. I prefer to go across the seeding using this type of equipment after about two or three weeks. Using more seed, particularly with bent and these disc seeder type arrangements, induces competition, overcrowding, stunting, and an ultimate failure of that young grass seedling to mature. I prefer to have two or three seeds that have germinated within a linear inch than to have that dark green fuzz that seems so satisfying when we first see grass start to germinate. Disease down a row of new bent can completely wipe it out. You want that grass plant to mature as quickly as possible, and that is not accomplished by overcrowding.

When using a drop seeder, preferably over aerified prepared seed beds, 15-17 pounds of bent is an adequate amount. If you elect to spread seed and then spike over the areas, which is a perfectly satisfactory way of renovating, increase the amount of seed and spike a great number of times to insure an adequate seed-soil contact.

I feel the timing of the application is extremely critical. We plan our program thoroughly, checking our equipment so that it is in good working order, have supplies on hand, and train the crews so they know what to do and can get the job done quickly.

In the Indianapolis area Poa annua can start germinating as early as July 5. The preponderance of Poa germination takes place between July 20 and the first part of September. I consider the time between September 10 and 20 the prime time for bentgrass seeding - a short but adequate period of time.

In fairways I prefer to use an open-tined coring type machine such as the Ryan, Grassland, or the dedoes. The secret to success is to make as many holes as possible to bring up the maximum amount of soil. You need to be prepared to stop when chunking of turf occurs. The seed is spread using a drop spreader. We have found that we can use a Mott Mower set in the mulching position to break up the plugs. Then we can drag, mow, clean up any debris, and have the area ready for play.

Another method is using the disc seeder type machine. The disc seeder is a great machine for seeding bluegrass, but is not designed for handling the fine bent seed. It does not place the bent seed as accurately as it does the heavier seed.

The last method used is spiking. We have used this method with a great deal of success in isolated areas.

Gain as much experience as possible with seeding operations. We have had very desirable results with 50 percent Penncross and 50 percent Emerald (weight). Now with the availability of Penneagle, we have gone with a three-way blend of one-third each of Penneagle, Penncross, and Emerald. Incidentally, it takes a few years for Emerald to show, but it has a very desirable characteristic in that it is not as aggressive as the Penncross, and it has a more upright growth pattern.

Successful seeding and germination doesn't insure an early success of the conversion to bent. What happens if you don't get as much bent as you thought? By golly, you are going to have to grow some Poa up to a certain point in time. It is important to be honest in evaluating your turf. Ask someone to look at your turf with you, decide which way you will go, and what your plan of attack will be. Over the first several years I chose to roll with the punches during the early part of the spring and live with the Poa to get through our heavy tournament schedule. Traditionally, at the end of July we have our invitational tournament for which we try to keep everything green. By good communication of your plans to the membership, they expect the Poa to take a nose dive after that, and they can understand that brown spots will be showing.

We have tried to maintain adequate levels of N and K over the last few years, and this past year we started using a complete fertilizer, 3-1/4 pounds N, 1 pound phosphorus, and 2-1/2 pounds potash. I don't like to fertilize the bent early in the spring, but prefer to wait until the soil warms up and the bent is growing. We want to encourage it as much as possible and discourage the Poa. During early spring we try to maintain dry fairways to favor the bent.

We start our fungicide programs as early as possible to maintain healthy turf prior to warm weather stress and disease, and we mow regularly at the height we want to maintain the entire year. I don't agree with the idea of raising cutting heights when you get a problem, particulary in hot weather. That seems to compound the problems because you are harboring moisture and disease. The best thing for bentgrass is to get it dried out as soon as possible. We remove the dew in early morning. We plan our watering program so we will have a minimum amount of free water from six to nine in the morning. I've come to work many times at six or seven a.m. and can see no Pythium, but by 8:30 Pythium can be over the entire course.

We have chosen a weed seed inhibitor herbicide. We maintain maximum protection for as long as we can and still leave room to punt on fourth down if things go bad in July and August. Bent has tremendous recuperative powers, and is the best of two worlds. It is a cool-season grass, yet if you manage it well in the heat of summer, bent can produce strong growth spurts at the expense of Poa.

During stress periods in July and August, syringing is a good Poa control mechanism. The Poa seeds will germinate, and if you can hold off watering while the Poa plant is being stressed, normal seedling vigor is reduced. The bent will recuperate more quickly than the Poa. We are more fortunate than some others in that we still have some arsenic level in our soil, and this causes the Poa seedlings to get the characteristic leaf curl while in the one-leaf stage. The leaf will be green in the morning, but by late afternoon it will be brown and shriveled during heat stress periods.

Syringing can help, but it can also hurt if done improperly. We try to be alert to Pythium weather; try to keep the turf as dry as possible. We are going to increase the use of wetting agents. It is not an expensive process and does not take large amounts of material when you consider the amount of turf that can be lost to Pythium. One thing to remember is to water turf when it will dry quickly. The late afternoon syringing can serve as the evening watering. We can let the sprinkler system cycle a little longer. We find during the stress periods in July and August there isn't much difference in our watering program between a syringing cycle and a light watering.

Bentgrass, with its remarkable recuperative powers, has been a blessing. I have enjoyed the work of converting our fairways to bent, even though we miscalculated the time it would take to complete the project.

SWITCHING TO ZOYSIA FAIRWAYS

Tom Brehob, Superintendent
Hyde Park Golf & Country Club, Cincinnati, Ohio

The reason Dr. Daniel asked me to talk at the Conference is to describe what Hyde Park Golf & Country Club is going to do with zoysia and why. But to understand that, I must explain some history of the conditions. When I was hired, I was told that the fairways were the main problem. The fairways had 50-60 percent Poa annua. An overseeding program with bentgrasses had been started in previous years with marginal advances. But it seemed that although we had very good success with bent germinating and growing in the fall, the next summer a large percent would be lost to disease and wilt. These circumstances came to a head last year when Pythium wiped out almost thirty percent of the fairways.

Yearly, problems always seemed to start around the middle of July and continued through the first of September. Last year the problems started earlier. I have a Taylor temperature recorder in my office which indicated that during the period of time from June 11 through June 24 the daily high reached near 90° with temperatures hitting 90° on the 12th, 15th and 16th. And in the four day period June 25 through 28, it hit 90° and above. The night temperatures during the period June 25-28 were close to the 70° mark. Until the Fourth of July there was a slight easing in temperatures, but then they started climbing. During the period from July 4 through the 27th the day temperatures reached 90° and above, and the night temperatures didn't get below 70°. Even though I was spraying with Tersan SP at a 4-6 ounce rate every five to seven days, Pythium was still taking its toll. During all this mess, one fairway was looking better and better. Number 14 fairway is 90 percent Meyer zoysia and 10 percent bermuda. Members hoped they could last through the heat just to play on a solid piece of green turf.

Losing grass is one thing, but when you lose grass it is quickly replaced by goosegrass, a very severe problem at Hyde Park. Last year we sprayed twice the recommended rate of Dacthal on the fairways. And we still had an overabundance of goosegrass.

During this period of time the discussion of going to zoysia increased. Then in September, the board of governors voted to go to zoysia in the spring of 1981. I made a study of different methods of installation and presented the alternatives to the board. After considering the length of time to install zoysia, and to get the fairways to good condition, dollars, and inconvenience to members, the board decided to contract with Southern Turf Nurseries to rowplant the zoysia.

The installation is scheduled for the first part of May. Approximately two weeks before that time I will spray Embark on the fairways at 1-1/2 pints per acre. This will hold the growth of the bent and Poa so that when we start putting down the fertilizer we don't have to be mowing every day. A growth regulator was chosen rather than a non-selective herbicide because we wish to keep the fairways as playable as possible. We will be using Roundup in the driving range where we are going to establish a nursery.

Then Southern Turf Nurseries will come in and install the zoysia by means of sprigs placed in rows at 12 inch spacing. The rows will be parallel to the fairways starting at the beginning and ending around 30 yards short of the green. Immediately upon row planting zoysia, the sprigs will be watered sufficiently to keep them from wilting. After one week a fertilizer application of 5-10-15 at 500 pounds per acre will be applied. In the second and third weeks, 105 pounds per acre of 33-0-0, ammonium nitrate, will be applied. In the fourth and fifth weeks, 75 pounds per acre of ammonium nitrate will be applied. Around the seventh week 10-10-10 at 400 pounds per acre will be applied. This takes us up to about the first of July. After that, ammonium nitrate will be used at one-half pound N per 1000 square feet for the remainder of the season. With a final fertilization of 10-10-10 at 400 pounds per acre applied before the zoysia goes dormant. That will give a total for the year of at least 7-1/2 pounds N per 1000 square feet, 3-1/4 pounds of P, and 3-1/2 pounds of K.

After installation, spraying of MSMA at 1-3 pounds ai/acre will be used to remove and contol any crab and goosegrass. This spray schedule will be at intervals of seven to ten days, or as needed. To allow the goosegrass to get substantial growth will accomplish two things: (1) bring on a large amount of criticism, and (2) restrict the spread of zoysia. We must keep goosegrass under strict control.

The expectation of coverage is that by the third season the fairways should be in fair shape, with increasing quality thereafer. This summer I will be mowing the zoysia at 5/8th inch, but as the coverage increases the height will be dropped to 1/2 inch or slightly below.

This program has not been exempt from criticism;it has been widely discussed. Some members feel the grass will not be good to play on, others have a dislike for the brownness during the winter. My personal feelings are:

1. If a grass can grow and stay green during the hot and humid summer, fine.

2. If zoysia can reduce my increasing chemical cost, fine.

3. Once the fairways grow into a fine turf more man hours and money can be spent on higher priorities and bring the entire course to the best possible condition.

Editor's Note:

A telephone call confirmed that as of 22 May 81 the project was finished. A total of 23 acres of fairways was sprig planted within a three week period of operations (including much rain). It was reported the machines worked well, although some extra sprig material fell outside the grooves so was not implanted.

The crew moved to the next job at Hurstbourne Country Club near Louisville, Kentucky.

ARE IDEAS NEW OR OLD?

Andy Bertoni, W. A. Cleary Chemical Company
Northville, Michigan

The idea of communication is great. We used to place a large artist's panel on the first tee telling the players what we were doing on the course. Maybe they didn't read it, but at least they knew the sign was there. Communications are most important. Like the fellow said, "I haven't talked to my wife for a year; I don't want to interrupt her."

We are talking about the old and the new. They say there is nothing new under the sun, but that is a premise. You need to avoid the premise that everything done in the past was wrong. The fellow said if he hadn't quit school in the eighth grade who would be hiring all these college graduates?

The early superintendents had the same elements to use as you have - the earth, water, air, and heat. Those are the things you need for your grass. The basics are the same, but you have more sophisticated equipment. That is the difference. They mowed fairways with horse-drawn equipment, and it took two weeks to mow all the fairways. An architect told me they used to build golf holes around trees so they could rest the horses in the shade of the trees. They fertilized with manure. Another superintendent told me they waited at 5:00 a.m. regularly for the inter-urban to bring them manure from the race track in Toledo. They did all their watering by hand, which is by far the best way to do the job. Some of the finest superintendents with good budgets still have men watering the greens by hand. The day may come when we have to save water. How much of our water is wasted? We may come to the point of needing to target the water precisely where it is needed, and that is what hand watering does.

The early superintendents also aerified. I've seen pictures of sixteen fellows in a row, each with a pitchfork, aerifying the soil. The principle is the same; they lacked the equipment you have. (We can't afford to use that process today - can't afford the price of the pitchforks.) What they did, they did well. Their tractors had big lugs on the wheels, and that helped to aerify. Then Tom Mascaro came along, bless him, with ideas and equipment for aerifying.

Then came fungicides. Most of them were mixed and scattered with sand from a pail. They had the slurry of mercury, sodium arsenite with Milorganite. Everybody had tears in his eyes! It was a tough job to topdress with fungicides. They used Paris green, mercury; iron sulfate was used as a fungicide. Lime was a big thing; mixed with sand and applied every week, it took care of disease and many things. They topdressed, not with sophisticated machinery, but I have never seen such artists with shovels as those fellows when they were spreading topdressing as precisely as machines do today. The primary purpose of using sand was to smooth greens to achieve better putting surfaces.

The chief difference in management is the sophistication of the equipment. How fortunate you are to have improved products such as custom-made fertilizer for your particular situation.

The trend today is to return to calling you Greenskeepers which is really a more accurate word than Superintendent. The book of golf rules tells us the "green" is the entire golf course. Joe Dye lamented, and I fought it, too, when the name changed. You may want to call yourself the Master Greenskeeper and your workers Greenskeepers.

Those earlier greenskeepers were quiet and inbred with what they were doing, and they wouldn't tell you anything. We'd ask questions, and they would laugh. The only fertilizer we had was ammonium sulfate and that was effective for about six days at most. They told me to water down the greens first and spread the ammonium sulfate. Well, I burned out several greens before I realized what I was doing. They all sat back and laughed, but that has changed, and a big advantage now is that we all share information.

After World War II there new chemicals - mercury, 2,4-D, and Mallinckrodt came out with new products that required new approaches. A graduate of an agriculture college in Germany asked me technical questions, but suggested one should walk around one's course to see that no one was spying on you. He told me what to do about chickweed, a very secret process. That seemed to be the trend. No one wanted to be blamed for getting anyone else into trouble.

We didn't have as many grass varieties either. We had basic bluegrass, fescue, and the native bents. Many greens were bluegrass, but soon changed over to bent. What ever happened to redtop? At one time that was the panacea for a green that was in trouble.

There were great minds among the early greenskeepers. One of those whom we have honored is Bob Dunning. He has done a great deal for us. Joe Valentine laid out a great course for us, along with High Wilson, Marshall Farnham, Maples at Pinehurst. M. Francis developed some primitive but technical processes. He would try to burn out plots of grass, and the areas that did not burn out he would use for his preferred grass, Vesper bent, one of the most beautiful of all the bents. We all profit from the experience of others; that is progress. Newton said, "I have stepped on the shoulders of many great people to reach my heights."

During the trial and error period we didn't have many researchers. There were Monteith, Noer, Grau, Dickenson and Musser. Bill Daniel has served as a catalyst to bridge the days of those great ones to the era of the trained agronomist. George Toma said he would not have gotten where he is on his athletic fields if it had not been for help from agronmists.

In the industry we have had great men - Stan Fredricksen, Bob Miller, Paul Sartoretto. They were pioneers who served to help us. Gene Johanningsmeier is one who serves others; he is a knowledgeable turf man who happens to sell products.

Those older fellows looked professional too. They dressed the part. Alex McDonald, greenskeeper at Detroit Country Club, Scotsman, would walk through the course in his Scottish tweeds, knickers, tie, vest, cane - and a whistle which he used to call the workmen.

With turf diseases you wonder sometimes if God wants people to play golf on grass. Bobby Jones had such good scores; some of his records are still unbroken. He played on the turfs of the times we have been talking about. Maybe we have spoiled the golfer. We have made things so nice he doesn't have anything to blame. If only the average player could realize what goes into making good turf.

I would like to compile a book of incidents that have happened on the golf course. Al Radko tells of when he was working on the course where a little Italian was hired to rake sand traps. (Trap rakes have been mechanized since 1929). Following a party, one of the members passed out in one of the sand traps. During the morning the worker found him lying there, but didn't report it until noon when he went in for lunch. The superintendent went out to check on the situation. The man was still out, but the sand around him had been raked perfectly following the contours of his body. Another story that could go in the book would include the one about the worker who had a minus-19 IQ. After being told that fairy ring was caused by fairies playing at night on the course, one night he was found resting on the green, "waiting for the fairies to come do their dance".

Our working conditions are different today. In past years there were fewer golfers, they were gentle, they tolerated roughs that were really rough. That was when Ladies Day was once a week. Now you need to put lanterns on the tees every morning for the ladies. The course is so busy that the grass doesn't have time to grow because someone is always standing on it.

Now where do we stand? You people are the lucky ones. You have the advantage of past progress. You now have the duty of improving on it. Never downgrade the past, but never underestimate the future. You must accept the challenge, must hold the torch high, must go forward and improve. The past generation has gone from the horse and buggy days to the days of men on the moon. The time is almost here when a superintendent can stand in one spot and control the watering and aerifying of his entire course. Use your brain, look for new and better ways to do things. Our motto was, "Go two steps farther". You must use new tools and chemicals. I challenge you. When you have your course out of play for ten days why don't you plow up the fairway, harrow it, and add fertilizer - open up the ground. In October 1954, we did a fairway that way - plowed, harrowed, leveled, resurfaced, working in the fertilizers, and got the phosphorus and potash where we wanted it. In 1955 it was the best of our fairways for the PGA tournament. Plow it up when you can. Otherwise you are putting on a Bandaid. Try one half of the fairway at one time; you'll be surprised. With your equipment you can have the contours and drainage you desire. You will also know what you have for the grass to grow in.

Jim Watson suggests we need to work toward getting some drought-free grasses or cultivars, salt tolerant grasses so we can use the ocean water. Recognize the pertinent problems and ask for solutions. The Michigan golfers have decided to support research. There is a little tag for the golf bag that reads, "I have a right to gripe, I donated to turf research". We have designed a round aperture that can check the roundness of the ball (patent pending). Only two balls in one hundred are perfectly round. We hope the golfers' support will be a domino thing that will catch on. Keep your mind young and active. You are getting old when you think of Friday as the end of the week instead of the beginning of the weekend.

Cardinal Newman said, "Growth is the only evidence of life." Isaac Newton said of life, "I was like the child playing on the seashore, seeking sea shells or smooth pebbles when the great ocean of truth lay before me undiscovered." The ball is in your court. We take advantage of the past, but we need heroes today. You need to support research. Remember the best is yet to be for you.

John, you have been a good president. You have left a big track for Gene to follow. Have a wonderful year.

PENNEAGLE ONTO EXISTING TURF

Robert Brame, Superintendent
Broadmoor Country Club, Indianapolis, Indiana

Broadmoor Country Club is approximately fifty-five years old. It was designed by Donald Ross. Fairway turf has been, before overseeding, a combination of bluegrass, ryegrass, and Poa. The irrigation system consists of a single row of quick coupler valves down each fairway; notice I didn't say,down the middle of each fairway . Fertilization and pest control programs in the past have been of high quality. All in all, the course has been very attractive and playable in recent years, and the membership happy with their layout. With these factors in mind, you may be asking, "Why overseed? Why not maintain what you have?"

Although I came to Broadmoor the day after fairway overseeding had started, I understand there were basically two factors which led to the need for overseeding: (1) budget cutbacks in early 1980 which reduced fairway maintenance, and (2) the hot, dry weather we all experienced during the summer of 1980. By midsummer, the combination of these two factors made it obvious that something had to be done. Greens and tees stayed in excellent condition, which emphasized even more the poor condition of the fairways. Considering all angles, the decision was made to overseed all fairways. Since our membership preferred bentgrass, we could take advantage of the problem and convert to the playing surface they wanted. Then we needed to decide which bentgrass would best fit our needs. It was decided that Penneagle would be the most aggressive grass to combat our Poa annua problem, with maximum disease resistance.

The next question was one of procedure. Some test plots had been set up to explore the possibility of using Roundup herbicide to make a clean start. However, the Greens Committee felt the cost and the possibility of having to close the course for a few days ruled out this option. So we decided to allow a three to five year time span to make the conversion a gradual one. During this same period we would also install a completely automated irrigation system which we feel is a must for quality bentgrass fairways. Spreading the conversion time out over several years has its advantages, but it also has one significant problem - maintenance. With bluegrass, ryegrass and Poa, we now add bentgrass. However, with all maintenance practices shifted to encourage the bentgrass the population should increase with continued seeding until we have made the complete change.

Planned 1980 Fairway Improvement Program --

Materials Needed:

Quantity	Description
1000 pounds	Penneagle bentgrass (25 lbs. per acre)
4 tons	6-24-24 starter fertilizer (100 lbs. per acre)
4 ea. 30 gallon units	Aqua-Gro wetting agent
6 cases (36 lbs.)	Tersan SP fungicide for damping-off control (5 lbs. per acre)
5 tons	Par-Ex 31-0-0 coarse IBDU (250 lbs. per acre)

Equipment Requirements:

One Rogers 590 aerator with 5/8" spoons

Two Rogers 548 Aero-blade machines with seeder removed

One Lely fertilizer spreader

One Gandy spreader for seeding, min. 8 ft. width

One John Bean 100 gal. sprayer mounted in truckster w/ single KCL-36 nozzle

One 9-gang pull type fairway mower

One Rogers 40 blower

Two 2110 Ford tractors or equivalent

Two G-10 tractors for utility type work on fairways

One double thickness type cyclone fince fairway drag mat

Two Cushman trucksters or Workmaster

One Rogers sweeper with rubber fingers

One Jacobsen triplex with verti-cutters

One Hahn triples with verti-cutters

Twelve basic steps:

1. One week before seeding, lower mowers to 5/8 inch cutting height
2. Seeding with Penneagle using drop spreader (10') - 25 lbs./acre. We mixed the seed with (5) calcined clay
3. Aerate twice for maximum opening
4. Aero-blade to cut slits, verti-cut thatch, and break up soil cores
5. Drag mat, several passes, staying in confines of fairway
6. Blow debris, windrow in center of fairway, sweep and haul away
7. Mow fairways to clean up. This was done to smooth and clean surface for fertilizer application
8. Apply 200 lbs/acre 6-24-24 Par-Ex
9. Apply 250 lbs/acre 31-0-0 IBDU
10. Apply Aqua-Gro wetting agent (3 gal./A) to prevent the soil from drying out quickly and reduce the frequency and intensity of watering.
11. Water frequently and lightly - keep moist
12. Reestablish normal mowing. We were able to do this about ten days after seeding.

The first fairway was seeded on September 3, and all renovation work was completed by the 18th. On days when we had no delays due to weather or equipment breakdowns, we were ablt to get three to four fairways completed from seeding to turning on sprinklers. We did not close the course during this time; however we did restrict golf cart traffic to roughs.

I'd like to mention that the procedure we used was put together by my predecessor Oscar Miles, and his assistant Paul Mayes. I think it worked very well.

ROUNDUP^{R} - ITS BROADER USAGE

Edward E. Jordan, Monsanto Company
Fort Wayne, Indiana

Other parties at this conference have adequately covered the use of Roundup^{R} and its fit in turf renovation which is taking place in the fall on fine turfgrasses. The potential problems and opportunities have been amply covered by Jim Brandt, J. L. Harris, Joe Himburg and Steve Frazer.

We will consider other uses. Managers of the various green industry segments have utilized the basic characteristics of the product to assist and improve their finished vegetative cultures at reduced cost. These product characteristics are:

1. no soil residual activity
2. no volatility
3. rapid microbiological breakdown
4. no root uptake
5. no leaching
6. relative safety to people, animals, fowl, fish and insects

A few of the green industry's business segments which have integrated Roundup^{R} into their cultures are:

1. spring renovation of fine turf
2. landscape industries
3. aquatic vegetation control
4. brush work in the utility industry

We will also explore the wick and rope applicators for selective weed control.

Turf Renovation Spring Application - The home lawn renovation affords a suitable target for the landscape and lawn care industries. Roundup^{R} has been utilized to destroy all undesirable vegetation and allows a suitable seeding media for reseeding or sodding to bluegrasses, fine leaf fescues, bents, or ryegrasses.

Low amounts of tillage, only sufficient tillage to get necessary seed-soil contact, such as core aeration, spiking, or slice seeding are necessary after a seven-day delay to allow the Roundup^{R} to translocate in the target species being eliminated.

Landscape Industries - The landscape industries have capitalized on the Roundup[R] characteristics of no root uptake and no soil residue for the economic creation of new planted beds and removal of unwanted vegetation in old beds by directed or shielded spraying. Grounds maintenance industries have capitalized on Roundup's[R] lack of lateral movement and excellent internal translocation in sprayed species for crack and crevice work and trimming and edging along hard surfaces where rain could move chemicals into adjacent non-target areas.

Aquatic Cattail Control in Dry Ditches - Cattails are now labeled for control with Roundup[R] when they are present in dry ditches. Performance is best achieved when the cattail plants are storing carbohydrates for catkin formation in mid-September or in early fall when storing food reserves for the next season's growth. Spraying with a 1 percent solution in late July, August, and September has given the most total and consistent control. Performance is best measured the summer after spraying, and is rated from 95-98 percent control.

Brush Control - A limited tree and brush label has been added to the present Roundup[R] label. Again, the best performance is from 1-1-1/2 percent solutions applied in late summer and early fall before fall color forms upon the target species. This spray pattern concurs with the species' storing foor reserves for the next year and the best tranlocation patterns in the species. The present label lists the following common species: berries, honeyscukle, kudzu, maple, oak, multiflora rose, trumpet creeper, and willow.

This has been a limited look at a few segments of the green industry and how they have integrated the characteristics of Roundup[R] into successful business practices.

PENNEAGLE AFTER ROUNDUP[R]

Joe Himburg, Superintendent
Woodland Country Club, Carmel, Indiana

Woodland Country Club was built by Bill Diddel in 1952. Over the years, the common Kentucky bluegrass faded and Poa annua readily took over. Attempts to seed into the existing turf were met with limited success. Everyone knows the severity of the last summer, and being over 80 percent Poa, by the first week of August our fairways were reduced to a brown mat. With the help of Ed Jordan, Steve Frazier, Dick Gray, Dr. Daniel, and others, I started formulating a Roundup[R] program. In August, after a lot of research and soul searching, I approached the Board of Directors with the program, and they approved unanimously.

The first part of the plan was to get as much of the Poa annua germinated as possible. So the first of September we aerified heavily. We then started watering as much as possible. On September 15 we aerified again. All aerification was done with a Hahn-Westpoint aerifier with 1/2 inch open spoons. Besides bringing the Poa back, we felt these aerifications would help reduce our thatch layer. Some areas were reconstructed and several water heads straightened and lowered.

In our original plan our Roundup[R] spray was supposed to occur during the second or third week of September, but for some reason the Poa had not come back as strongly as expected. So, to get full benefit of the spray, the Roundup[R] wasn't put down until the 6th of October. The Roundup[R] was sprayed in one day, with the course being closed. Recommended rates of two quarts to the acre were used.

With late fall approaching, we started seeding on the third day after spraying. On October 9 we made two or more passes with the aerifier, hoping to make as many holes and bring up as much soil as possible. In several areas, the lack of a root system caused the turf to roll up on the aerifier just like a carpet. Knowing we were at a point of no return and that we had to get the seed in the ground, we just kept on going.

Behind the aerifier we put the seed down with a Gandy drop spreader with seed rate of 3/4 pound per 1000 square feet. A Gandy was used to insure straight fairway lines and to get an even distribution of seed. In the same pass as the seeder we ran two Rogers verticut units. By overlapping these a little we got the same width as the seeder, and this gave us a line of sight for the next pass over the fairway. The final operation was that of dragging and rolling.

I can testify that Roundup^{R} works. Caution should be taken to avoid drift. We made a point of staying away from trees and shrubs with any equipment we were using. Also, foot traffic on the area should be avoided until you're sure its dry. Care should also be taken in application because it readily tells you what you missed and what you didn't want to hit.

In conclusion, I'd like to say that complete renovation by this program is difficult, but at Woodland, this Roundup^{R} renovation program has really shown us which direction we are going.

BLUEGRASS FAIRWAYS UPDATE

James W. Brandt, Superintendent
Danville Country Club, Danville, Illinois

A very brief review of our preliminary varietal testing and plot work is in order. In fall of 1973, Dr. Bill Meyer, of Warren's Turf Nursery, established nine varieties with eight inch plugs on three foot centers in the 16th fairways. The results were recorded in August 1980.

Average Coverage of Three Replications

	sq. inches	diameter inches	
H-7	932	36, 34, 24	
I-13	576	29, 23, 27	
I-16	502	26, 20	
A-20	412	9, 21, 27	FR*
A-20-14	146	8	FR
A-20-5	128	24, 0, 0	
Fylking	0	0, 0, 0	
I-2	0	0, 0, 0	FR
Baron	0	0, 0, 0	

*Fusarium roseum

From the above summation it is readily apparent that Warren's H-7 and I-13 cultivars persisted best. Encouraged by earlier results in fall of 1978, it was decided to set up a pilot program for the possible renovation of the fairways. Sites were selected on the 1st, 6th, 14th and 16th fairways. The areas represented varying degrees of turf quality.

At the selected sites a swath of 16 feet running the width of the fairways was sprayed with Roundup^{R} at the rate of 2 quarts per acre. One week later four strips, each four feet in width, were planted using the Rogers seeder.

Width of Fairway	
4 ft.	Warren's cultivar H-7
4 ft.	Warren's cultivar I-13
4 ft.	Blend equal parts Adelphia, Baron, Glade, Nuggett, Pennstar and Sydsport bluegrasses
4 ft.	Equal parts of Manhattan, Derby, and Pennfine ryegrasses

We had what appeared to be excellent germination in all plots. In evaluating the various plots during the summer of 1979, the following observations were made:

Warrens H-7 was very mediocre in its performance

Warren's I-13 was outstanding from mid-summer to fall

Mixtures of "elite bluegrasses" were non-existent in plots

Ryegrass mixture looked good in spring and fall but had a serious invasion of Pythium in August

The decision was made to spray the entire front nine with Roundup^{R} at two quarts per acre, followed with an overseeding of equal parts of H-7 and I-13. Fairways were seeded immediately after Labor Day. Seeding rates were 20 pounds per acre using the Rogers seeder going at 45 degree angle on second coverage.

Germination was excellent. All fairways were mowed five times prior to winter dormancy. The decision was made to use Tupersan in April at the recommended rate to control crabgrass but still be able to overseed if necessary. Based on our previous year's experience, it was thought that the new seedlings would be very competitive with Poa annua, but Poa annua did germinate and was very competitive.

All of you are aware that Poa annua did not survive the rigors of the July-August period of 1980. Although we were very disappointed with the 1980 results, the new fairways were somewhat superior to the existing fairways. The Board of Directors agreed that we should proceed with the renovation of the back nine.

It was decided to delay the renovation program by approximately four weeks. It is believed that the cooler soil temperatures of a later seeding will favor the bluegrass germiantion over Poa annua. This spring the front nine will receive two applications of Endothal at the rate of one quart per acre. This is to be followed by an application of Balan at 90 pounds formulation per acre. This procedure will be followed again in early fall if conditions warrant.

We also plan on using Endothal only on the newly seeded nine this spring. The Danville Country Club is cooperating with Dr. Bill Daniel in the use of some experimental materials for the control of Poa annua. It is hoped that a superior control may be found.

Although I would not deem our first venture in renovation to be an outstanding success, I am positive that our fairways will get better each succeeding year. It is believed that with using the improved cultivars and some materials for Poa restriction, we can again have excellent fairways.

A BLUEGRASS BLEND FAIRWAY

J. L. Harris, Superintendent
Hillview Country Club, Franklin, Indiana

When I assumed my duties as golf course superintendent in February 1979, my first observation was that Poa annua was dominating the golf course.

In 1971, at the time of expanding the course from nine to eighteen holes, the specifications called for the seeding of fairways exclusively to Park bluegrass. As a result, Fusarium has been very troublesome through the stress periods. In addition, the Park bluegrass does not offer enough competition to Poa annua.

In July 1980, at the monthly meeting of the Board of Directors, I made an appeal for the approval to renovate our #15 fairway with the use of Roundup to destroy all vegetation - removal of K-31, coarse fescue, nutsedge, Poa annua, in addition to the Park bluegrass. I also explained the advantages of planting the newer varieties among the elite cultivars.

On September 18th I applied Roundup at the rate of two quarts per acre. I made the treatment about 7:30 a.m. so as to avoid high winds, and was cautious not to permit drift onto a golf green or other area for which the application was not chosen. The dew present aided in marking the pattern of application.

A John Bean sprayer equipped with the R-10 series pump, 8006 tee jets, 30 psi, and a ground speed of 4 mph delivered 39 GPA.

Since we are a low budget club it was necessary for me to rent some equipment.

On September 22, four days later, the fairway received approximately 1-1/2 inches of water to prepare the soil for maximum penetration with the aerifier. In the afternoon we aerified the fairway four times with the Rogers machine.

On September 24, we again irrigated thoroughly, applying about one inch of water to prepare the soil for seeding. On Septebmer 25th and 26th we cross seeded the fairway. This was seven days after Roundup had been applied. We seeded the fairway at about 80-85 pounds per acre with the use of the Rogers seeder. We selected a four-way blend of America, Adelphi, Glade and Touchdown.

Upon completion of the reseeding we applied starter fertilizer, delivering .7 lbs. of N, 1 lb. of P, and .2 lbs. of K, and began irrigating. Every attempt was made to keep the newly seeded area moist at all times to enhance the germination.

On September 30, twelve days after the Roundup was applied, and five days following the reseeding, germination occurred. I was amazed.

On October 7 (at 20 days) I applied the fairway fertilizer product at the rate of 65 lbs. per acre, thus applying one-half pound of N so as to promote the new seedlings. On October 10 (at 23 days) I repeated the starter fertilizer application, putting down .3 lbs. of N, 5 lbs. of P, and .1 lbs. of K.

You may wish to raise the question, Is there now Poa annua in this fairway? Did Poa annua come up after the Roundup was applied and the soil was aerified and reseeded? The answer is, Yes. I would speculate the Poa annua count was about 50 percent.

Soon after the new seed had germinated the members began asking, "Are you going to do others? When? Which ones?" The Board of Directors is pleased with the results.

If you are planning a Roundup program on your golf course, I suggest you inform your membership. Post a letter, insert an article in the newsletter, stating precisely what you are doing and why. Inform them of your goals and objectives.

WHAT DO YOU LOOK FOR IN A PUMPING STATION?

Roy I. Anderson, Builders Plumbing Supply Co.
Addison, Illinois

1. Protection
2. Efficiency
3. Low maintenance
4. Compatibility to your piping and watering capabilities

These are some of the areas discussed to achieve the above points:

1. Be able to control pressure
2. Protect against high pressure surge
3. Protect against debris entering the intake system
4. Turn on and sequency pumps efficiently
5. Control high pressure
6. Control low pressure
7. Control air
8. Have means to screen and clean wet wells
9. Protect against loss of prime
10. Have proper lake and pump intakes

Cross-section of a wet well pumping station:

1. Intake screen stainless mesh. Please note the intake is elevated off the bottom of the wet well pit.
2. Intake pipe - ductile iron pipe preferred for it is stronger.
3. Intake gate valve operated from the pump platform. This enables you to clean the wet well.
4. Sump gap below gate valve and pump intake. A place for debris to settle.
5. Means of entering the well.

Have provisions to replenish lake water by private well, municipal water, drain tile and surface drainage.

If you have a lake(s) the location is not important if it is in the confines of the golf course. The pipe needs don't vary by more than five percent for any location on the course.

All of these protective features are designed to protect your pump and piping system, as well as your grounds. The main goal is to operate your sprinklers at a proper pressure so you have an even precipitation rate.

What does a completely automated pump station look like?

1. Jockey pump
1.A Main pumps
2. Check valves
3. Pressure relief valve to port off excess water and pressure not being used
4. Y-strainer with automatic blow-off
5. Combination control valve with pressure sustaining, check, two stage opening, and main pump control switches
6. Control panel starters, low pressure cut-off, high pressure cut-off, time delays, and main disconnect

Jockey pump function: A Jockey pump plays a very important part in the pumping system:

1. It maintains pressure in the main lines
2. It supplies water for your lower volume needs such as syringe, spray tank fill-up, low volume watering, cleaning equipment, etc.
3. It starts your pumping cycle. It is actuated by a pressure switch at (example) 75 psi on setting and a 100 psi off setting.
4. The Jockey pump can return to the on position any time during the pumping cycle when the pressure in the system drops below the on position setting of 75 psi (as in this example) adding an extra amount of volume and pressure boost. Today we suggest a 20 or 25 HP pump is used with a relatively flat pressure curve which will deliver 200 GPM at 125 lbs. psi. It enables you to water up to four fairway sprinklers or ten tee or green heads at one time.

Your main pumps can be a centrifugal type or hollow shaft turbine. The turbine pump can be used in shallow wet well or in a deep well application. One advantage the turbine has over the centrifugal pump is that the impeller bowls are submerged below the water level which eliminates loss of prime.

The centrifugal pump's volute bowl and impeller are attached to the motor at ground level. In order for the centrifugal pump to lift water it must be primed with water from the foot valve in the wet well to the impeller. The foot valve must be a very reliable type. A butterfly valve is highly recommended.

A butterfly wafer check has spring-loaded flaps that compress against a neoprene collar. This same check is used on each pump in your system for the following reasons:

1. The check valve will keep the piping system water from returning to its source - the well, pond, etc. - which could drain your system.
2. If two or more pumps are used a check on each pump will keep the water from being pumped back through the pumps that are not running.

The pressure relief valve:

Installing a pressure relief valve upstream of the pressure reducing valve relieves excess pressure build-up. When the water demand is at the low end of the pump's capacity, the excess pressure then is ported back to the well. An adjustable pilot prohibits the valve from slamming open or closed. It opens very slowly and closes slowly - it modulates.

Y-strainer with automatic blow-off:

The Y-strainer's function is to filter any small particles of debris that pass through the intake screen. The water has to pass through the filter chamber in the Y-strainer to continue down-stream. After all of the pumps shut down, an electrically operated valve will open at the bottom of the strainer reservoir and blow out the debris that has accumulated during the last watering cycle.

Pressure reducing feature on the combination valve:

The pressure reducing feature on the combination valve will maintain a predetermined pressure setting such as a 125 psi down-stream of the pumping station. This pressure is adjustable. The valve will modulate to maintain that high limit, no matter what the water demand down-stream may be. Its nature is to maintain the higher setting (125 psi). If it can't, it will open all the way.

1. When the water demand down-stream becomes greater, the line pressure will drop and the valve will open further to maintain the pilot's 125 psi setting.

2. When the demand increases down-stream (i.e. when the sprinklers shut down) the pressure will increase down-stream above the 125 psi pilot setting and the valve will close slowly to maintain the 125 psi pilot setting.

3. When the demand down-stream stops the pressure will increase above the 125 psi pilot setting and the valve will close and that pressure remains in your lines to be used at will.

TAXING PROGRAMS IN INDIANA

Randy Ballinger
Walnut Creek Golf Course, Upland, Indiana

When Dr. Daniel asked me to talk about taxes, I immediately thought back to my first exposure to golf course taxes. In 1970 my father and I opened a new golf course. I was a student of turf management under Dr. Daniel, and in the spring of 1971 I attended my first MRTF Conference. There were three successive talks about taxes; Bill Lyons "Taxes and Serving Golfers", Thomas Tuttle, "Golf Course Taxes", and Harry Amt, "Taxes and Serving Golfers". These talks were not high on my interest list, but I did get one thing out of them - someone was having trouble with taxes! Well, ten years and one reassessment later, we are all having trouble. As soon as I got the word on what was happening, in March 1979, I began to talk to others. I talked to twenty-some county assessors and many more golf courses. I talked to Harry Amt and Bill Lyons, and from there I began to see the need for an organization, and we now have the IAPGC.

What are property taxes? Property tax is the method developed by our legislative process to raise money to support local government and the services rendered. To appreciate (?) property taxes, one must understand the breakdown of these monies. Example of a township:

51% schools
10% school transportation
25% cumulative fund
10% debt service
1% fire
2% cumulative fire
2% poor relief
1% township fund

Now, how many kids does your golf course have in school? My point is this, property tax is not the proper way to support schools. If the schools alone were removed from property tax, over fifty percent reduction could be realized. Let sales tax pay the school bill.

If you live in a municipality, then the municipality can sell bonds to raise revenue. The greater the valuation of a municipality, the greater the amount of bond money that is allowable, even if the valuation comes from non-taxable churches and other benevolent organizations. The more bonds that are issued, the higher the tax rate that will be needed. Benevolent organizations don't care what the assessment or tax rate is; they don't pay the taxes.

What is the problem? The threat of being taxed out of business! As John Marshall, former Chief Justice of the Supreme Court once said, "The power to tax is the power to destroy."

Many golf courses in Indiana have realized unbelievable tax increases - as high as 600 percent. That is destructive. Property taxes in Indiana are based not on potential resale or income potential, but on reconstruction costs. This can work in some areas and some courses, but is not workable in many situations. Many golf courses in Indiana are Ma and Pa type operations. Many were built with a lot of hard work and little investment. These are the ones to be hurt the worst.

Many courses are in marginal areas with modest incomes. No return on investment was considered. Now, with high taxes, high money cost, everyone must look for a return on investment. Most courses perpetuating solely as golf courses do not make a suitable return for investment if you must use the replacement cost value. That is evidenced by the lack of construction of new facilities.

Will the problem continue? YES! Every governmental agency wants more and more money. The Indiana Appraisal Guide, written by Sabre Systems, Inc., Dayton, Ohio, is the guide that must be followed year after year. It was written to indicate replacement costs as of 1975. It has a 50-60 percent inflationary increase built into it. The next time the manual will be revised will be in 1986. We must stand together and offer a better solution.

What can be done? PLENTY! First of all, know the tax structure. Address yourself to the problem.

Legislative action is only a remote possibility at this point. Legislators favor the most votes, and we, as golf course owners, have few votes. We also do not have enough money now to influence legislative activity by lobbying efforts. The only thing that can be done on this level now must be done one-to-one with your own legislator. Maybe Proposition 13 type feelings will begin to work in our favor.

Work throuth your local assessors and try to help them see your problem. Educate them, they cannot be experts in all areas of assessment. Often they do not realize life isn't a bed of roses for us. Hopefully, they will show some compassion for you.

You must document reasons to be graded lower than the assessor might want to place you. Pictures. Know the physical measurements of your course. Use all the depreciation you can, waste land, etc. Let the assessor know the service you offer the community and the benefits of your providing a golf course. Oh yes, your increased taxes will feed inflation. This extra money doesn't come out of your pocket. The customers pay for it or you don't exist.

If your assessor fails to see things the way you do, then appeal to the local board of review. You have thirty days from the date you receive your assessment notice. Do your homework. But remember, by law, the county assessor is the chairman of the board of review.

If this effort fails, you can appeal to the State within thirty days. After the State makes a decision, the next possibility is within the courts. One more thing, in case you feel all is lost because you didn't appeal soon enough, you can appeal every year from January 1 through March 31.

Costs per hole are given for five quality grades of golf courses, ranging from cheaply built courses to excellent quality courses designed for professional play.

Grade AA - Base Cost Per Hole, $32,000.00

Superior quality course, designed to accommodate professional championship play, 18 holes on 180 acres of rolling and laked terrain, 7,200 yds. long, rates par 72, and featuring a completely automatic sprinkler system throughout, 10,000 S.F. tiled greens, 2,400 S.F. tees with 3 tee locations, 3 to 4 bunkers per hole (average), good quality asphalt paved roadways.

Grade A - Base Cost Per Hole, $27,000.00

Excellent quality course, designed to accommodate championship play, 18 holes on 160 acres of rolling and laked terrain, 6,800 to 6,900 yds. long, rated par 72, and featuring a completely automatic sprinkler system throughout, 8,000 S.F. tiled greens, 2,100 S.F. tees with 2 to 3 tee locations, an average of 3 bunkers per hole, and good quality asphalt paved roadways.

Grade B - Base Cost Per Hole, $22,000.00

Good quality private club type course, 18 holes on 130 acres of rolling terrain, 6,400 to 6,500 yds. long, rated par 70, and featuring an automatic sprinkler system serving teh greens and tee and a manual system on fairways, 5,000 S.F. tiled greens, 1,800 S.F. tees with 2 tee locations, an average of 2 bunkers per hole and good quality asphalt paved roadways.

Grade C - Base Cost Per Hole, $19,000.00

Average quality public and municipal type course, 18 holes on 110 acres of primarily flat terrain, 6,000 yds. long, rated par 67 to 70, and featuring a semi-automatic sprinkler system, small tees and greens with few bunkers and average quality asphalt or gravel roadways.

Grade D - Base Cost Per Hole, $16,000.00

Fair quality course, 18 holes on 90 acres of flat terrain, 5,400 yds. long, rated par 64 to 67, and featuring a manual sprinkler system, small tees and greens with very few bunkers and gravel roadways.

- LAWN CARE SECTION FOLLOWS -

HUMBLE BEGINNINGS IN LAWN CARE

Fred V. Grau, President
Musser International Turfgrass Foundation, College Park, Maryland

Our farm lawn in Douglas County Nebraska, a mile north of Bennington, was common Kentucky bluegrass. Dame Nature watered the lawns and fields. I cut the grass occasionally with a dull hand-pushed reel mower. Dandelion and buckhorn plantain were attacked with a knife, mostly. Shade from high-trimmed soft maples and white ash kept the grass greener during heat and drought. No fertilizer was used. Moles tunneled and raised the sod occasionally. We would stomp it down flat again with our hobnails and try to poison the moles with strychnine on pieces of potato. A cat would catch one once in awhile.

Our one-room school lawn, sitting on one acre of land, retained all the characteristics of the original prairie. There was big bluestem in no-traffic areas, little bluestem and gramagrass where play was heavier, and here and there a patch of buffalograss. Mowing was done with a hay mower just before school began in the fall. The hay was fed to our horses.

My next lawn experience was at Bennington High School where the "lawn" was bare ground with embedded gravel. If there had been grass there at one time it had long since been worn out by hundreds of running feet.

At the School of Agriculture on the campus of the University of Nebraska the lawns were a mixture of Kentucky bluegrass and weeds. Most of the mowing was done with horse-drawn units. No attempt was made at weed control. There was no irrigation at all. In 1927 I became acutely aware of lawns by virtue of working on weed control under a modest grant from the USGA Green Section. My first "research" in weed control consisted of staking out 4' x 4' plots in a Colonial bent-bluegrass lawn turf. Fertilizers were applied at intervals and included sulfate of ammonia, cottonseed meal, tankage, superphosphate, nitrate of soda. I would remove with a knife all weeds from each plot, weigh them, then evaluate each fertilizer material as to which one was responsible for the smallest weight of weeds. I cannot recall any hard and fast conclusions, but it did start me on a career in turfgrass science.

About this time Professor Zahnley in Kansas had published a paper on the effect of sodium chlorate on weeds. A University of Nebraska botanist had been spraying sodium chlorate on weeds on a warm dry day. The solution soaked into his shoes while it dried. While walking along the pavement, a nail in the man's shoe struck a spark and his shoes caught fire. He got them off in time to prevent a disaster, but the lesson was clear.

I had read about weed control in lawns with fused powdered sulfates of iron and ammonia. The idea originated in England. I knocked out many dandelions and plantain with this powder which turned everything black. The bluegrass recovered more quickly than the weed so, in a measure, the treatment was successful.

As house manager for the Acacia fraternity in Lincoln, one duty was to keep the bluegrass lawn looking presentable. We were just across the street from the famed Nebraska capitol building. Lawn work, besides mowing by hand, consisted of supplying the pledges with knives and showing them how to remove weeds. No matter how many bushels of weeds went to the dump, there were plenty there for the next activity by the pledges.

Sodium arsenite was made known to me about this same time, but I didn't make too much progress with it until 1931 when I came to Washington, D.C. to pursue my graduate work at the University of Maryland.

When I started my Master's degree work in 1931 I began to learn about lawns in Maryland. Crabgrass was dominant all summer, dotted with dandelions and buckhorn plantain. Fairy rings were plentiful and had to be avoided. I put my faith in sodium arsenite in spite of a previous report that it didn't work on crabgrass. My strategy was to "burn" the turf when the crabgrass plants were small. It worked! A repeat treatment to catch the later germinating seeds also worked.

In addition to my lawn work on the Maryland campus, I had plots on lawn areas at the Arlington Turf Gardens (where the Pentagon now stands). There I made massive applications of arsenic both as arsenic acid and sodium arsenite. For years those plots were beautiful, clean, weed-free bluegrass with no crabgrass at all.

At Arlington there were plots of fine zoysia matrella and coarse zoysia japonica. They were considered botanical curiosities and had not been introduced into lawns. Work was done on rates of seeding vs. rates of fertilization, and the conclusions were eye-opening. Lightest seeding rates coupled with heaviest fertilizer applications produced the best weed-free turf in the shortest time.

My PhD work took me into every county in Maryland where I saw the beginnings of lawn sod industry. Horse-drawn sled-type sod cutters loosened the weedy bluegrass pasture sod which then was cut in lengths with a goose-neck sod lifter or a straight spade, rolled and loaded for transport. Sod bed preparation was minimal and, soon after laying, the area became mainly crabgrass. Many newspaper garden editors advocated seeding common annual ryegrass into crabgrass for winter green turf, allowing the crab to take over again the following summer. "It's green, isn't it?"

In Pennsylvania, beginning in 1935, I saw about every kind of a lawn there was. At the University of Pittsburgh Tower of Learning a bent-bluegrass mixture was planted and maintained at 1-1/2 to 2 inches in height. The folly of that effort was evident when disease wiped out the fluffy thatch of bent.

In Erie, Pennsylvania, homes had no water meters. Cool Lake Erie water flowed continuously through sprinklers. That, plus great shade trees (elms mostly) resulted in beautiful emerald lawns of Poa trivialis that could be cut closely.

A wealthy man near Philadelphia saw a velvet bent lawn in New England and was impressed. He directed the golf course superintendent to plant his large lawn with velvet bent. For one year it was the envy of all. Disaster struck in the form of brownpatch during a hot humid spell the next summer, and that was the end of the velvet bent lawn.

Most lawns, and even greens and fairways in northern Pennsylvania were creeping red fescue. In the fall they were covered with strawy horse manure, raked off, and added to the garden in the spring. This was the sum total of fertilization, and the turf was remarkably good. Change came with irrigation and commercial fertilizer. Fescue suffered and weeds came in, Poa annua, too. Few good fescue lawns remain.

To my knowledge the first lawn school was held at Haverford College, near Philadelphia, in 1935, organized by the late C. K. Hallowell, County Agent and estate gardener. It was a very popular event, but there was so little that we could tell the lawn lovers. Fertilizers and lawn maintenance equipment were primitive and there were virtually no research results to talk about. When, in 1934, I put a soil testing service into operation at the University of Maryland for my PhD project, a whole new vista in soils management was opened up for all turf.

Sodium chlorate had its day and was eminently successful. It made softened goosegrass stems stand up so they could be cut off with the lawn mower. I saw my first rotary mower on a lawn in Delaware County about 1935.

I sprayed sodium arsenite on a lawn that sloped down into a pasture. That night there was a bad rainstorm which brough tree branches down. The next day two steers in the pasture lay dead. The owner held me and the sodium arsenite spray responsible. I disagreed, then set out to find the answer. I found it! The storm brought down wild cherry branches. The steers ate of the wilted cherry leaves which were loaded with prussic acid, and that's what killed the steers. Case closed!

In York County where limestone soils received liberal dressing of limestone, the bluegrass lawns were unbelievably good. There was nothing that I could suggest that would make them any better.

At the huge farm show in Harrisburg in 1936 I had a booth where people were invited to stop and fill out a simple questionnaire on lawns. It was most popular. Hundreds of cards gave us a background of information that developed into a lawn bulletin.

In southeastern Pennsylvania I held identification clinics with county agents. Cup-cutter plugs of weeds and different grasses were numbered and displayed for identification. Most county agents did not recognize Kentucky bluegrass. High score was 55; low score was a dismal 20 (based on 100). This quickly told us that a very big problem was identity!

In 1945 I became Director of the USGA Green Section at Beltsville, Maryland. Soon I saw lawns on a national scale. On my first trip to California to set up turf research and to participate in the first turf conference, I heard a seed salesman recommending 15 pounds of seed to 1,000 square feet. In the mixture were redtop, bent, fescue, bluegrass. These lawns came up so thick with seedlings competing with others that disease quickly wiped out the new grass. The next recommendation was to rake out all the debris and reseed - at 15 pounds to 1,000 sq.ft.

When tall fescue appeared to be a decent lawngrass, some seed companies put five or ten percent in a bluegrass mixture. Result: isolated ugly clumps of tall fescue that were weeds.

Lawns and turf began to get their day in the sun when, in 1946, my colleagues and I convinced the American Society of Agronomy to establish a Turf Committee. I was chairman for eight years, during which time nearly every agricultural experiment station developed turf research and extension activities. That, plus the release

of Merion Kentucky bluegrass and Meyer (A-52) zoysia in 1950, gave a tremendous stimulation to the expanding turf industry. These two grasses were a sensation on a national scale. They gave lawn owners such new hope that research in breeding and selecting new cultivars became frenzied. Today everyone knows about the many choices we have among improved grasses.

From humble beginnings the lawn industry has become a giant. In 1955-56 I was involved in custom lawn maintenance in New York where Powder Blue Nitroform was first used in water suspension for spraying lawns with long-lasting slow-release nitrogen.

Grasses grown for seed in the Pacific Northwest didn't always produce the turf we wanted in the northeast. When a B-27 bluegrass was tagged to be the one to release the seed growers objected. "Seed production is too low", they said, but the seed did produce quality turf so B-27 was named Merion, and we were off and running.

When, in 1939, Doc Keyser and I put the first water seeder together for the first stretch of the Pennsylvania Turnpike we didn't visualize what we were creating for the turf industry - the hydroseeder.

When, in 1946, the first aerifier was built and tested at Beltsville and Penn State we were quite sure that we had turned a big corner in lawn management. Then came the verticut and its potential for managing thatch.

Lawn service has come a long, long way from the humble beginnings in which I was permitted to share. It has been a privilege.

THE PULSE OF THE TURF INDUSTRY

Robert Earley, Editor, Lawn Care Industry
Middleburg Heights, Ohio

My magazine is Lawn Care Industry. I would like to talk to you about government regulations as related to the lawn care industry. If you want to know what the government regulation will be in the 1980's, it will be similar to that of the 70's, and more. More regulations, more pressure from environmental groups, more public concern, more worker concern, plus the possibility of more pesticides being used. Some EPA people have said because some pesticides used in this industry are being banned or restricted, they could be replaced by others, less effective to be sure, so more of them will have to be used.

What will be the effect of the change in administration? Some say that if Jimmy Carter had stayed in office we would have had forced integrated pest management, IPM, in two years. If we are to believe what Reagan said during the campaign, there may be a slow down in regulations. This seems to be true to some extent, but these things move slowly. You might look for changes on the state level more quickly; that's where the actual enforcement is being done.

Let's talk about the Resource, Conservation, Recovery Act. You are going to be hearing a lot more about it in the coming months. The fact of the matter is that two weeks after the country elected a President to get the government off the backs of the people, that government began enforcing what may be the most complicated set of regulations ever devides. This RCRA law went into effect a few months ago, November 19, 1980. The law covers all businesses involved in hazardous waste generation, transportation and disposal. EPA officials say that for the first time since the chemical revolution began after World War II, the government will know who is generating the waste and how the wastes are being disposed of. To put the regulations in place the EPA required all companies that generate or store waste to notify the agency of their existence. Some 58,700 companies have done so, and they have been assigned identification numbers. Most lawn care companies can be exempt from the law; however, it appears that all lawn companies have the potential of becoming hazardous waste generators. To preclude possible fire and liability problems for owners and managers it is deemed advisable for people in the lawn care industry to fully understand the regulation and even register with EPA central waste generator. Due to the very serious nature of this issue, the industry needs to give it serious attention. As an industry we are very visible because we are out on the lawns every day during the lawn care season. I feel that one of our prominent concerns right now is to avoid negative publicity which could result from violation of RCRA regulations.

Please do not assume that this regulation concerns someone else. Every lawn care business should address this matter immediately by investigating the law, reviewing the current operation, and knowing the policy that is currently administered to preclude a non-exempt status. A single major violation can cause long term harm to the industry. Negligence could create public pressure to make the regulation tougher. In the chemical industry they say there are 2,000 pages of rules which took four years to draft, generated 100,000 pages of negative comment, and which composes an annual compliance burden of one billion dollars. But no one expects the newly elected president to push for their elimination because the new rules regulate hazardous chemical waste. Congress passed RCRA in 1976 and directed the EPA to get a handle on the 57 million tons of hazardous waste produced each year. EPA says that only ten percent of that waste is being disposed of properly now, a situation the new regulations are designed to correct by making chemical companies and other waste generators liable for product disposal. EPA has established careful categories of chemicals according to their potential in causing harm for environments and the public if improperly handled. At the present time quite a few products that you are using might be characterized as acute hazardous waste, including 2,4-D, Lindane, Methoxoclore, PCNB, Cygon, and there may be others. There are several exemptions in the law which are primarily the reasons why most lawn care firms can be exempt from the law. The exemptions regard the amount of waste generated or stored by each location, or a firm. If yours is a multi-location operation, the law regards each location as a separate entity.

We, as an industry, can be both a generator and a storer of hazardous waste materials, Waste is the key word. If the location generates a hazardous waste greater than the established limits within one month, it becomes non-exempt and is therefore subject to meeting the requirements of the law.

In summary, RCRA has dire potential for PLCA. We must be alert!

PREEMERGENCE, SITUATION AND USAGE

Barry C. Troutman, ChemLawn Corporation
Douglasville, Georgia

Annual grass control in many respects is the backbone of the lawn care industry. Homeowners are more aware of crabgrass than other weeds and judge performance of the lawn care program on the presence or absence of crabgrass.

Dacthal and Betasan have been the preemergence herbicides most frequently used by lawn care operators because they are reliable and cost efficient. These two products are available in both granular and sprayable forms providing a choice of liquid or dry programs.

Balan and Ronstar have been used less frequently. Until recently both were available only in granular formulation. Crabgrass control provided by Balan is somewhat poorer than that provided by either Betasan or Dacthal. Ronstar is a relatively new product which is as effective as Betasan or Dacthal, but which may be phytotoxic when applied to wet turf. In addition, Ronstar is a much more expensive treatment than either Betasan or Dacthal.

Tupersan has performed well in research plots for many years, but because it is expensive, its use has been limited to situations where seedling turf will not tolerate other preemergence herbicides. Tupersan is also used as a very early postemergence treatment providing some control of two-leaf crabgrass.

In the last two years supplies of Betasan and Dacthal have been limiting factors in their use. Both products are produced in older production facilities which are operating at near capacity. Expansion of these facilities is not likely. As a result, we can expect several trends for the future years. We can expect prices to increase and supplies to remain very tight. If growth is to continue, Balan, Ronstar, and Tupersan use will increase. Development of new herbicides will become critical to the industry. Unfortunately, our industry represents only a small market to pesticide manufacturers. If a new herbicide is developed, it will likely be a spinoff of production agriculture.

Our future is indeed a challenge. Yesterday we had to choose between Betasan and Dacthal. Tomorrow we must work to minimize Betasan and Dacthal usage while looking toward overcoming the deficiencies of Balan, Ronstar and Tupersan. Can we program to eliminate preemergence herbicides? Can we identify lawns which don't need preemergence herbicides? Will customers accept lawn care without preemergence herbicides? Lawn care has come a long way in the last twelve years. The hard work and innovation that brought us to March 1981 will be required to meet the challenges of the future.

WICK APPLICATION USE FOR THE LAWN CARE INDUSTRY

Rick Stanforth, ChemLawn Corporation
Lapeer, Michigan

The recent development of the wick applicator for use in agricultural weed control has led to the production of hand-held models that may be very useful in lawn care service. When used to apply Roundup, these applicators can control weeds that cannot be selectively controlled with conventional equipment and provide single application control of weeds that require two or more applications for selective control. In ornamental beds the wick applicator can eliminate the problem of spray drift inherent with spray applications.

Wick applicators in turf depend on a height differential between the turfgrass and the problem weed. Coarse grasses like Johnsongrass and paspalum species are prime examples of the types of grasses that can be controlled with wick applications of Roundup which would require at least two applications of a selective herbicide such as DSMA. Successful applications require the proper coordination of mowing before and after the application.

In ornamental beds, the wick applicator can be used to precisely control an application. With reasonable care an operator can touch only the problem weeds and totally avoid treatment of non-target plants.

SUPPLYING THE LANDSCAPE TRADE

Wm. J. Huber, Huber Ranch Sod Nursery
Schneider, Indiana

Huber Ranch Sod Nursery, Inc. is an 820 acre sod farm in Schneider, Indiana. It is on Route 41 just north of the Kankakee River. We have been in the sod business since 1966 and grow a five-way blend of bluegrasses called our "Executive Blend". These grasses are: Baron, Adelphi, Aquilla, Glade and Parade. The entire farm has a black sandy-loam mineral soil. It is ideal for compatability with other soils and will adapt to any use. It was a cattle farm prior to 1966 and had quite a few barms which are put to good use now as valuable warehouse space.

After we had reached an economical level of sod sales volume, it seemed that we could perform a valuable service to our customers by starting to handle some items that are essential to the landscape trade. We first began supplying grass seed and fertilizer, which are natural compliments to the sod business. We have used Northrup King and its array of blends for our prinicpal source. The fertilizer we work with is supplied by Lebanon Chemical Co. They have an excellent quality and a wide variety of analyses. The fertilizer we feature is a 12-8-4 in our own bag, called Huber's Sod Grower Special.

We have extended this line over the last few years to include timbers, railroad ties, bark, peat, topsoil, plastic products, bagged stone, and even spreaders, sprayers, and tools. We also supply straw and a hydroseed mulch called "silva fiber". We can now offer an extensive line of products to golf courses. Par-Ex made by Estech Corporation has an excellent program using slow release material. One of our big service features is forklift delivery. In this way, "shrink-wrap" or "stretch-wrap" products can be delivered in perfect condition that can be maintained in a warehouse. We also offer milorganite, gypsum, lime, and other products to enhance a maintenance program.

For years I have heard comments about the hard-to-find trees and the frequent trips that landscapers had to take in search of trees or ground cover. We were able to put together a complete line of trees and ground cover from California, Oregon, Connecticut, Tennessee, Kansas, Illinois, Michigan, and Indiana. They will all be balled in burlap or in containers. The larger trees will be in wire containers. We have several acres next to our seven acre lake set side for our trees. The thirty foot deep bays will be serviced by twenty foot stoned roads. The trees will be set up in rows, all well marked with information signs, and set on shredded bark for drainage and some moisture retention. An irrigation system and even some shade cover will be utilized to insure the trees top-notch conditions. We will re-order to maintain our variety selection and its freshness. We are also able to "drop-ship" larger quantities.

The other area we have gone into this spring is a complete line of bulk stone and bulk shredded bark. A new full truck scale will insure accurate weights. We also can deliver with semi dump trucks.

We are stricly wholesale and feel we have attained our goal of becoming Indiana's only one-stop wholesale landscape supplier.

POOR MIX - BIG BURN

Dennis Baker, Green Grow Lawn Care Service
Auburn, Indiana

One thing we worry about in the lawn care industry is a bad mix! It can come from a large company or a small supplier, but either way you end up with the problem.

You may think you are resourceful, tactful, and have a silver tongue, but when you confront forty-one customers on their lawns which look like the Mojave Desert, you find you are all alone in a hostile world.

We discovered the problem on Thursday evening, June 5, 1980. There was about a twelve hour time period between nice lush green grass and total above-ground desiccation. I called on Jon Fuller of Turf Specialties to help find the solution to the problem. Jon sampled the 2,4-D, and I sent samples of the fertilizer from the truck and large storage tank to A&L Laboratories. The tears in my eyes must have had an effect because A&L technicians worked until 11:00 p.m.

Friday as Jon and I were looking at the lawns and trying to find the answer, I left notes on the customers' doors asking them to begin watering immediately. My wife was on the telephone calling accounts affected. We had no idea what was wrong, but at that point, watering couldn't hurt anything! On Friday night at 11:00 p.m. the answer came from the laboratory. We had sprayed forty-one lawns out of a load of solution with an equivalent of 231 pounds of actual N as 28%N per acre, which equals 5.5 pounds N/1000 sq.ft. (in June).

I had promised my customers that I would advise them of the cause as soon as I knew it. So Saturday we called and left notes indicating the cause and advised them to keep watering, and that we would pay the cost incurred. We worked Saturday and Sunday starting sprinklers and moving them for our elderly customers and those away for the weekend.

For the next three Saturdays I made the rounds of the affected accounts. I tried to make sure I talked to someone directly involved so they knew I was sincere in my promise to do all I could for them.

When everything was over and calculated, we found we had sprayed 420,000 sq.ft. of lawn, spent over 180 hours in lawn inspection, overseeded 133,000 sq.ft. of lawn, and paid over $500.00 in water bills. My advice to anyone involved in a similar situation is to be sure the insurance adjustor is involved from the start because they do not have any concept of what you have to go through or spend on this kind of accident. The costs were supposed to be covered by the supplier's insurance, but be very sure you keep exact records of what, when, and how you proceed.

During the problem I had my customers were very understanding. Since I was being honest and sincere about what had happened, I was not mistreated by anyone. I was ready to take a considerable amount of verbal abuse and a limited amount of physical abuse, but received more sympathy than abuse when I told a customer I had forty more lawns that looked like his!

It is important that each of us surround ourselves with competent professionals who can help when we have any kind of problem. The superintendent at the golf course can be a valuable asset to your business.

Even after the disaster I have just described, I still feel that professional lawn care is a challenging and satisfying business.

CORING, SLITTING AND OVERSEEDING

Jim Mello, Nice 'N Green Lawn Care
Lisle, Illinois

All of us in the lawn care business have encountered yards with problems that we really can't solve. The environmental conditions may favor Fusarium blight which may cause severe damage on bluegrass. Very deep thatch is one of the basic causes of Fusarium blight on lawns. We also find Fusarium blight on lawns grown on peat sod, or laid on top of clay. The interface causes poor rooting and creates drought. Fusarium is a drought-related disease. Thatch is decomposing organic matter , and thatch high in cellulose is slow to decompose. The layering effect hinders the penetration of water. Once it dries out it is very difficult to get water to infiltrate to the rootzone for proper cooling.

The characteristic frog eye effect of Fusarium makes it easy to diagnose on a hot dry summer day, however, symptoms appearing in the fall appear to be cool weather brownpatch.

We have used fungicides against Fusarium, but the price and the results don't always justify the problems. Thatch and monocultures of Merion (and other varieties) didn't offer a good foundation for the home owner. Leafspot, another common disease, especially as the weather gets hotter and the disease approaches the melting out stage, is very discouraging. Through plant breeding we have some good resistance to the melting out stage. One solution to blight is to apply 1991 at a rate of 8 oz. per thousand (12 to 15 dollars).

The golf course people have a program of annual aerification to combat their thatch problem. They aerify twice a year for greens as well as fairways, depending on the course's budget, etc. They try to prevent the thatch problem which is a basic cause of the disease. I have been using the Dido unit and a John Deere 400 tractor which separate hydraulic fluid reservoir and down pressure from the pistons actually uses the weight of the tractor for penetration. (about 1200 pounds). A 10 or 12 horsepower unit could be used if weights are added. The transmission is a hydrostatic drive and can be used to aerify forward and reverse - a real time saver. It does seem to aerify better in reverse. It does remove soil cores which act as a topdressing. One lawn was sod on muck, and as we aerified it, it rolled up like a carpet - as if it had grubs in it. They had had problems two years before and to solve those problems they decided to put down new sod on top of existing sod. There was a quarter inch of soil and the thatch layer and the soil beneath it. We aerified in August, and by going through both layers we had good rooting by September and October. The machine is versatile. We go over the lawn about three times.

We have a slit seeding program for diseased lawns. For a 100 percent Merion lawn we introduce a blend of bluegrasses so there will be a degree of disease resistance. I have incorporated a blend of four bluegrasses and a perennial rye (15%) to be used in shade areas. Many of the lawns are fine fescue which at one time were under elm trees that are no longer there. The fescue is not good in the sunny areas and so we incorporate bluegrass. Landscapers tend to sod in shade areas, and sometimes within a year or two they thin out which proves they were the wrong grasses for those areas. A blend of red fescues with Glade and perennial rye is desirable. With the slit seeder we can apply seed to the desired areas, sunny or shady. The slit seeder has tines or blades in the front which cut a slit in the thatch and bring up a lot of debris in a heavily thatched lawn. In the back you have another row of discs which ride in those slits to keep them open. The seed drops from a hopper into the slit.

Core aerifying prior to slit seeding is better than just slit seeding. It has to do with reducing the sod layer. In some lawns with heavy Merion, aerification and the vertical mowing seem to rejuvinate the lawn. The debris from slit seeding needs to be removed. Slit seeding in the spring produces lots of weeds - broadleaf weeds, crabgrass, and winter annuals. Any disruption of the surface invites weeds, so the scheduling of the operation is important. The best time to schedule this operation is August, September or October. In areas where Fusarium blight is heavy it is better to seed in early August. Even though we will have some weed problems we do some spring slit seeding because of a few lawns that are in such bad shape. We apply Tupersan and then we slit seed in the spring. Often the custmer is dissatisfied with slit seeding; he expects too much too soon. People must be educated to realize that sod growers grow their sod from seed, and it takes one and a half to two years before that sod is ready to be cut.

Increase in the number of bluegrass varieties is good. A lawn that had much thatch and Fusarium blight was aerified and slit seeded with new varieties and one year later was much improved. Once a frog eye develops rejuvination or reseeding with the slit seeder will help to fill in the bare areas and hopefully improve later resistance. We don't go in two directions when slit seeding. In some lawns there would be nothing left if we did. In poor lawns we spread one pound per 1000 square feet by broadcast then two pounds per 1000 with the slit seeder. If the thatch is severe we rake the debris, and then spread the seed.

WHAT'S YOUR BUSINESS PLAN FOR 1981?

Steve Derrick, Professional Turf Specialties
Normal, Illinois

Each year large and small companies alike face a new season with expectations of higher sales, increased profits and increased net worth. The question facing every business is how much and when? It would take more than a well tuned crystal ball for even the best forecaster to read his market within a ten percent error. However, pro-forma forecasting can be an extremely useful guideline for funds flow and income analysis.

Your initial step is to develop a chart of accounts. List those accounts that produce income such as lawn spraying, mowing, snow removal, etc., and then list all accounts that require an outward flow of cash; chemicals, supplies, fertilizer, labor, gasoline, rent, etc. The use of a thirteen-column pad would be ideal. Each expense can be listed monthly, the last column being used for totals. All income per month is added and summarized, then all outward payments are totaled. Notice these are not expenses incurred that month, but only those that will be paid out. This is funds flow, not an income statement. Subtracting expected income from expected payments gives projected funds flow.

What does all this tell you? To some people, not a whole lot. However, if used properly this document can point out those months that will run a negative cash flow. Of course this means you will have to work harder to get more money in during these months or arrange with your bank for short term loans.

The funds flow statement leads directly into the next financial forecasting tool, a pro-forma income statement. The income statement differs from a funds flow statement in that expenses incurred during the period are included regardless of whether or not they are paid. Also, depreciation, which is not an "out of pocket" expense, is included in an income statement. Two more points: sales figures are stated as actual sales whether or not they have been collected, and a provision for bad debts can also be included.

Of course the pro-forma statement of income as well as the funds flow is only an estimate. When done correctly, it can give a manager a reasonable estimate of his forthcoming profitability. If the profit picture should look bad, he then has time to take action instead of seeing profits only at the end of the year when it is too late to make corrections. You can use these records to help you determine what is the minimum you can charge and still break even. Basically, however, you can use the well-documented records for borrowing power.

It isn't wise to depend on your competitor to determine your prices; you need to make your determinations on your own records. Don't make mistakes just because someone else had made them.

Grow Rite Spray Service
Proforma Income Statement
1981

Total Customers	3800	
Total Sales		$400,000.00
Operating Costs:		
Salaries	$106,000.00	
Chemicals	72,000.00	
Advertising	25,000.00	
Equipment Depreciation	20,375.00	
Gas	8,800.00	
Supplies		
1. Shop $20,500		
2. Uniforms 1,000.		
3. Office 1,500		
Water	700.00	
Postage	600.00	
Travel Expense	500.00	
Professional Fees	400.00	
Telephone	4,500.00	
Filling Station Setup	2,000.00	
Workman's Compensation	5,445.00	
Truck Insurance	3,681.00	
Insurance	1,644.00	
Vehical Maintenance, Gees	4,000.00	
Truck License	1,500.00	
Total		262,165.00
Net Profit		$137,835.00

GROW RITE SPRAY SERVICE
PORFORMA FUNDS FLOW
1981

	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Income	-0-	-0-	30,000	50 000	50,000	40.000	40,000	40.000	50,000	50,000	25,000	25,000
Disbursments												
Salaries	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33	8833.33
Cost of Goods	-0-	-0-	-0-	10000.00	20000.00	-0-	1000.00	-0-	1000.00	22000.00	-0-	-0-
Advertising	-0-	-0-	-0-	-0-	10000.00	1000.00	1000.00	-0-	4000.00	-0-	-0-	-0-
Gasoline	-0-	600.00	800.00	1000.00	1000.00	800.00	800.00	1200.00	1200.00	1000.00	400.00	-0-
Supplies	100.00	100.00	1000.00	500.00	500.00	400.00	400.00	1000.00	400.00	400.00	100.00	100.00
Water	25.00	25.00	50.00	50.00	100.00	100.00	50.00	50.00	100.00	100.00	25.00	25.00
Postage	20.00	20.00	100.00	150.00	150.00	50.00	25.00	25.00	50.00	50.00	10.00	-0-
Travel Exp.	-0-	0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	500.00	-0-
Prof. Fees	-0-	-0-	400.00	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Telephone	300.00	300.00	400.00	600.00	600.00	600.00	600.00	600.00	200.00	100.00	100.00	100.00
Equipment	-0-	2000.00	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Workmans Comp.	453.75	453.75	453.75	453.75	453.75	453.75	453.75	453.75	453.75	453.75	453.75	453.75
Ins. Vehicle	306.75	306.75	306.75	306.75	306.75	306.75	306.75	306.75	306 75	306.75	306.75	306.75
Insurance	138.66	138.66	138.66	138.66	138.66	138.66	138.66	138.66	138.66	138.66	138.66	138.66
Vehicle Maint.	500.00	1000.00	-0-	-0-	300 00	-0-	300.00	200.00	200.00	-0-	500.00	1000.00
Truck Lic.	-0-	-0-	-0-	1500.00	-0-	-0-	-0-	-0-	-0-	-0-	-0-	-0-
Total Disbursments	10677.49	13777.49	12482.49	23532.49	42382 49	16682.49	22907.49	12807.49	25882.49	33382.49	11367.49	10957.49
Net Flow	(10677.49)	(13777.49)	17517 51	26467.51	7617.51	18317.51	17092.51	27192.51	24117.51	16617.51	13632.51	14042.51

INDUSTRIAL SPRAYING - IDEAS, PRODUCTS AND PROCEDURES

Randy and Chris Bellinger, Bellinger's Professional Grounds Maintenance
Lafayette, Indiana

Hopefully I can convery some of what we are doing, and you can apply some of the ideas to your situation. Whether you are mowing an industrial area, maintaining a residential lawn, sweeping a large industrial area to remove clippings or applying your designed fertilizer program, the goal is the same; that is, to achieve an esthetically beautiful landscape. It is very important to keep that goal in mind. In these times when people are becoming quite specialized, our company is involved with all aspects of grounds maintenance. Because equipment is very expensive it is important to capitalize on all aspects of lawn care service.

Our spray truck serves not only for spraying but for tree service, dumping, soil sterilizing, all sorts of things. It is a multipurpose machine. It is equipped with two hose reels. One is a high pressure hose used for tree spraying; the other is a lightweight hose to be used for lawn spraying. The black hose is not used for herbicides because the oils may be absorbed by the rubber. Both are equipped with electric hose reels for ease of operation and both are 300 feet of hose.

A Ross root feeder can be attached with little expense. It is equipped with four holes and an off-and-on valve for easy control. For deep root feeding of trees - for every inch trunk diameter DBH, one-half pound N per year. This type of application is good for trees in parking lots or which are otherwise somewhat isolated. We can formulate our own mix for any tree. One redbud tree has doubled in size in the last year because we pushed it with fertilizer. Using the rod feeder aids in getting the fertilizer down to the root area.

By attaching the tree gun to the high pressure hose we can reach trees with little problem. We can treat trees 100 feet high. At 700 pounds pressure it is difficult to pull the trigger. In spraying it is important to remember which way the wind is blowing; work up-wind. We apply a dormant oil spray to silver maples. We can apply the iron treatment for iron chlorosis on pin oaks, however, the best method is to deep root feed them. Our engine is a 18 horsepower one. A twist of the wrist can adjust the gun spray to treat smaller trees and shrubs with a fan spray. We can attach the lawn spray gun when the deep root feeder is removed. This gun does not corrode and can be used for several applications, such as a soil sterilant. We apply it on drive ways or parking lots that are being taken over by grass. For the use on a lawn, 100 pounds pressure seems best.

It is nice to have a weed-free turf. One industrial lawn had lots of dandelions prior to the application of our mix of weed killer. Four hours following application wilt was evident. For large industrial areas we use a Groundsmaster 72 with a front mounted sprayer. This sprayer with a 15 foot boom and two 25 gallon tanks can cover about three acres without a refill.

To maintain some large areas we usually mow twice a month, but since they are near residential areas we need to keep down the weed population. The large trucks can be used in areas such as this with no damage to the lawn. We used pipe to make booms for the sprayer; the holes and height are adjustable and have flood jet nozzles.

For us it is fun to find neglected areas and have the opportunity to improve them. First we mow the area and then apply an oil sterilant, haul in gravel and in general improve the total area. We do a lot of railroad sterilizing, not for the railway companies but for industries. Alcoa has seven miles of track within its yards. Our truck is designed to run on the tracks, hydraulic systems, just pull the lever and the wheels are in place. The back end is adjustable so you can adjust the amount of pressure on the rail. We normally spray a 15 foot width. We have a control valve in the truck and in this way the solution can be turned of when crossing drives, etc. Getting the unit on or off the rails can be done in about five minutes. With the use of turnbuckles and chains and the use of a screw driver we can hoist this unit off the truck bed, and that makes the truck available for other uses. The boom is lowered onto a dolly made specially for the tank and stored in another part of the shop - a ten minute operation.

Each of these operations contributes toward our goal of making areas more beautiful.

PUBLICIZING RESEARCH

Dr. Robert W. Schery, The Lawn Institute
Marysville, Ohio

Perhaps we had best begin by examining what "research" is. Certainly it has come to be big business in the modern, technological world. No wonder, then, that one of the motivations for research, especially the applied research of the commercial world, is to gain expertise which will enhance profitability. An equally strong motivation in the academic world involves satisfaction that comes from achievement, acknowledging that this leads to personal advancement and prestige.

The multifarious results from research are generally highly technical, abstruse to the average individual. Being at the leading edge of discovery, they are ill-defined and always changing. How is the 99 percent-plus of the population not directly involved in such research to be made aware of its importance? Because the dollar makes the mare go - and often it is the tax dollar - researchers increasingly realize the need to acquaint the public with research and its benefits. Today, when belligerants seek a "whipping boy" for the ills of the world, it even becomes necessary to counter an anit-science attitude. Most scientific societies are trying to better explain themselves to the lay public, something Dr. Daniel and the Midwest Regional Turf Foundation have done for years through meetings such as these.

Few research workers, individually, take pains to explain their activities publically. Partly this is because there just isn't time nor easy opportunity. Partly, a "salesperson" personality is foreign to scientific methodology. And partly, some professional conceit exists, such that peer approval results from communicating within the group, not from popular indulgences: thus researchers are generally talking to one another, not to the non-specialist.

Just as corporations discovered the advantages of having a public relations department, "pure" science is realizing the desirability of conveying information about its research accurately and broadly.

Which brings us to the mechanism for getting information out. Our Lawn Institute has found effective ways for distributing information. One can't always foresee the opportunities for communicating with the public, so it is necessary to be constantly alert. Avenues for expression include personal presentations, invitational appearances on television and radio, but especially the written word. Flooding publications with convenient, authoritative, easily-utilized items of information is de rigueur. Press kit mailings, custom articles and stories, correspondence, informational leaflets, and so on can all play a part.

Yet a "mechanism" is of no avail if not accompanied by adequate talent. All too often a public relations house quite adept with mechanisms fails for lacking expertise in the field. Someone must scrutinize every step, guiding the flow of information to be certain the fruits of research are properly explained. One boo-boo can destroy the credibility of a major, costly effort. Of course information must be conveyed in a literate fashion.

Publicizing research should not be difficult,for an innate hunger exists for new information. Present this information with the golden rule in mind, i.e. - Do unto others as you would want done unto yourself! A few reminders may help polish up your public relations techniques:

- Put yourself in the place of your reader/listener; use understandable language, but don't "talk down"; avoid unintelligible expressions (e.g. statistical significance, specialized vocabulary).

- Try to achieve smooth-flowing expression that conveys interest and excitement, but stay "down to earth" avoiding "slick" mannerisms that breed distrust; humor adds interest; personal involvement in research instills confidence.

- Be as brief as possible, or provide summaries for longer presentations; highlight important points, explaining why these make a difference to the reader/listener.

- Emphasize the positive. Useful end results are what the reader/listener seeks; he is often appalled by expense, tediousness, or difficulty (as is often characteristic of fighting turfgrass diseases, for example).

- Try to forsee irreconcilable obstacles, and not dwell upon them; but be honest - it is better to say "I don't know" than to feign expertise. There will be conflicts, because all human activity depends upon support from other human beings, and not all agree; recognize this, but don't let it compromise personal integrity.

NEW CULTIVARS AND TURF CARE

Dr. Robert Schery, The Lawn Institute
Marysville, Ohio

Specially bred and highly selected turfgrass cultivars are a fairly recent innovation compared to agricultural crops for which "varieties" have been chosen since time immemorial to enhance production and facilitate harvest. It began with Merion bluegrass about mid-century, and is currently reaching a crescendo. Merion (and subsequent improved cultivars) proved that without doubt a market exists for better quality, esthetically pleasing turfgrasses even at a premium.

New cultivars are invariably screened for low-dense growth and disease tolerance. However, other characteristics can weigh heavily, too - things like durability under climatic extremes, vigor, tolerance of special conditions (such as acidity or alkalinity, or chemical treatments), and so on. Indeed, today, sophisticated choice may extend to color, texture, length of season, response to weather, palatability to insects, seed size and its germination, compatibility in mixtures, tendency to thatch, mowing quality, perhaps even allelopathic responses. In short, a new cultivar may feature almost any imaginable quality, but it must show no serious deficiency in other respects.

The breeding of new cultivars follows many avenues. Sometimes this is simply left to nature, and selection made from the grasses on display. This has been particularly successful with Kentucky bluegrass, where a high level of ploidy and aneuploidy allow a good bit of genetic heterogeneity even with an apomictic "inbred". But proven bloodlines have been isolated and crossed, too, to yield elite cultivars.

With the perennial ryegrasses and most of the fescues, well-adapted bloodlines are isolated, then intermixed for random crossing (the "polycross"). Parental lines are subject to rigorous mass selection and isolation, of course, but polycross recombination seems to impart enough heterogeneity here, too, to avoid inbred weaknesses. Some turfgrasses are used as pure lines, an attestation to the remarkable flexibility within the grass family. Interspecific crossing to yield sterile progeny has proven remarkably successful where vegetative propagation is feasible, notably so with the "Tifton" series of bermudagrass hybrids (Tifgreen, Tifway, Tiffine, etc.).

With seeded turfs, two or more cultivars may be combined into a blend, or two or more species into a mixture. This further diversifies the planting in anticipation of a differential environment. In some instances synergesis seems to occur, as when the stand better resists disease than might a monostand. The broader adaptability of a mixture is constantly witnessed, for instance where one component dominates in the shade, another in the sun, or where one covers quickly until another can gain ascendency. One might regard blends and mixtures as turf care "insurance".

Of course turf care is involved with the interplay of many factors; few can be foreseen, and many are subtle and hardly measurable. Their interaction with the cultivar's genotype will determine success. A skilled turf manager directs major inputs - things like fertilization, mowing height, irrigation, and where necessary, pest control. Less pronounced, more subtle responses are characteristic of cultivars within a species; indeed, a cultivar's personality may differ from one location to another, or under one kind of management as compared to another. And with scores upon scores of cultivars these days, it is all but impossible to chart individual characteristics with meaningful exactitude.

I try to keep up with observations concerning the Lawn Institute's Variety Review Board acceptances. Even for just this limited group of about 40 selections it is hard to develop full scale information. Seldom is any cultivar rated "tops" in all areas, by all observers, under all modes of care; early in the season as well as late, and year after year. Reciting the evaluations for even a handful of the VRB acceptances would be deadly boring. What I can state confidently, however, is that comparing almost any modern selection to old-fashioned common grass usually reveals striking differences. Newer cultivars are almost invariably more attractive, because they are more disease resistant, more decumbent (thus retain more foliage after mowing) and more responsive to care. Under neglect some of the old-fashioned selections stand out, at least in certain habitats, 'Arboretum' bluegrass, for example. More cultivars are being chosen for minimal care aptitude now that everyone is so conscious of fuel scarcity and soaring costs.

In summary, the "new cultivar revolution", although perhaps confusing, has brought the kind of respect once accorded mainly crop plants to the ornamental turfgrass realm. The fruits from the breeding and release of improved cultivars should yield more attractive, more readily maintained, less troublesome turf for America in the years ahead. Certainly there will be ample cultivars.

PURDUE AND ITS CHANGING LANDSCAPE - IMPLEMENTATION OF ARBORIST PROGRAM

Patrick S. McDonald, Landscape Supervisor
Purdue University, West Lafayette, Indiana

You have had an opportunity to tour our campus and have noticed the construction that is in progress. Eight projects are in process, and four are in the planning. As you can see, Purdue is growing, and the landscape has taken on a new face.

Our campus is becoming increasingly crowded with new buildings, and we are finding ourselves losing the open green areas that once predominated the campus. At the same time, we find that areas that were once parking lots are now buildings accompanied with extensive, detailed landscapes. Perhaps this is not new to you, but to our department, it is going to have a drastic impace on the way we will maintain the campus in the coming years.

A parking lot used to exist where the A. A. Potter Engineering Center now stands, and now it consists of islands of vegetation that require additional maintenance, where maintenance was virtually unneeded before.

As part of the "overall landscape plan" of Purdue, most of the existing parking lots will be slowly eliminated and parking garages will be located along the perimeter of the campus, as some already do. The ultimate goal is to "block off" all traffic going into the main campus, and thus making an "all pedestrian campus". Keeping the campus compact will allow time for class changes to remain at ten minutes.

With the new buildings going up we have discovered that the landscapes around them are becoming very compact and detailed, which require a more skilled employee (and additional training). I would like to show you a brief comparison study.

The old (and now defunct) Pierce Conservatory was a small laboratory building with greenhouses. Utilization was limited. But with the new building, student use is heavy, which adds additional maintenance such as litter removal and trash disposal. There will be three times as many shrubs around the new building. Another maintenance consideration is the increase in bike pads and sidewalks which will require snow removal.

As a result of this larger new building turf areas have been reduced in size. Labor time has increased due to the need for trim-mowing with the small pushmower.

The old Pierce Conservatory landscape consisted of 25 well established trees and about ten shrub beds. This landscape required very little maintenance. The new building has a landscape that consists of 155 trees and 880 shrubs. With this amount of plant material to be installed, maintenance requirements will more than double, and the cost will be exceedingly high until plants have become established. Pruning needs will increase drastically in a few years. Many hedge-type plantings have been installed and pruning demands will be higher in order to keep those trees and shrubs "in bounds" off and away from adjacent walks and bike pads.

The old Pierce Conservatory landscape did not have any wall ivy or ground cover, but the new building landscape will include wall ivy and extensive groundcover beds. Groundcover will definitely cut down on our weed removal costs, but groundcover must also be maintained and kept "in bounds".

With the expansion of campus (as far as increase in buildings), the landscape has become more compact and detailed, which will require more skill in maintaining the variety of plant material being installed. Additional labor with good skills is expensive and hard to come by, especially when we are anticipating some budget cutbacks.

In the past we have depended heavily on private contractors to do most of our tree work. But with the increasing tree population (9,345 trees as of January 1981), and most of the trees being young (20 years or less), we felt that it is time to start a more comprehensive, scheduled tree maintenance program. We now have a full-time arborist and hope to hire another arborist in the next year or two. We also have obtained a new tree truck with utility bed designed to fit our specifications.

In closing, I wish to say that the future holds a lot of challenges for us, but I feel that we will get that pot of gold at the end of the rainbow.

TURF MAINTENANCE AT PURDUE UNIVERSITY

David L. Stark, Turf Supervisor
Purdue University, West Lafayette, Indiana

There are over 500 acres of turf to be maintained regularly on Purdue's main campus and its surrounding facilities. The quality and types of turf vary from fine bluegrass lawns to tall fescue-rye mixtures that are used at the airport and other low maintenance areas. It is the goal of our department, and specifically the turf section, to ascertain pleasing and aesthetic turf areas throughout the university's properties.

Turf maintenance is a viable and actively changing profession. As landscapes become more intricate, different types of mowing equipment are needed to provide the proper maintenance. Changes are also dictated by higher labor, fuel and equipment costs. This was our mowing crew about five years ago. We are still doing the same job, but the numbers and types of machines have changed. We currently operate a F-10, F-20, 15' Batwing, four small riders, two Jacobsen and two Groundsmaster, ten 21" push mowers and two trimmers. The Nationals and Toro Professionals are used on occasion as backups.

These were the small riders that were used to trim areas that the large mowers couldn't reach. The National and the Toro Professional are still used in certain areas due to their excellant performance in these specific areas. The National is used specifically on steep hills and banks while the Toro Professional is used in areas where a fine cut is desired. The Yazoos that we have are in poor mechanical shape and are being replaced with Jacobsen Turfcats or Toro Groundsmaster.

The Roseman was once a mainstay in our mowing system but is now used solely as a backup machine for the F-10 and F-20. The tall cabs mounted on our tractors decrease the closeness of mowing under trees and other obstacles.

The F-20, F-10, and a 15' Batwing rotary mower are our main large mowing machines. The F-10 and F-20 mow all the large bluegrass areas on campus while the 15' Batwing mows the airport and other rough outer areas that we mow. Most lawn areas are mowed once a week.

The small riding lawn mowers that have all but replaced the Yazoo, Toro Professional and the National, are the Toro Groundsmaster and the Jacobsen Turfcat. These machines provide us with good maneuverability, good cutting quality, excellent tranport speed and the ability to jump curbs. They also have a large fuel capacity that allows them to run all day on one filling.

The 21" push mower is still needed in many areas to add the finishing touches. The 21" Dayton lasts one to one and a half seasons. The cost of this machine is roughly one-third the cost of the commercial mowers and is lighter in weight. This is an important fact since we hire some women who can't easily handle a heavier mower all day or on hills or banks. This mowing season will be the first year to eliminate trimming with hand clippers. In past years we have had our operators stop their mowers and trim around sidewalsk, buildings, sign posts, street lights, etc. This year we are going to try to do all of our trimming using two nylon string trimmers.

Another aspect of turf maintenance is the removal of clippings, litter, leaves and debris from the turf area. This is accomplished through the use of Toro leaf vacs, hand labor and other leaf vacuuming machines.

Leaf removal is a long drawn out operation that runs from fall to spring clean-up. We have attached a vacuum to one of our trucks which is enclosed with plywood sheets and covered with a canvas top. It picks up piles of leaves that have been raken into place by hand laborers.

With the construciton of new buildings and malls, irrigation to maintain these areas is a necessity. Our irrigation specialist works with a two to three man crew to install new irrigation systems that provide adequate moisture to fine turf areas. He is also responsible for repairing and maintaining existing irrigation systems.

Our turf construction crew has the job of rebuilding lawn areas after utility repairs, building construction or any other incident that results in turf damage. Sodding is most often done to restore a job site since we want instant green and need to establish lawns in a very short time period. In areas that allow it, tiller-rakes are used to prepare the area. Unfortunately, most of the work has to be done by hand labor.

Our turf construction crew consists of two full-time employees and six seasonal employees. This crew sods and repairs areas from early spring to late winter, depending on the weather.

The sod is cut and transported from our 30 acre sod field located west of campus to the job site. The sod consists of a blend of four bluegrasses and several different blends are available. We have two sod cutters that we use. One is used strictly for cutting of our sod while the other is used as a grading tool to help loosen up existing vegetation, thus making the grading job easier.

The sod field is mowed once or twice a week at 1-5/8 inch. Herbicides and fertilizers are applied at the same time and rate as on the main campus. Areas that are being harvested for any particular season, however,are given special treatment. This may consist of more fertilizer, extra herbicide treatments and irrigation. This is done to insure good quality sod.

An irrigation system is used for watering newly seeded areas and areas that are being harvested. Irrigation for the whole sod field is not available. Our production time from seed to harvest is approximately two and a half to three years. Since our yearly harvesting of sod doesn't reach a third of our total sod area, there is no reason to reach a harvest date any sooner. This extra time also allows for the development of a strong sod.

Our turf spray program is handled by one man and a Cushman vehicle with a 100 gallon tank Bean sprayer. It is equipped with three five foot booms that can be turned on in several combinations. The two outer booms can be raised from within the cab to allow for greater efficiency and maneuverability.

The turf applicator applies not only broadleaf herbicide but also preemergent and total kill herbicides. He makes one application of a preemergent herbicide, two applications of broadleaf herbicides and sprays sidewalks, electrical vaults, fences, streets, etc. with a total kill herbicide. He is a certified pesticide applicator in both ornamentals and turf, and is expected to keep abreast of usage and regulations concerning pesticides. Our good quality turf areas, weed-free sidewalks, and other well maintained areas are due to the effective herbicide program.

Our fertilization program consists of two applications of 18-5-9 fertilizer. It is applied at the rate of 1-1/2 pounds of nitrogen per 1000 square feet. The first application is applied starting May 15, while the second applicaton is begun September 15. Each application takes approximately two weeks. A Lely spreader is used to apply fertilizer to all large areas while hand spreaders reach those areas too small for a tractor.

Almost all equipment maintenance is done in our own shops. Our mechanics do repairs that range from rebuilding engines to grinding reels and bedknives. Cleaning of all mowing equipment is done during the winter months. Machine parts are coated with "Gunk" cleaner, and are then washed down with a jet stream of water. Machine parts are then dried and painted if necessary.

A vital part of our organization is communication. All trucks are equipped with FM radios that enable us to communicate with our people and also so that they can call back to the shop in case of emergency, equipment failure or a question about job assignment.

There is a network of underground tunnels that criss-cross the campus. They vary from 4 inches to 10 feet underground and can cause soil temperatures to reach 90-100° F. At present zoysia can survive these conditions and is used on a limited basis.

Another problem is vehicular traffic on turf areas. Parking is at a premium on Purdue's campus, and any area not posted or not having a curb is open game. Pedestrian traffic presents quite another problem. Well traveled paths are as hard as concrete and can't support vegetative life. Better planning and landscape design could eliminate many of these problems.

A COMPUTER PROGRAM PACKAGE FOR GRASS CULTIVAR AND SURFACE APPLICATION TEST PLOT TRIALS

Phil Hess, Applications Programmer
Department of Agronomy, Purdue University, W. Lafayette, Indiana

The six interactive programs which make up this package were written in 1979 to meet the anticipated turf data organizing and processing needs of W. H. Daniel and R. P. Freeborg, both of Purdue's Agronomy Department. Two programs, ENTER and RANK, allow the user to enter, edit, average, rank and output data gathered from grass test-plot trials whose designs were stored using a third program, LAYOUT. Additional variables can be defined using a fourth program, UPDATE. CATALOG allows the user to list and change pertinent information about an experiment's data base. Another program, STAT, initiates an analysis of variance on user-selected data.

Each program is written in Digital Equipment Corporation's PDP-11 BASIC-PLUS language, as implemented on DEC's Resource Sharing Time Sharing System, RSTS-11 (version 6A-0Z), running on a PDP 11-45 computer at Purdue's Agricultural Data Network. BASIC-PLUS is an extension of BASIC as originally developed at Dartmouth College, and provides many useful features which the earlier version did not have.

The programs are self-documented to a certain extent, with comments interspersed throughout each listing. Additional documentation has also been written, including variable and line number cross-references, variable and file number definitions, a user's guide, and a programmer's guide. These documents are not included here, but they are available.

All input is done interactively on the terminal, while output can be directed to either the terminal or the lineprinter. Each program produces one or more different listings reflecting its particular function(s). These listings are in a form suitable for proofreading, filing, and photocopying.

SHARING HOME AND GARDEN INFORMATION

Dr. John A. Wott, Department of Horticulture
Purdue University, West Lafayette, Indiana

The interest in consumer oriented horticulture products began to expand rapidly during the years of the Green Revolution. It was fueled by the Green Belt programs of the Johnson Administration as well as the "back to nature" and environmental movements. Rapid expansion in the construction market also created a new clientele in the landscaping-ornamental fields. This has rapidly spread to include the use of indoor plants for aesthetic purposes.

During the last decade, interest in family food gardening also grew. A peak in vegetable gardening was reached in 1975 when 49 percent of the households were gardening. In 1980, the incidence was 43 percent, but gardens were larger and more varieties of vegetables were being grown. In addition, the Midwest has consistently had the highest percentage of food gardeners (55 percent).

The home horticulture program in Indiana involves plant, product, and culture-oriented information. The position at Purdue is staffed by a full time faculty member , Dr. John A. Wott, and a professional assistant, Juliann Chamberlain. The staff must interact with other members of the academic community, the commercial growers, wholesalers, and retailers as well as the ultimate consumer. Information must be related in both directions of the chain of communication, i.e., informing scientists of society's needs and concerns as well as introducing new information to the field.

The Home Horticulture Program in Indiana is a model for other programs in the United States. Not only does it serve the five and one-half million people of Indiana, but it also is known nationally. It encompasses a full array of informational techniques.

Presently there are 130 horticulture, 56 botany and plant pathology, 46 entomology, and 16 agronomy (turf) publications available through our county extension offices. All but one are free of charge, and some are dual purpose (commercial orientation). In 1980, it was estimated that 200,000 publications were distributed.

In 1980, 174 pages of Home/Yard/Garden news was released to 433 media. These include short, how-to-do stories, feature articles, and camera-ready materials.

The Home/Yard/Garden Radio tape service supplied over 3000 one-minute tapes on garden subjects. Estimated value of this radio listening time was $975,000 in 1979. A regular weekly TV tape service was sent to five television stations. This supplements the regular TV programming already conducted by extension agents.

The program also has built a library of trifold (3' x 4") displays for use at Flower Shows, Fairs, and general exhibits. Seven Communikits on Planting Ornamentals, Pruning Ornamentals, Annual Flowers, Ground Covers, Shrubs, Trees, and Roses (averaging 150 slides each) have been developed which include slides, written pictoral script, cassette tapes. Several of these have been in demand nationally.

The specialists annually conduct numerous garden schools, plant clinics, etc. in the counties, and the agents receive training in all areas of home horticulture. A major exhibit is annually displayed at the Indiana Flower and Patio Show, Indianapolis.

In 1977, a Master Gardener program began. Thus far 283 Master Gardeners or volunteers have been trained. This has grown to include an Advanced Master Gardener program and a Professional Gardener program.

The Vegetable Garden Plan program was developed in 1977-79 as part of the FACTS state-wide computer system. This program has been widely accepted. It has been licensed to a major seed company who is selling it as a part of their retail garden program nationwide in 1981.

PESTICIDE REGULATION FOR INDIANA

Richard Kercher, Indiana State Chemist's Office
Purdue University, West Lafayette, Indiana

I am sure most of you have had experience with the friendly EPA or OSHA representative who called on you and said he was there to help you... Well, I am the friendly Indiana State Chemist representative who is here to help you. You can believe that or not, depending on your conscience or guilt feelings. Dr. Daniel asked if I would discuss some of our field experiences.

The Indiana Pesticide Use and Application Law went into effect in October of 1976 and states that anyone applying restricted use pesticides must be certified and licensed. The law also states that any individual or business applying any pesticide for hire in Indiana must be certified and licensed or have a certified and licensed person in the business who shall supervise and be responsible for all pesticide applications.

I have been a County Extension Agent and have operated a landscape nursery. Since December 1976 I have traveled the State of Indiana from one end to the other calling on licensed and unlicensed applicators and investigating pesticide complaints of various types. Although it doesn't happen as much now as in the past, I have always been amazed at the number of individuals who do not understand or want to understand pesticides. Many times I've advised individuals whom I found spraying weed killer for hire that it was illegal to spray pesticides for hire without being certified and licensed, only to have the individual say, "Oh, I'm not using any of those dangerous pesticides. I'm only spraying 2,4-D." I have to advise them that the law defines a pesticide as any substance or mixture of substances which is intended for preventing, destroying, repelling or mitigating any pest, and of course, anything you don't want, such as weeds, is a pest.

As far as the turf industry is concerned, we've had very few problems, and most of those have been due to failure of the applicators to have correct written guarantees and to provide them to the customer. Normally we advise the party as to what needs to be done and check back later to see that he is complying with the law.

Most of the problems in pesticide enforcement as experienced by our office appear to me to be due to (1. breakdown in communication; (2. failure to read the pesticide label; (3. lack of respect for rights of others.

The State Chemist's Office is interested in helping you live with the Pesticide Use and Application Law. Abuses of the existing law would result in further restrictions. Most of our enforcement problems are not with applicators who attend professional meetings and attempt to improve their professionalism, but rather with those who seemingly expend more time trying to circumvent the law than attempting to live with it.

I am entrusted with the job of enforcing the Pesticide Use and Application Law, and that I do, trying to realize in each situation how the pesticide applicator is thinking since I have been in his shoes.

EVALUATION OF THE POTENTIAL PESTICIDE EXPOSURE TO LAWN CARE APPLICATORS

R. P. Freeborg, W. H. Daniel, Department of Agronomy
Purdue University, West Lafayette, Indiana
V. J. Konopinski, Indiana State Board of Health, Indianapolis, Indiana

Only the wrists and thigh areas of lawn spray applicators showed pesticide accumulation!

Within recent years the commercial lawn care industry has developed into a major business employing thousands of applicators who treat millions of residential and industrial lawns with pesticides. The rapid development of the custom-type lawn care (since 1955) reflects the demand for such a service.

Home owners who avail themselves of the outdoor maintenance services expect qualified people with professional equipment to apply the correct materials, including pesticides, at the proper time to obtain desirable results.

Pesticides used for pest control on these sites are, by necessity, those that have low toxicity levels.

Pesticides

Preemergent annual grass control:

- bensulide--Beta-San, Pre-San, Lesco-San
- DCPA--Dacthal
- Balan

Broadleaf weed control:

- 2,4-D--amine formulations
- MCPP--mecoprop
- dicamba--Banvel
- also combinations

Insecticides

- diazinon--Diazinon, Spectracide
- chlorpyrifos--Dursban
- trichlorfon--Dylox, Proxol

Occasionally ome may find other pesticides being applied when a local condition or problem warrants their use.

Exposure studies to evaluate potential applicator exposure to diazinon insecticide were made on 3 August, 18 and 28 September, 1979, and for the insecticide trichlorfon on 5 September 1979.

Materials and Methods

It was the intent of this study to determine both inhalation as well as dermal (skin) exposure. Air sampling began during tank preparation procedures and continued until application equipment was returned to the garage. Inhalation exposure time is reported as actual time in the process of spraying the pesticide, as well as total work time including tank preparation, travel, application, and clean up time. (Table 1)

The following data were collected from each of four exposure sites. Three were for diazinon and one for trichlorfon exposure. Both of these are organophosphate insecticides. All studies were made under actual conditions normal for the application procedure. Data are reported so that similar pesticides may be compared. They are not reported in chronological order.

Test 1

Location: Company - Nice 'N Green
Downers Grove, Illinois
Applicator: Mike Oatis
Date of application: 3 August 1979
Insecticide: Diazinon AG500, liquid
Application rate: 2.7 lbs. ai/acre
Total work time: 300 minutes
Total exposure time: 113 minutes

Sample ID	Concentration of diazinon micrograms/100 sq.cm [1,2]
Surgipad	
front upper	6.9
back upper	6.9
right wrist	3.9
left wrist	19.9
right ankle	6.9
left ankle	6.9

1. One ounce contains 28.3 grams or 28,300,000 micrograms
2. An area 100 cm^2 is approximately 4 inches x 4 inches

Test 2

Location: Company - ChemLawn Corp.
Indianapolis, Indiana
Applicator: Dave Souder
Date of application: 18 September 1979
Insecticide: Diazinon AG500, liquid
Application rate: 5.5 lbs. ai/acre
Total work time: 400 minutes
Total exposure time: 106 minutes

Sample ID	Concentration of diazinon micrograms/100 sq.cm.
Cotton gauze pads:	
front upper	12.8
front lower	12.8
back upper	12.8
back lower	12.8
Surgipads	
right wrist	5.9
left wrist	5.9
right ankle	23.7
left ankle	5.9
right thigh	29.6
left thigh	189.4

Test 3

Location: ChemLawn Corporation
Indianapolis, Indiana
Applicator: Dave Souder
Date of Application: 28 September 1979
Insecticide: Diazinon (granular) 5% GR
Application rate: 5.5 lbs. ai/acre
Total work time: 326 minutes
Total exposure time: 34 minutes

Sample ID	Concentration of diazinon micrograms/100 sq.cm
Cotton gauze pads	
front upper	12.8
front lower	38.3
back upper	9.2
back lower	12.8
Surgipads	
right wrist	43.4
left wrist	130.2
right ankle	17.8
left ankle	6.9
right thigh	592.
left thigh	237

Test 4

Location: ChemLawn Corporation
Indianapolis, Indiana
Applicator: Rod Haggart
Date of Application: 5 September 1979
Insecticide: Dylox (trichlorfon) W.P.
Application rate: 8 lbs. ai/acre
Total work time: 456 minutes
Total exposure time: 161 min.,application
24 min.,trans-mixing

Sample ID	Concentration of trichlorfon micrograms/100 sq.cm
Cotton gauze pads	
front upper	n.d.[1]
front lower	n.d.
back upper	n.d.
back lower	n.d.
Surgipads	
right wrist	n.d.
left wrist	0.35
right ankle	3.5
left ankle	2.1
right thigh	1.0
left thigh	1.4

1. none detected

Inhalation exposure, diazinon

The amount of diazinon to which operators were exposed via inhalation was 0.010, 0.023, 0.013, and 0.021 mg/cu m of air for the total work day. Work day times varied from 67, 300, 400, and 625 minutes. The amounts applicators were exposed to if the measurements were based on application time only were 1.11, 0.061, 0.48, 0.205 mg/cu m. Actual application times were 6, 113, 105 and 34 minutes. Table 1.

When inhalation concentrations were determined based on a TWA (Time Weighted Average) work day, the total exposure concentration was less than 0.1 mg/cu.m TWA established. However, when determined based on actual application time, exposures for 23 July of 1.11 and 29 September of 0.205 mg/cu. m were recorded. These two exposure levels were above the 0.1 mg/cu. m TWA. These exposure concentrations, however, were based only on actual time required to make the application. The Threshold Limit Value-Short Term Exposure Limit (TLV-STEL) for diazinon is reported as 0.3 mg/cu. m. Thus, based on the STEL, on 23 July only,the exposure level was still above the 0.3 mg/cu. m limit.

The STEL should be considered a maximal allowable concentration, or ceiling, not to be exceeded at any time during a 15-minute excursion period. The actual spray application times for these four dates were 11, 158, 201, and 65 minutes. These time periods are an accumulation of multiple individual home-site treatment times. The average time spent treating on any one residential site was approximately six minutes.

Table 1 - Custom lawn applicator exposure to insecticides, 1979

App. Date	Pesticide	Flow rate	Exposure Total/[1]	App./[2]	Total	Air Vol. App.	Filter analy.	Concentration Total	App.
		l/min.	minutes			liters	mug.	mg/cu.m.	
3 Au	diazinon	1.4	300	113	420	158	9.6	.023	.061
18 Se	"	1.9	400	106	760	201	9.6	.013	.048
28 Se	"	1.9	326	34	619	65	13.3	.021	0.204
5 Se	trichlorfon	1.9	456	161	866	306	2.	.002	.007
5 Se/[3]	(mixing)"		24			46		0.109	

1. Total time is based on time from initial morning operation procedures until spray truck is returned to garage
2. Application time is that which was devoted to spray application only
3. Mixing time is that required to prepare the tank mix for application

Inhalation exposure, Trichlorfon

There appears to be no available TWA or TLV-STEL for trichlorfon. However, based on the organophosphosphate level as established for diazinon, the concentrations of 0.002 for the total work day and 0.007 mg/cu.m for the application time were low. The concentrations of 0.109 mg/cu. m measured during tank preparation was at the 0.1 mg/cu. m TWA limit value, but below the 0.3 mg/cu. m TLV-STEL established for diazinon.

Dermal exposure, Diazinon

Dermal concentrations were determined by adhering absorbant pads to the body and then extracting the insecticide adhering to the pads.

Front and back body pads as well as ankle pads generally showed only traces or low levels of diazinon. Pads with the greatest amount of exposure contamination were those on the wrist and on the inner thigh just below the scrotal area. Table 2 includes a list of wrist dermal exposures.

Table 2 - Wrist dermal exposures

Date	Wrist Right	Left
	mug/100 sq.cm.	
23 July 1979	6.9	6.9
3 August	3.9	19.9
18 September	5.9	5.9
28 September	43.4	130.2

Concentrations above the lower detectable limit were found on 3 August, left wrist 19.9 micrograms/100 sq. cm. pad, and on 28 September, right wrist, 43.4 and left wrist, 130.2 micrograms/289 sq. cm. It should be noted that on 29 September the applicator used his left hand to hold and guide the spray application. This may partially account for the greater exposure concentration on the left wrist.

The highest exposure levels were found on the 289 sq. cm. pads taken from the upper thigh, scrotal area. Table 3.

Table 3 - Thigh-scrotal area dermal exposures

Date	Thigh exposures Right	Left micrograms/100 cm^2
18 Sept. 1979	39	189
28 Sept. 1979	592	237

Thigh samples were collected only on the last two dates of the exposure study. The application on 18 September was a liquid spray, that on 28 September was a dry granule applied with a rotary type spreader. In practice, the applicator normally walks at a brisk pace, and the hand held nozzle releasing the spray is swinging from side to side in a rythymical motion. During several hours of operation the clothing and internal pads received some material in the thigh area. Exposure was greater for the granule than that experienced from the liquid spray application.

Dermal exposure, Trichlorfon

Dramal exposure levels for trichlorfon were not detectable on the front or back of the upper body. Also all wrist and ankle pad exposures were low. The thigh exposure levels did not reflect those high concentrations measured for diazinon.

Conclusion

In conclusion, it would appear that inhalation exposure levels based on total work day time are below the TWA for organophosphates diazinon and trichlorfon. Dermal exposure levels were generally low, the exceptions being that for the wrist and thigh-scrotal area, and for the STEL for inhalation on 23 July 1979. Frequent cleaning of hands and wrists would tend to reduce the potential for a build-up in the wrist area. Thigh-scrotal area concentrations, which were high on two occasions, may need additional confirmation. To reduce the exposure in the thigh area an adsorptive but water-proofed backed apron could shield the applicator using hand held spray nozzles and protect this part of the body from potentially hazardous exposure levels.

EVALUATION OF THE UTILIZATION OF PESTICIDES APPLIED TO RECREATIONAL TURF

R. P. Freeborg, W. H. Daniel, Department of Agronomy
Purdue University, West Lafayette, Indiana
V. J. Konopinski, Indiana State Board of Health, Indianapolis, Indiana

Summary

Only wrist and hand exposure proved significant when workers on golf courses applied pesticides according to detailed studies in 1978-79 by Dr. W. H. Daniel and Dr. R. P. Freeborg of Purdue University.

Data was secured on four different fungicides and two insecticides during applications made on eight different dates and which involved three different methods of spray application.

Inhalation determinations were surprisingly low in all applications. Any form of clothing effectively minimized body exposure as indicated by test pads placed on the body. Applicators normally apply product for two to four hours about 15 times per season with changes in pesticide utilized for best control. Applicators normally work upwind of the point of application during outdoor application; thus exposure to a chemical is minimized.

Introduction

The frequent use of pesticides in turf management has become a cause for concern as to the degree to which an applicator may be exposed to them. The major objective of this study is to measure concentrations of pesticides a golf course spray applicator would encounter in the performance of his assigned work schedule. Where possible, an effort was made to measure those pesticides that had been placed under the existing Rebuttal Presumption Against Registration (RPAR) classification. All exposure studies were made during the normal work schedule and under actual field conditions.

Pesticide treatments of the golf course putting greens were monitored in 1978-79. Applicator exposure studies were completed on 11, 15, 18 September, 16 and 20 October, and 20 November, and in 1979 on 31 July and 31 August. Pesticides applied on these eight dates were:

Fungicides	Source	Application Method(s)
1. benomyl from Tersan 1991	duPont	hand, boom
2. cycloheximide from Actidione TGF	Upjohn	boom, field jet nozzle
3. cadmium succinate from Caminate	Mallinckrodt	hand spray
4. thiophanate from Cleary's 3336	Cleary Corp.	boom, 'Spray Hawk'
Insecticides		
5. carbaryl from Sevin	Chevron	boom, 'Spray Hawk'
6. trichlorfon from Proxol SP	Upjohn	boom, 'Spray Hawk'

Materials and Methods

It was the intent of this study to determine both inhalation exposure as well as dermal exposure. Concentrations of pesticides encountered by inhalation were measured by the use of a Bendix Model BDX44 personal air sampling pump. Air sampling was begun prior to tank pesticide mix preparation and continued until the application equipment was returned to the maintenance building. It is reported as the total elapsed time inclusive of that required for travel between greens, delays waiting for golfers to play through, time involved in equipment adjustment, repair or replacement. Exposure time for inhalation concentrations was also reported as actual operational time required for the applicator to prepare a tank mix and make the application. All applications were made under conditions that would be normal for the application procedure. Data is reported so similar pesticides may be compared. Inhalation exposure results are recorded in Table 1.

Test 1 - Tersan 1991 (benomyl) study

Site I -
Location: Meridian Hills Country Club, Indianapolis, Indiana
Sueprintendent: Steve Frazier
Applicator: Mark Kaser
Date of application: 11 September 1978
Fungicide: Tersan 1991 (benomyl) in 1 lb. soluble plastic bags
Application rate: 1.14 oz/1000 sq. ft. Tersan 1991 formulation (50% WP)
Application equipment: Bean sprayer, 10 gpm pump. Hand held shower-spray nozzle
150 gallon tank
Total work time: 202 minutes
Total app.-mix time: 113 minutes

Results:

Sample identification	Concentration of benomyl micrograms/100 sq.cm.
Cotton gauze pads (4"x4")	
body - front upper	< 10
" front lower	< 10
" back upper	< 10
" back lower	< 10
Surgipads (5"x9")	
ankle - right	< 10
" left	< 10
wrist - right	18.1
" left	40.7
pad placed on turf surface	535

Test 2 - Tersan 1991 (benomyl) and Actidione TGF (cycloheximide) tank mix

Site II -
Location: Broadmoor Country Club, Indianapolis, Indiana
Superintendent: Oscar Miles
Applicator: Mark Peters
Date of application: 15 September 1978
Fungicides: Tersan 1991 (benomyl 50% WP)
Actidione TGF (2.5% cycloheximide)
Application rate: 0.5 oz/1000 sq.ft. - Tersan 1991 formulation
1.5 oz/1000 sq.ft. - Actidione TGF
Application equipment: 100 gal. Bean sprayer
18 foot boom with 8004 Tee Jet nozzles at 50 psi
Cushman truckster, speed 2 mph
Total work time: 309 minutes
Total app.-mix time: 63 minutes

Results:

Sample identification	Concentration of benomyl	Concentration of cycloheximide
Cottom gauze pads	micrograms/100 sq.cm.	micrograms/100 sq.cm.
body - front upper	<10	<0.8
" front lower	<10	<0.8
" back upper	<10	<0.8
" back lower	<10	<0.8
Surgipads		
ankle - right	<10	<0.8
" left	<10	<0.8
wrist - right	<10	3.23
" left	<10	3.85

Test 3

Site II - Broadmoor Country Club
Date of Application: 20 October 1978
Fungicide: Tersan 1991 (benomyl 50% WP)
Actidione TGF (cycloheximide)
Application rate: 1.0 oz/1000 sq.ft. Tersan 1991
2.0 oz/1000 sq.ft. Actidione TGF (2.1% cycloheximide)
Application equipment: 100 gal Bean sprayer with KCL-36 nozzle at 50 psi at 10' spray width. Toro Workmaster truckster, speed 2 mph
Total work time: 270 minutes
Total app.-mix time: 98 minutes

Sample identification	Concentration of benomyl	Concentration of cycloheximide
Cotton gauze pads	micrograms/100 sq.cm.	micrograms/100 sq.cm.
body - front upper	<10	<0.8
" - front lower	<10	<0.8
" back upper	<10	<0.8
Surgipads		
ankle - right	<10	<0.8
" left	<10	<0.8
wrist - right	193.8	<0.8
" left	263.	<0.8

Test 4 - Cadminate (cadmium succinate)

Site I - Meridian Hills Country Club
Date of Application: 18 September 1978
Fungicide: Cadminate (cadmium succinate 60%)
Application rate: 0.5 oz/1000 sq.ft. Cadminate formulation
Application equipment: Bean sprayer and pump, pump set at 125 psi
Hand sprayer shower nozzle application
Total work time: 243 minutes
Total app.-mix time: 90 minutes

Results:

Sample identification	Concentration of cadmium
Cotton gauze pads	micrograms/100 sq.cm.
body - front upper	15.4
" front lower	13.5
" back upper	13.5
" back lower	25.
Surgipads	
ankle - right	8.
" left	11.
wrist - right	516.
" left	467.

Test 5

Site I - Meridian Hills Country Club
Date of application: 16 October 1978
Fungicide: Cadmium - Application rate: 0.5 oz/1000 sq.ft. formulation
Application equipment: procedures same as those used on 18 September
Total work time: 239 minutes
Total app.-mix time: 95 minutes

Results:

Sample identification	Concentration of cadmium
Surgipads	micrograms/100 sq.cm.
wrist - right	346
" left	181

Test 6

Site I - Meridian Hills Country Club
Date of application: 20 November 1978
Applicator: Mark Kaser - Individual air samples were collected during tank mix preparation & during actual spray application. (Table 1)
Fungicide: Cadmium
Application rate: 0.5 oz/1000 sq.ft. formulation
Application equipment: Procedures similar to those used on 18 September
Total work time: 241 minutes
Total exposure time: tank mix only - 9 minutes
app.-mix time - 64 minutes

Results:

Sample identification	Concentration of cadmium
Cotton gauze pads	micrograms/100 sq.cm
body - front upper	< 1
" front lower	< 1
" back upper	< 1
" back lower	< 1
Surgipad	
ankle - right	2.1
" left	2.1
wrist - right	60.
" left	22.5

Test 7 - Thiophanate + Trichlorfon
Site II - Broadmoor Country Club
Application date: 31 July 1979
Fungicide: Cleary's 3336 (thiophanate)
Proxol 80 SP (trichlorfon)
Application rate: Fungicide: 0.5 oz/1000 sq.ft. formulation, Cleary's 3336
Insecticide: 2.75 oz/1000 sq.ft. formulation, Proxol
Total work time: 276 minutes
Total app.-mix time: 89 minutes

Results:

Sample identification	Concentrations of thiophanate	trichlorfon
Cotton gauze pads	micrograms/100 sq.cm.	
1. Applicator		
body - front upper	n.d.[1]	n.d.
" front lower	n.d.	n.d.
" back upper	n.d.	n.d.
" back lower	n.d.	n.d.
Surgipads		
ankle - right	n.d.	n.d.
" left	n.d.	n.d
wrist - right	n.d.	n.d.
" left	n.d.	n.d.
2. Hose man		
body - front upper	n.d.	n.d.
" front lower	n.d.	n.d.
" back upper	n.d.	n.d.
" back lower	n.d.	n.d.
ankle - right	n.d.	n.d.
" left	n.d.	n.d.
wrist - right	n.d.	30
" left	n.d.	n.d.

1. none detected

Test 8 - Thiophanate + Carbaryl

Site II - Broadmoor Country Club
Application date: 31 August 1979
Fungicide: Cleary's 3336 (thiophanate)
Insecticide: Sevin (carbaryl) 50 WP
Application rate: fungicide: 1 oz/1000 sq.ft., Cleary's 3336
insecticide: 6 oz/1000 sq.ft., Sevin
Application equipment: similar to that used for Test 7
Total work time: 265 minutes
Total app.-mix time: 96 minutes

Results:

Sample identification	Concentrations of thiophanate	carbaryl
1. Applicator		
Cotton gauze pads		
body - front upper	n.d.[1]	4.8
" front lower	67	96
" back upper	0.58	19
" back lower	0.87	19
Surgipads		
ankle - right	n.d.	n.d.
" left	n.d.	5536
wrist - right	242	692
" left	28	311
2. Hose man		
Cotton gauze pads		
body - front upper	n.d.	n.d.
" front lower	87	13.8
" back upper	--	--
" back lower	n.d.	n.d.
Field monitor pad	n.d.	n.d.
Surgipads		
ankle - right	n.d.	n.d.
" left	n.d.	n.d.
Wrist - right	21	96
" left	21	96

1. none detected

Results -

Tersan 1991 (benomyl) was below detectable levels of 10 micrograms for inhalation for Tests 1, 2, and 3; 11 Se, 15 Se, and 20 Oc. Trace amounts were evident. Table 1 lists air concentrations in mg per cu. meter determined for this measurement.

Dermal (skin) exposures on body pads were negative for all three tests. Those on the wrist pad from Test 1 and 3 had concentrations of 18.1 and 40.7 micrograms per 100 sq. cm. on right and left wrists for Test 1, and 194 and 263 micrograms per 100 sq. cm. area for the right and left wrists for Test 3.

Tank mixes with Tersan 1991 (benomyl) and Actidione TGF (cycloheximide) were applied in Test 2 and 3. Cycloheximide inhalation levels were below the detectable limits on cassette filter pads and for all body pads except those on the wrists. Concentrations on the right and left wrists were 3.23 micrograms and 3.83 micrograms per 100 sq. cm. pad for Test 2, and were below the detectable limit for Test 3.

The following inhalation air exposure levels are reported as milligrams/cubic meter (mg/cu m) for the time required to make the application, as well as that exposure level for the entire work day. See Table 1. Cadmium inhalation air exposure levels for 18 Se, 16 Oc, and 20 No were 0.026, 0.010 mg/cu m; 0.008 mg/cu m; and 0.021, 0.006 mg/cu m for these respective dates. Concentrations of 0.026, 0.023, and 0.021 mg/cu m were based on exposure levels inclusive of tank mix preparation and actual application times. The cadmium air concentrations of 0.010, 0.008, and 0.006 mg/cu m were exposure levels related to the total elapsed time for the work day. Total elapsed time for 18 Se was 243 minutes, for 16 Oc 239 minutes, and for 20 No 241 minutes. Two measurements for inhalation concentrations were made on 20 No. One was during the time required to weigh and mix fungicides in the tank. The other was for total elapsed time. The air exposure level for total tank mix preparation time of 9 minutes was 0.052 mg/cu m, for application time 0.02 mg/cu m, and total towrk time 0.006 mg/cu m.

Cadmium dermal exposure levels were measured on 18 Se, 16 Oc, 20 No 1978. On 18 Se, cotton gauze pads on the chest and abdomen had 14.4 micrograms/100 sq.cm. area; at similar locations on the back, 19.2 micrograms/100 sq. cm. area. Torso and ankle measurements were not made on 16 Oc 1978. Dermal exposure levels on 20 No indicated only traces of cadmium. Levels were below the 1 microgram detectable limit.

Wrist dermal exposure concentrations encountered were 516 micrograms (mug) for the right wrist and 464 mug/100 sq.cm. pad area for the left wrist on 18 Se 1978. On 16 Oc 1978, dermal exposure levels were 345 mug for the right and 181 mug/100 sq. cm for the left wrist. Dermal exposure levels on 20 No 1978 were the lowest recorded.

Potential exposure to thiophanate fungicide (Cleary's 3336) and its metabolite EBC (ethyl 2 benzimidazole carbamate) were measured on 31 July and 31 August 1979. Dermal measurements were made on the hose handler on 31 July, and both dermal and inhalation measurements on 31 August 1979. There was no EBC detected at either date for either individual. Only traces were found on the putting green turf surface pad samples. Thiophanate concentration on the inhalation filter was 0.015 mg/m^3. There was no detectable thiophanate on inhalation filter pads for 31 Au 1979.

Dermal exposure concentrations were not detected on 31 July on either the applicator or hose handler. On 31 August thiophanate concentrations were observed on the lower front torso of both the applicator, 67 mug, and the hose handler, 87 mug/100 sq. cm., and on the back torso of the applicator, upper 0.2 mug and lower 0.3 mug.

Dermal wrist exposure levels were 242 mug on the right wrist and 27.7 mug/100 sq. cm pad on the left wrist for the applicator. The hose handler had 20.8 mug on the right and 20.8 mug/100 sq.cm. on the left wrist.

The thiophanate fungicide applications of 31 July and 31 August were made with a tank mixture including an insecticide. On 31 July, the insecticide was trichlorfon (Proxol 80), and on 31 August, carbaryl (Sevin).

Inhalation exposure was not detectable for either trichlorfon or carbaryl on either date. Only low level wrist exposures were recorded for trichlorfon on 31 July 1979.

Dermal exposure levels for carbaryl on 31 August were: applicator - front torso, 50.5 mug/100 sq. cm, back torso, 19.2 mug/100 sq. cm. Hose handler only on front lower pad, 38.5 mug/100 sq. cm.

Wrist dermal exposure levels for carbaryl on 31 August were: applicator - 629 mug, right wrist, and 311 mug/100 sq. cm. on the left wrist. Hose handler - 34.6 on the right and 34.6 mug/100 sq. cm. pad area on the left wrist.

Table 1. Golf course applicator inhalation exposure to turf fungicides-insecticides, 1978-79

App. Date	Pesticide	Flow rate	Exposure Application	Exposure Total[1]	Air volume Application	Air volume Total	Field monitor Filter analy.	Concentration Application	Concentration Total
		l/min	minutes		liters		mg found	mg/m^3	
9/11/78	benomyl	2.4	113	202	271	485	10.0[4]	0.037	0.021
9/15	benomyl	2.4	63	309	151	742	10.0	0.066	0.013
	cycloheximide	2.4	63	309	151	742	8.0[5]	0.053	0.011
9/18	Cadminate	2.1	190	243	189	510	5.0	0.026	0.010
10/16	Cadminate	2.4	195	239	228	648	5.0	0.023	0.008
10/20	benomyl	2.2	98	270	216	594	10.0	0.046	0.017
	cycloheximide	2.2	98	270	216	594	8.0	0.037	0.013
11/20	Cadminate[2]	2.1	9	---	19	---	1.0	0.052	---
	Cadminate[3]	2.2	64	421	141	530	3.0	0.021	0.006
7/3/79	trhiophanate ethyl	1.5	89	276	134	414	6.0	0.045	0.014
	trichlorfon	1.5	89	276	134	414	n.d.	n.d.	n.d.
8/31	Applicator								
	thiophanate ethyl	2.0	96	265	192	530	n.d.	n.d.	n.d.
	carbaryl	2.0	96	265	192	530	n.d.	n.d.	n.d.
	Hose man								
	thiophanate ethyl	2.0	96	265	192	530	n.d.	n.d.	n.d.
	carbaryl	2.0	96	265	192	530	n.d.	n.d.	n.d.

1. Exposure times are based on application time when exposure potential is high as well as on total time which incldues that from first tank mix preparation until spray equipment is stored
2. During tank mix preparation only
3. Continuous application
4. The lowest level of detection for benomyl was 10 mg/filter pad
5. The lowest level of detection for cycloheximide was 0.2 mg/ml or 8 mg/filter pad

- ATHLETIC TURF SECTION FOLLOWS -

Editor's Note:

TURF TIPS were published by Robert C. Dunning over a period of twenty years. One issue widely distributed was Vol. 7 No. 2, 1954, 15 pp. It is reproduced in part because of its relevance to current concerns. Ideas from an earlier article, Turfgrass for Athletic Fields, 1949, and Vol. 4 No. 3, 1951, The Construction and Maintenance of Thaletic Fields, 10 pp. are within the 1954 article. This article was also published in Athletic Journal.

TURFGRASS FOR ATHLETIC FIELDS IN THE SOUTHWEST

Robert C. Dunning

The primary objective of this article is to encourage the proper use of championship grass and to give the establishment and maintenance functions necessary for its development conducive to safe play.

Bermudagrass responds favorably to proper maintenance. Much can be done in a relatively short time once an improvement program is initiated. The results, seen and understood, create enthusiasm. Good management of football fields pays handsomely in improved turfgrass. Although price should be secondary,it can be done at a reasonable cost.

Good turf on athletic fields is essential for two reasons:

1. It permits use of the field during wet weather
2. It greatly reduces the number and severity of injuries

A dense dark green turfgrass has eye appeal that is appreciated by the sports fan. This is illustrated by sportscasters saying, "The field is beautiful here today."

It is only of late years that the importance of a good turf and its reduction of injuries has been appreciated. Country-wide studies and surveys have verified the fact. Sports writers and coaches point out that the percentages of ankle and knee injuries are higher on fields with poor turf. Chipped elbows and broken bones are increased on areas with a thin turf. Knee and ankle injuries are particularly high on shallow rooted turf that tears loose when a player turns sharply. A good turf is needed to provide a firm footing as well as a protective cushion.

To produce a championship wear-resistant turfgrass these maintenance practices should be considered:

1. Drainage
   a. construction
   b. choice of soils
2. Fertilization
   a. new
   b. established
3. Choice of grasses
4. Planting
5. Maintenance of existing fields

6. Maintenance
   a. mowing
      1. height of cut
      2. changing height of cut to suit the purpose
      3. frequency of cut
      4. type of equipment
   b. aerification
7. Watering
   a. frequency
   b. quantity
   c. irrigation equipment
8. Chemical
   a. weed control
   b. insect control
   c. disease control

Drainage - The first prerequisite for a football field is drainage in four phases: 1) surface runoff, 2) internal, 3) lateral, 4) drainage by diffusion.

Construction - A field should be graded to provide a minimum slope of 1.5%. Thus an athletic field 200 feet wide should have a center crown 18 inches higher than the side line. In dry areas with sandy pervious soils, the slope may be reduced to 1%, but grading must be done carefully to eliminate depressions. The crown should be rounded to provide a smooth contour. To obtain this crown it usually is necessary to haul some soil to the site. The existing soil should be graded to drain well prior to the addition of soil. A good uniform layer of topsoil should be applied over the entire field.

Tile should be installed not less than 14 inches deep on proper slope bedded into and covered with well graded gravel and at least 8 inches of friable well-drained soil. The trench should be at least 20 inches deep.

Editor's Note: Obsolete today. (See Vertical Trenching.)

Choice of Soils - The so-called perfect soil is a medium mellow sandy loam with a low silt content. It, however, may be desirable to use one part sandy loam, one part sharp medium and coarse sand and 10-15 percent peat (by volume) according to the content of silt and clay of the sandy loam.

1. By medium it is meant that the majority of sand particles are medium in size.
2. By mellow that it should contain from 10-15 percent organic matter by volume.

Acceptable organic materials are well decomposed sawdust, leafmold, waste from gin mills, etc. Peat should be purchased in the summer when the moisture content is low to reduce cost of transportation.

Soil for an athletic field should not contain too much sand as it tends to give under quick turns, making it much more difficult to maintain a good turf. Only enough sand should be present to provide drainage and keep the soil from becoming hard and packed.

Fertilization - Fertilizing the new field is somewhat different from that on the established field. This is the time to incorporate such materials as phosphate, potash, dolomite, gypsum, and lime with the soil for maximum benefit.

The need for lime should be established by having the pH (relative acidity or alkalinity) of the soil determined. If the pH is below 6.0 it will usually be desirable to apply agricultural limestone, the rate varying from one to three tons per acre depending upon the degree of acidity of the soil.

A good practice is to apply a minimum of 400 pounds of 20 percent grade superphosphate and 100 pounds potash per acre. These may be applied separately or in the form of a complete fertilizer such as a grade 10-5-5 organic base fertilizer. Both the lime and fertilizer should be incorporated in the top three to four inches of soil.

The secret to maintaining a dense turfgrass under heavy traffic is the knowledge of how and when to fertilize. Nitrogen promotes rapid leaf growth. Bermudagrass has a high nitrogen requirement. Good sport turfgrass will usually require 300 pounds of actual nitrogen per acre per year. The quantity of nitrogen applied will depend on the density desired. If fertilizing is discontinued turf will deteriorate rapidly and may become less good than before the initial fertilization.

Accordingly, once lime, phosphate, potash, etc., are provided the principal consideration is the application of nitrogen in sufficient quantities to develop and maintain the turf desired. The rates of nitrogen should be decreased in the late summer and early fall.

To achieve the very best playing conditions fertilizer should be applied frequently at decreasing rates. The initial application of 100 pounds of N per acre should be applied as soon as the bermudagrass shows signs of growth. This should be followed by monthly application of 40 pounds per acre. Rates of applied fertilizer can be increased if more growth is desired. To slow plant growth fertilization can be reduced or temporarily discontinued. For deep green color before a game, 20 pounds of iron sulfate in 400 gallons of water may be applied per acre as a surface spray, and should not be watered in.

Choice of grasses - Several superior selections of bermudagrass have been made and are being developed. At this writing, U-3 bermudagrass is the only one of these selections that has been used extensively on athletic fields. Grass for an athletic field should be tough, wear-resistant, vigorous, and have the ability to recover rapidly from injury. Some of the zoysia grasses, Meyer Z-52 and Z-73 promise to be superior grasses.

Planting - A great deal could be written about planting methods. However, for bermuda, three will be discussed: topsoil planting, sprigging and seeding.

The first is as the name implies - bringing in topsoil containing bermuda roots or sod. This is an excellent method if soil must be brought in and the proper soil can be obtained with bermuda already growing in it. If such is not the case, then planting should be accomplished by sprigging or seeding.

Sprigging involves opening furrows about four inches deep on 18-inch centers, dropping bermuda rhizomes in the furrow and covering with soil. While there is much talk about the difficulty of killing bermudagrass, it is entirely possible to have a failure by this method if certain simple rules are not followed: These are:

1. Use only fresh sprigs
2. Open and close the furrows in the shortest time possible
3. Compact the soil thoroughly after planting with a heavy roller
4. Water planted area as soon as smoothing is completed
5. There should be an abundance of soil moisture at the time of planting

Seeding is a simple and economical method of planting. Seed may be planted either by broadcasting or by drilling. If the seed is broadcast it should be harrowed lightly or cultipacked to cover the seed more than one-half inch. Immediately following seeding, the area should be hand watered. Once an area has been seeded it should be kept moist, but not excessively wet, until the seedlings are thoroughly established.

Hulled bermudagrass seeds should be sown at a minimum rate of 40 pounds, and unhulled bermuda, 50 pounds, per acre. We recommend 100 pounds of hulled bermudagrass seed per acre where a dense turf cover is desired in a short period of time. Unhulled seed should be used for earlier plantings and on areas which cannot be watered.

Maintenance of existing fields - Usually repair work will be needed after the playing season where topdressing will be necessary. A recommended mixture of one part medium sandy loam, one part sharp, medium, and coarse sand and 10 percent to 15 percent high grade organic matter such as peat. This mixture should be used to level and fill depressions and to retain the crown of the field.

The thin, worn areas are more subject to winterkill than areas of dense turf cover. Kill on these worn areas is more apt to be caused by dryness (desiccation) than it is by freezing. In bare or thin areas evaporation is greater than in areas of dense turf.

Another method is to spread a loose mulch of native grass hay or leaves or waste from gin mills or cotton burrs or pine needles, etc. Water thoroughly before mulching. Remove mulch in the spring when bermuda first shows signs of growth, then initiate the regular improvement program. Leveling, smoothing, fertilizing and replacing the crown of the field should be done immediately after the grass starts to grow in the spring.

Maintenance (mechanical) - Mowing. In the development and maintenance of championship sports turfgrass, mowing is more than just keeping the grass and weeds down. High, irregular mowing results in an erect, open turf. Low, regular mowing produces a dense tight turf that will spread laterally.

The frequency of mowing is equal in importance to the height of cut in that there should be no sudden change. Low mowing will help remove dead leaves, stems and stubble of early spring. Allow the grass to grow to the height of one and one-half or two inches for a few weeks. However, as soon as the grass shows a good healthy appearance, accompanied with warm days and nights, height of cut should be gradually lowered to three-fourths to one-half inch. Adequate fertilization and tillering, promoted by frequent mowing, will produce dense upright, tough, wear-resistant turfgrass that will take maximum wear. On heavily fertilized turf, clippings should be removed, particularly during hot weather.

Aerifying - Probably the most critical problem in maintaining good turfgrass on an athletic field is compaction. There are two solutions to this problem. One is to cultivate the field and start over. This is not necessary as a very high percentage of the compaction is in the top two inches. The other method is to cultivate the soil periodically without destroying the turf cover. This can be accomplished by making openings in the soil with the aerifier which increases the infiltration rate of water.

The aerifier has a series of spoons which penetrate the soil to a depth of three inches and brings up soil cores that are deposited on the surface. This cultivating action has a two-fold effect. It opens up the soil, letting in air, water, and fertilizer. This softens and loosens the soil and allows the interchange of soil and atmospheric gases. The second effect is that of improved root development, giving additional cushion or resilience to the turf.

During the first two or three aerifications in the spring, generally three or four passes over the field are adequate. Up to six or more may be required. Cores for topdressing may be spread by use of a drag mat. Shallow aerification in several directions before seeding is highly desirable in obtaining a dense stand of seedlings.

Aerification may be necessary during the growing season if the soil is not taking adequate water. Aerifying should usually be discontinued after August 12 to allow theholes to fill with roots and give time for loosened sidewalls to move laterally into the aerifier holes.

Watering (written 1954) - The shortage of water has become a problem that is vital to our national welfare. It is of great importance that the supply be conserved and used to the best advantage. Feeding roots of properly maintained bermudagrass may penetrate the soil to a depth of five to six feed. If this root horizon water capacity is brought to field capacity, there is then created a reservior even in sandy soils, that will be adequate to supply the grass for periods up to three weeks. Soil texture, temperature, wind velocity, humidity and other factors govern this process. A good rule of thumb - water the grass thoroughly and deeply and then withhold water until the grass shows signs of suffering or wilt, then water again thoroughly.

Irrigation Equipment - There are four systems or methods commonly used in watering athletic fields. The Buckner Company offers:

1. Rotary pop-up system
2. Quick coupling athletic field valve system
3. Portable pipe system
4. Rainmobile traveling sprinkler system

The most expensive system initially is the Sportsfield rotary pop-up system, with rubber protective cover permanently attached for athletic fields, and playgrounds or wherever safety to persons is required. It provides complete coverage of the area by proper spacing of pop-up heads.

Next most expensive is the quick coupling athletic field valve with rubber sleeves and caps which presents little hazard to players. This sytem utilizes a large sprinkler head inserted onto a coupling valve. When not in use the valve is covered with a rubber cap to prevent injury to players.

The most widely used and most economical system initially is the Rainmobile traveling sprinkler which winds itself on a steel cable, watering as it moves. This model with 300 feet of cable will water a strip 400 feet long and 100-150 feet wide in one setting. This sprinkler is equipped with automatic shut-off so adapts itself to off-hours or night operation. It is used with 150-200 feet of one-inch hose which is coupled to a valve at the edge of the playing field. Due to the fact that it moves as it waters, the traveling sprinkler gives excellent distribution. For large areas several sprinklers may be operated simultaneously.

Weed control - A dense, vigorous turf is only slightly susceptible to invasion by weeds as compared to a thin, open turf.

Crabgrass and silver crabgrass are probably the biggest weed problems for athletic fields. They thrive on light applications of water and invade areas of thinned turf. They die before the football season, which leaves bare ground. Crabgrass can be controlled by PMAS (Phenylmercuric acetate solution), an excellent material that has to be applied three to four times to obtain complete control.

PMAS is a 10% solution and should be applied at the rate of 3 ounces per 1000 square feet in 5-10 gallons of water. Repeat treatments must be made within seven to ten days or the effect of the prior treatment will be lost.

Silver crabgrass can be controlled with a mixture of PMAS and 2,4-D Formula 40 used at the rate of 3 ounces of PMAS and 1 to 1-1/4 ounces of 2,4-D Formula 40 in 10 gallons of water per 1000 square feet. Control measure should be started at the time crabgrass germinates and before the emergence of silver crabgrass. Three to four applications at seven to ten day intervals is usually sufficient. However, if the field was badly infested, five to six applications may be required to give 100 percent control.

There are eight insects that generally cause damage to turfgrass in the Southwest. They are white grub, wire-worm, sodwebworm, cutworm, grass termite, chinchbug, ants and mole crickets. These can be controlled with some of the newer hydrocarbon insecticides such as DDT, Chlordane, Aldrin, Dieldrin, and Heptachlor. It appears that Aldrin and Dieldrin are less affected by lime and other materials. This does not rule out the use of some of the older chemicals such as lead arsenic for white grub control. Manufacturers' recommended rates should be followed.

Disease damage to bermudagrass is seldom a problem.

Later in 1958 the new TURF TIPS Vol. 1 No. 3 April 1958 updated the athletic field technology and gave nine benefits of core aerification:

1. deep placement of fertilizer
2. promotes the interchange of soils & atmospheric gases
3. savings in water consumption increases water retention
4. reduces denitrification and putrification
5. promotes deep and lateral roots
6. favors structure in the soil
7. promotes internal drainage
8. reduces need for topdressing
9. creates a dense, cushioned, safe turf.

The most change is the deletion of paragraph seven of the 1954 'Turf For Athletic Fields in the Southwest', "Soils...should not be too sandy as it tends to give under quick turns, making it more difficult to maintain a good turf under playing conditions. Only enough sand should be present to provide drainage..."

By 1974 Dunning wrote, "Over a period of years a higher percentage of (finer textured) sand has been progressively recommended until the use of soil, as commonly known, has been deleted. A stable mixture with a good turf excels all other covers."

PLAYERS' RESPONSE TO TURF CONDITIONS

George P. Toma, Director of Fields & Landscaping
Kansas City Royals, Kansas City, Missouri

Good afternoon, fellow turfmen. I sincerely appreciate the opportunity to be here at Purdue and this great Conference. Whenever I have the opportunity to speak to a group as we have here today, I look across the room and think to myself, "Gee, I sure wish there could be two or three times the number of people here, for this reason - it would be so helpful if two or more members from your organizations came along. The people that I would like to see at all these tuff meetings are our stadium managers, the directors of parks and recreations departments, athletic directors, high school and college coaches, and, yes, even the owners of all professional sports teams. If we could only get these people to come for a day it would be so worthwhile for all of us concerned with the care and management of athletic fields."

Many times our turf programs have to start with these people, and I believe there is often a gap in communications between all of us in our organizations when we propose improvements in our playing fields. Here is where natural grass really suffers. Those higher up in command would get a better idea of the problems involved in maintaining and improving playing conditions if they would attend such Conferences as this. We could show them ways of saving money or that at times the expenditure of a few more dollars could give them a playing field that is superior to artificial turf.

In Kansas City our past playing field of natural grass was the envy of every baseball, football and soccer team. The most important factor was that we operated on a limited budget with very poor soil conditions - no tile drainage, just the natural sloping surface drainage, no automatic irrigation system, and with very little necessary turf maintenance equipment. Working under these conditions, we maintained a field that was used by baseball, football and soccer teams as well as for other events. With the help of Dr. Jim Watson, Dr. Ray Keen, and Dr. Bill Daniel we survived. Most important of all, we had only one knee injury in nine years, and it was not one that required surgery. Foreign soccer players stated that we had the second best soccer field, surpassed only by one in England. So in looking back, we had a field that players enjoyed playing on, one of beauty from the fan's standpoint, one that was run economically, even though we had poor maintenance equipment and natural conditions.

We often have conversations that some day in the future our natural grass will return from its vacation. In fact, Dr. Jim Watson is checking on flights for its return from Kansas City in the next year or so.

Professional sports such as baseball, football and soccer today are played in what we call multi-purpose stadiums, those which are built to house all these events for the sports fans of America. The players are the best men available to supply the people who pay their freight with sporting thrills. The athletes have the best coaches, doctors and equipment. Stadium playing field walls are padded for their protection. Usually everything is looked into to prevent injury and to protect the players and the club's investment.

However, at times the playing field gives us a different picture. Players become aware of a poor playing field and they turn gun-shy. When players make such remarks as, "What a rock pile", "Sand pit", "Pavement", "Obstacle course", it is a safe bet that the playing of the game will be second-rate. So when it comes down to the playing field where good natural or artifical turf is necessary in order to give players the best possible conditions, this is where we all come in. The man responsible for the playing surface, is he a professional in his field as the athletes are in their fields? Is he trying to give them the best possible surface to play on?

We all know players do not like artificial turf. It is expensive, and very, very expensive to maintain,and can cause many types of injuries. In Kansas City our Chiefs try to practice as much as they can on natural turf. It seems players cannot heal rapidly from injury during the week if they practice on artificial turf. Many coaches claim that the players seem to lose the spring in their legs when they practice all week on artificial turf. We have artificial turf in Arrowhead Stadium, and at the end of the last practice session on Fridays the players wish they could place our natural grass practice field on their backs and carry it to Arrowhead Stadium so they could play on it each Sunday. A player expects excellent playing conditions - a field that has good dense turf, mowed at the proper height, footing that is not too hard or too soft, a field that is level and smooth.

Many artificial turf fields are like concrete and washboards, and there is more work to maintaining an artificial field as compared to a natural grass field. In our grass practice field we spend an average of five hours a week for maintenance for about twenty hours of practice. On the artificial turf, for a sixty minute game, we could spend as much as 64 hours to remove the burn marks, shoe polish, etc. from the surface. It could take one hundred hours if we went after all the tobacco stains.

Players will respond and play better if they know they have a good field. In professional baseball some teams will not take infield practice in certain stadiums because of poor playing field conditions. A poor field can cause players to develop poor habits; a good field will prolong players' careers. The Professional Players Association through the teams' player representatives will sometimes get down on poor playing conditions.

So, we are the 'man' in management. We must manage to present a field with the best playing surface for the athlete, that is one of beauty for the spectator, and one that is a sound and economical operation for the owner.

Many times people expect too much from natural grass and in return give too little. It is our job to grow good turf and we must work hard, be dedicated, and have pride. I have been a head groundskeeper for thirty-five years, and I have had help from Drs. Watson, Keen, Daniel and many, many other agronomists. You have never met finer people. They have saved many of us. As a groundskeeper, if you do not have pride and intiative and interest in your work you should get into other work. Some groundskeeper are just giving natural grass a bad name by doing a poor job, and if many of us don't care, artificial turf is here to stay! For, say, a half to one million dollars, artificial turf is still experimenting, maybe with your own money as they install the field you are paying for.

I thank you for inviting me here, and to one and all, may your good fortunes be a numerous as blades of grass.

SPORTS TURF AREAS

W. H. Daniel, Department of Agronomy Purdue University
West Lafayette, Indiana

Our common interest is to provide wear tolerant turfgrassed areas for recreational purposes. Improved or adequate drainage is a key to encouraging the use of turf. Because of the increased use of athletic fields, vertical drainage deserves special attention.

Our University research and observation confirm that vertical slitting, vertical trenches, porous rootzones, and suction pumps can be used to create more wear tolerant playing surfaces.

At Green Bay the silt loam soil was soupy wet at times, yet ten inches below was a layer of clean pea gravel. Vertical slitting was installed which allowed the excess water to bypass to the gravel.

Linton, Indiana, High School had a flat wet field, built on a clay soil. The quality was improved by the use of vertical drainage. The teeth of the trencher were re-set to create a three-inch wide trench. The narrow slitted two-inch ID Turfflow tubing was placed into the 18 inch deep trenches made 20 feet apart. The trenches were then filled to overflow with washed sand. Seed was spread before the operation started, and the excavted soil was spread uniformly by dragging a chain link fence. When completed, any excess surface water should enter the sand and move uqickly into the drains, thus leaving the field with a comparatively dry, stable surface.

Grasses: Improved cultivars of grasses provide increased wear tolerance by their fast start and aggressive spread. There are currently available ten turf-type ryegrasses that offer quick germination. Overseeding as needed can help to counteract increased wear and reduce erosion.

Bluegrasses have been long time favorites. Currently more than thirty varieties are available. Among those cultivars preferred where Fusarium roseum may be a problem are A-20, Adelphi, Baron, Glade, Parade, Majestic, Touchdown, and Wabash. Wabash, a 1978 Purdue University release, promises to provide improved spread, extra drouth and disease tolerance. The fast germination (as fast as any bluegrass) of the Wabash seed used in a mixture of turf-type ryegrasses will provide increased wear tolerance. Currently there are 174 acres of Wabash for seed harvest in 1981.

For critical or important areas, resodding is recommended to provide maximum wear tolerance. Effective sod cutters, fork lifts and large trucks make a uniform sod supply readily available. The use of plastic sheeting for storage augments the options for laying or holding the sod. Increased use of the new ryegrasses and bluegrasses in mixtures of blends is recommended. A few new turf-type tall fescues are currently being introduced. They, like ryegrass, may be overseeded as needed.

Rootzones: Since soils (clay and silt particles) are easily compacted to maximum densities of less than 20 percent pore space, the trend is to use sandy soils or washed sand for turf areas.

The Turf Managers' Handbook by Daniel and Freeborg, Chapter 16, gives specifications for the construction of ten different rootzones. Of these rootzones described, soil predominated in five, and the other five are constructed primarily of sand.

The soil rootzones need vertical drainage to rid the surface of excess water. Vertical trenches with sand backfill above a slitted drain pipe are recommended for golf greens, tees and fairways, for athletic fields, sidewalk edges, and wherever shallow ponded water may collect. A stable surface capable of rapid infiltration can be achieved by the use of sand, peat (organic matter) plus a well rooted sod.

The Layer Rootzone (System 7), the Purr-Wick (System 9) and the Prescription Athletic Turf, PAT (System 10) offer unique improved rootzones for athletic use.

The Plastic Under Reservoir Rootzone with Wick Action, PURR-WICK, conserves available rainfall and irrigation water to the maximum. Only the excess flows from the perimeter drains. Water held at low tension (less than 50 cm) within the rootzone rapidly adjusts as evaporation or transpiration takes place.

More than 800 installations in 30 states, Canada, France, and Mexico as golf greens, tees, roof gardens, flower boxes, vegetable gardens, and athletic fields utilize the water-conservation-above-a-barrier system.

Leaflet #40 from Midwest Regional Turf Foundation, Department of Agronomy, Purdue University, provides specifications for the construction of the Purr-Wick System.

The PAT System as patented utilizes the conservation of the Purr-Wick System, but provides two additional features - suction pumping and automatic moisture sensing with subirrigation. This patented system is designed to control the

moisture content of the flat playing surface at all times. Should it rain, the pumps are put into use to maintain desired moisture levels. This sytem allows more fine particles to be used in the surface of the rootzone which in turn provides increased traction for the players.

In the twelve existing PAT fields the suction has proved adequate. Each of the installations has provided the opportunity for increased field use.

The automatic soil sensing control (sub and/or surface irrigation) is available. For use in a cool climate the winter drain is closed in late spring and the automatic sensor set to the desired moisture content. When the desired soil dryness occurs, the water recharges above the barrier until the probes spaced in the field are wet. In the late fall the controller is turned off and the winter drain opened.

Enkamat, a three dimensional nylon netting developed in Europe in the early 1970's, is designed to reinforce a sod playing surface. For best results, it should be placed near the turf surface just below the area of cleat penetration. Most placement of the comparatively new material has been too deep for maximum benefit. Prompt repairs of any exposed Enkamat are important for protection of the player and the surface.

Summary: For turfgrass for athletic activities, four of the ten rootzone systems discussed are recommended:

A. The rootzone composed of topsoil on topsoil with 1 percent surface slope and vertical drainage trenches at 20 foot intervals (System 2).

B. The thin layer rootzone (System 7a) permits the use of any subgrade. The drain trenches extend into the subgrade, the drain tubes are laid, then sand is spread. Since water storage in this system is limited, automatic surface irrigation is recommended. If the turf surface is breached, repairs should be made promptly. The system can be installed speedily and economically and allows fast water infiltration.

C. In low rainfall climates the conservation feature of the Purr-Wick System allows maximum water use efficiency. Surface irrigation of a flat field allows for controlled leaching of salts with minimum leachate.

D. For turfgrassed areas of heavy use and in climates where excess rainfall is a factor the patented Prescription Athletic Turf System offers maximum control of surface conditions. If it rains turn on the pumps! When dry, the automatic soil sensing signals the need for additional moisture in the rootzone.

VERTICAL DRAINAGE

John Moreland, Cambridge Soil Services of America
Glencoe, Alabama

An installation service of vertical bypass drainage (System 8) has been commercialized using Cambridge ideas from England. Major sideline drains are one or more 4" plastic drains. These are joined at 15' intervals by a 3" trench having a 2" ID Turfflow with narrow slits and a backfill of sand to overflow. At 19" intervals, a 9" deep, 1/2" wide slit is made and filled with sand. At 8" intervals a 4" groove is sliced and filled with sand. Vibrating injections of sand from hoppers makes for uniform operation.

TISSUE ANALYSIS

Dan Weisenberger, Supervisor, Athletic Turf Facilities
Purdue University, West Lafayette, Indiana

In order for tissue testing to be of use you must first obtain a good sample. It should be representative of the entire area under a given management practice. A few clippings should be collected from several spots in the field.

While collecting the sample beware of leaf blades of weeds which could contain different amounts of nutrients and thus alter the results. Other contaminates are soil and dust. These will have a marked effect on the results of the essential micronutrients. These contaminates could be encountered after such maintenance practices as aerifying or topdressing. Samples should not be taken until sufficient irrigation is applied to wash the soil from the grass blades. Dust can be a problem along gravel roads or during dry periods when it settles out of the air.

Samples should not be taken for five days after the application of pesticides or fertilizers. After the leaves have grown out and been mowed off a good sample can be obtained. After a fertilizer application the nurtients could be initially available but become tied up in the soil after a short period. Therefore sampling too early could give a false reading.

Field marking paints on sports fields or dyes and colorants on turf are other contaminates to be careful of. Some of the elements in these products are in the high micronutrient range for turf. This could cause some of your readings to be high and misleading.

When sampling turfgrass, only the new leaves should be collected. This is where the growth is presently taking place and where the nutrients are needed.

As older leaves begin to slow in growth some of the elements become fixed in their cell structure. Other elements have the ability to move from the older leaves to the newer leaves as required. For this reason samples should not be taken after a change in the height of cut or other maintenance practices that may cause the collection of older leaves.

A list of the nutrients that move from or are fixed in the older leaves is as follows:

Move	Fixed
Nitrogen	Phosphorus
Potassium	Calcium
Magnesium	Iron
Copper	Manganese
Molybdenum	Zinc
	Boron

Another factor that affects the results is the rate of growth for the grass at the time of sampling. It seems that during late spring and early fall when ample rainfall and optimum temperature occurs the readings will stay fairly stable for a well fertilized turf. This is probably due to a healthy and actively growing root system in conjunction with ample moisture for a well distributed nutrient solution in the soil.

During the heat of the summer the reading will become somewhat sporatic. When the grass approaches winter dormancy high readings of iron are expected. Some samples taken in November have had iron levels into the 400 ppm range when 100 ppm is adequate. Aluminum levels are into the 500-600 ppm range.

I feel it is very important that visual observations be made at the time samples are collected so comparisons of the two can be made later. In this way, if there seems to be something out of line with the results of the tests or a problem with the color of the grass, perhaps one can be explained by the other.

BLUEGRASS CLIPPINGS - PAT FIELD
PURDUE 1980

JUNE	N	P	K	Ca	Mg
		%			
16	5.0	0.50	2.91	0.34	0.18
18	4.5	.49	2.63	.32	.17
20	4.3	.44	2.63	.32	.16
23	5.1	.51	3.48	.38	.23
25	4.8	.51	3.12	.31	.19
27	4.4	.49	3.27	.33	.21
AVE.	4.7	.49	3.0	.33	.19

BLUEGRASS CLIPPINGS - PAT FIELD
PURDUE 1980

JUNE	Fe	Mn	Zn	B	Cu	Na	Al
				ppm			
16	90	62	28	4	6	29	36
18	90	56	27	7	5	27	35
20	168	54	26	8	6	32	99
23	111	71	31	10	7	60	44
25	90	68	29	8	7	30	28
27	92	63	31	8	8	47	28
AVE.	107	62	29	7.5	6.5	37	45

RANGE OF NUTRIENTS IN BLUEGRASS CLIPPINGS
1974-78 PAT, PURDUE U., DAVIS

	N	P	K	Ca	Mg
			%		
EXPECTED DEFICIENCY	2.5	0.1	1.0	0.2	0.1
LOWEST FOUND	2.0	.33	1.4	.34	.18
HIGHEST FOUND	6.7	.94	3.8	1.1	.44

RANGE OF NUTRIENTS IN BLUEGRASS CLIPPINGS
1974-78 PAT, PURDUE U., DAVIS

	Fe	Mn	Zn	B	Cu	Mb
				ppm		
EXPECTED DEFICIENCY	50	20	10	?	?	?
LOWEST FOUND	75	28	11	7	4	0.8
HIGHEST FOUND	640	104	54	25	14	2.1

CLIPPING ANALYSIS AND NUTRITION

Larry Davis, Field Consultant, Retired
Lafayette, Indiana

The turf industry decided the solution to a muddy athletic field was to eliminate the soil and replace it with a sand field. Concern was expressed that leaching of nutrients from the all-sand rootzone would make it difficult for the grass to grow vigorously. It was generally assumed the lack of sufficient cation exchange capacity in sands would increase the need for fertilizer applications and thus increase the cost of maintenance for athletic fields developed on all-sand rootzones.

In order to determine if nutrient leaching from a Prescription Athletic Turf (PAT) System presented a potential nutrient deficiency problem a five-year leaf tissue analysis program has been conducted. Kentucky bluegrass on Purdue University's stadium field was used as the test plot.

Secondary goals of this study were to monitor the various levels of nutrients found in the grass clippings and to learn if plant tissue analysis could be used as another tool in athletic field maintenance programs.

Methods and Materials - During the five year study the grass was mowed at a height of 1-1/4 to 2-1/2 inches two to three times a week. The clippings were not collected. The field was aerified twice a year, with the plugs being removed from the surface.

Four fertilizer grades were used throughout the study for the fertilization program. Between 6 and 8 pounds of actual nitrogen per 1000 square feet was applied to the turf each year. In 1975 four micronutrients were applied to the turf on three separate occasions. A chelated iron was applied separately one additional time in 1975. Throughout the 1976 season a chelated iron was sprayed onto the turf in nine separate applications at approximately fifteen day intervals in a fungicide solution. A total of 270 pounds was applied to the field.

Both surface and subsurface irrigation were used at first. Surface irrigation and rainfall were the primary means of watering during the last three years of the study. Other maintenance practices were the same as normal care for athletic fields.

Deficiency Levels for Nutrients - The grass did display visual deficiency symptoms when the nitrogen reading dropped to 2.0 percent. Therefore, the data from tissue anaylsis of the grass clippings does support the deficiency levels shown.

In grass plants, the expected levels of copper are 5 ppm to 40 ppm; molybdenum 2 ppm to 8 ppm; and for boron, 3 ppm to 20 ppm. The lowest levels of copper and boron found in the plant tissue correlated closely with the expected levels.

The mean level of molybdenum in the plant tissue during the five year study was 1.60 ppm. We did not get any wilting, stunting and cupping of broad leaves which are the symptoms of molybdenum deficiency.

Tissue Testing as a Maintenance Tool - Results from the tissue analysis provided information which could be used in the decision making process in managing the turf on athletic fields. Grass clippings were collected at approximately two week intervals throughout the growing season. A total of 72 samples were taken. All tissue testing was done by the Ohio Plant Analysis Laboratory at Ohio State University.

Discussion - Visual observation indicated a healthy vigorous grass which was mostly free of any disease problem. During the growing season the grass was mowed two to three times a week with clipping yields indicating ample growth of the plant.

Nitrogen content in the grass tissue was found to be as high as 6.7% in the second year of the study. From this information the amount of fertilizer applied to the grass was reduced in an attempt to hold the nitrogen reading in the 4.0% to 5.0% range. This was possible by continually monitoring the plant tissue and adjusting the fertilizer program.

To prevent the iron from becoming deficient foliar applications of chelated iron were sprayed onto the grass on four occasions in 1975. The result of these applications was a more stable reading of the iron in the plant tissue. The increased iron content in the plant tissue after each foliar application in 1975 led to the application of iron to the grass at approximately fifteen-day intervals throughout the 1976 growing season. This program maintained the iron in the plant tissue well above the deficiency level through the 1976 season.

My information was gathered from conversations with Dr. W. H. Daniel, Dr. R. P. Freeborg, and from their Turf Managers' Handbook, and also conversations with M. J. Robey and articles by Mr. Robey and R. L. Duble, and from my experience in collecting the grass samples and keeping the records.

CUSTOM ATHLETIC TURF CARE

Roy G. Zehren, Natural Athletic Turf Inc.
Mequon, Wisconsin

I must first explain that turf maintenance is not our company's main source of income. We are involved mainly in the construction of athletic fields, especially PAT, Purr-Wick and sand systems. We also do conventional turfing and landscape design and construction. However, in almost all our turfing contracts, we are liable for a 30-90 day warranty and/or maintenance period.

This talk will then be orientated to methods of construction that will reduce or make maintenance easier. The reputation of our company and our future work possibilities depend on a well constructed field, tee or green.

Whether the field is six months old or four years old, if it is not in good shape, the blame usually comes back to the construction contractor. It is very difficult to tell a maintenance supervisor that we gave him or her a near perfect field and that his poor maintenance is the cause of his problems. Therefore, construction and type of materials used must be the best for good results in the future life of the fields.

We must also explain to the maintenance supervisor how to take acre of his particular field.

Almost all problems in athletic fields, tees and greens come from compaction of wet woil. More maintenance time is spent on correcting the problems caused by compaction than all the other chores together. Solving compaction by coring, slicing, topdressing, mounding, improving underground drainage and surface irrigation and then, after all else fails, tear it out and rebuild it again and again.

The best way to solve these problems:

Eliminate the source
    Eliminate the soil
    Then what?
Use a sandy loam
    Use a sand/soil/peat blend
    Use pure sand with additivies
    Use a water retention barrier
    Use controlled drainage
    Use controlled surface and subsurface irrigation
Use the best turf for your area
Use the best fertilizer for your climate and your type of system

Put this all together correctly at construction time, give it a fast, sturdy start, and future maintenance can possibly be reduced fifty percent, or more.

If these specialized types of sand systems are built wrong you could have just as much, or more maintenance. These sand systems have to be maintained in a slightly different way. If a Purr-Wick (or PAT) system is used, 70 to 80 percent less watering is needed because of the poly barrier. Most of these systems go backwards because of too much water. Because these systems have such a deep and vigorous root system and water reserve, they grow very fast and will need twice as much mowing. We also advise to leave the clippings on athletic fields (when cut at the proper time).

Fertilizer - More is needed because of leaching. A water soluble fertilizer is best, but I use a combination. In starting turf in sand systems, up to 6 pounds N/1000 sq.ft. per year is needed, depending on the local seasonal conditions.

About once a year by the second year the areas should be cored, topdressed with the same type of material in the system, and overseeded. In hard play areas, this may have to be done more often.

With proper subsurface construction, using the turf best suited for your area and your needs, these sand type systems can develop 10-14" root systems in four to six months. With this type of root system the turf is so healthy and vigorous that very little maintenance is needed - except for more frequent mowing.

Because we're not a maintenance firm we use very few chemicals other than fertilizer. But, if you have a hardy vigorous turf, no drainage or compaction problems, you need less chemicals.

I guess the simplest way to summarize is to say - use the best type of system to meet your needs, use the best turf for your climate and needs, spare no money to construct it right, and your maintenance will be easy.

ATHLETIC TURF CARE

David Heiss, Turf Services
Spring Lake, Michigan

Generally we see three levels of athletic field maintenance procedures. I think of them as neglect, adequate, and programmed. A neglected field is left to fend for itself and is mowed a couple of times late in the year in preparation for the big season. The field of solid knotweed dies after the second game , becomes a dust bowl, then a mud pit, and causes a high injury rate to the players.

The adequate field stands out because it has adequate funding available for material and manpower but it lacks direction and generally falls below everyone's expectations. Unfortunately, most of our athletic fields fall into that category. I am going to outline what we should all be practicing - that is programmed maintenance.

To begin programming your maintenance you start with pencil and paper and decide what needs to be done and how it will be accomplished. There are no rigid rules to follow, and by working on paper you have a great deal of flexibility. Everybody's program will vary slightly, but the following will serve as a guide for you to get started on yours.

Water - Whether you have automatic, quick coupling connectors, or hoses, watering needs to be available from spring until November. Remember the turf when the temperature drops and a cold wind blows. Use a soil probe to check the soil and plan to irrigate enough to replace lost moisture. The soil should be moist only, not wet (where you can squeeze excess water) or dry (when the soils blow apart). Plan on having the irrigation system ready to go early in the spring, mark it on your calendar, then train someone to operate your system. Generally during the season we water heaviest during the first part of the week so the grounds will not become too wet if you get a heavy rain just before a game on the weekend.

Mowing - Check your equipment and do not try to stretch a mower for another season. Whether you mow with a reel or rotary, it must be sharp. Check the bushings on the gauge wheels so one side does not cut lower. Plan to have a backup mower from another school department, another school, or a repair shop, but do not neglect the grass cutting. Always mow to remove clippings no longer than the height of cut. A 1-3/4" height cut is preferred, so cut before the grass becomes 3-3-1/2" high. I like clippings returned to recycle potash.

Fertilizing - Planning is really needed here. If you use a soluble type of fertilizer, plan on four or five pounds actual nitrogen per growing season evenly spaced with the first application coinciding with your first mowing and your last application no later than your earliest average frost date. If you use a controlled release nitrogen fertilizer, you can reduce total nitrogen by one pound due to less leaching. Be sure to use a turf fertilizer that contains trace elements,especially sulfur and iron in significant quantities.

Weed control - Plan to eradicate those weeds that bothered you last year. Crab and goosegrass controls are applied in early spring. If you plan to overseed, use Tupersan so only the weed seeds are killed. For braodleaf, use Trimec or Trexsan for total broadleaf weed control, but be sure to follow the label directions. Our experience shows better control with liquid forms of broadleaf weed controls as compared to dry weed and feed products. You may want to consider an outside contractor for weed control. Always check to be sure he is licensed, guarantees his work, and has adequate insurance, in addition to knowledge of athletic fields.

Continued planning - Our experience proves a need for annual overseeding. Consult your local state university for the latest recommendations on bluegrass seeds. Your best results are going to be obtained by having the seed contact the soil. This means using an overseeding machine designed to do the job or to scarify the soil for good soil and seed contact. Plan for insect and disease controls on a need basis. By making frequent inspections of the field you will be aware of insect activity. By planning to have the insecticide on hand you will be able to make applications to eradicate the problem. Special projects such as aerification and topdressing the field also require planning. You will be able to integrate the jobs that you want to do with the schedule the athletic department has made for the field so that you will have the least amount of interference.

As you get into planning, you will find it valuable as you anticipate problems prior to their occurrence and have the material and manpower ready to deal with them. Assistance is always at hand from your friendly neighborhood golf course superintendent and professional golf course supplier. When you begin to plan for maintenance you will see a tighter, denser turf at the end of one season with fewer player injuries.

ATHLETIC FIELD MAINTENANCE

Dick Gray, O. M. Scott & Sons
Indianapolis, Indiana

Just some thoughts on athletic field maintenance: I'll touch on five main concerns of turf management for your fields. Proper equipment, timing of operations, a sound agronomic program, traffic control, and conscientious personnel are all required for a successful turf program on athletic fields.

Sharp mowers, adjusted properly, are mandatory. Reel mowers are preferred as they shear the grass blades cleanly - like scissors. Rotary mowers then to cut and tear grass blades, leaving jagged edges that heal slowly and look unsightly. When using a rotary mower, remove the blades after each eight hours of use and sharpen with a file or stone. Dull mowers can severely injure turf.

Mowing should be done on four to seven day intervals at a cutting height of 2-1/1 to 3-1/2 inches. Under wet conditions, should you get behind, set the mower up about one-third higher. This will prevent scalping during rainy periods. Also, clippings should be removed if mowing intervals are more than seven days. Once growth is under control, reset the mower back to its original height . Mowing can be done any time of day, but preferably when turf is dry. However, if turf is too dry and starts to wilt, do not mow! Severe injury to the plant will surely occur.

An aerifier is recommended for all types of playing turf. There are some good ones on the market - the Ryan Greens-Aire does the best job as it puts a hole on two-inch centers. It's more expensive and slower, but by far the best. There are two drum aerifiers, Dedoes and Cushman. These are half the cost of the Ryan and much faster, and will do a satisfactory job - not the best, but satisfactory. Large fairway aerifiers and cultivators are not recommended for either aeration or seedbed formation. The holes are too far apart.

On an athletic field there is no substitute for aerification. Next to finances, compaction is the biggest hurdle in turf management. Therefore the better your aeration procedures, the better your chances of having deep rooted, non-skid turf. Aerate heavily in May and mid-November. If you miss the late fall, come back earlier in the spring. Incorporate some seed in your aerifying program. It's a perfect seedbed if done properly. Some people aerate three or four times a year with outstanding results.

A good fertilizer spreader is a must. Without this, applications are guesstimates at best. A poorly adjusted spreader can result in poor weed and insect control. Don't guess. Do it right the first time.

As for irrigation, there are several methods. Obviously, automatic irrigation, when tended to properly, is best. The other end of the spectrum is rainfall. In between, traveling sprinklers and set sprinklers have been used successfully. However, these are slow and need regular attention. Puddling can result if not tended to properly and promptly.

The best time to water is just before the turf needs it. Bluegrass can wilt and still be brought back within a few hours with no damage if watered properly. Don't let it go dormant! You can water any time - day or night, hot or cold - <u>just don't puddle</u>.

Turf, like people, must have a regular diet and regular maintenance for proper performance. A good turf plant food is recommended, and should be applied four to six times per year. Overseeding should be an annual practice and done in the spring in conjunction with your aerification. Seed that has been dragged into aerifier holes will germinate and develop more readily than seed in thatch or on the ground. Therefore, the more aerifier holes, the better the results of your overseeding. Don't forget the starter fertilizer. This will insure maximum root and crown development for your seedlings. A preemergent herbicide can be incorporated with the starter fertilizer (Siduron). This will control crab that may germinate prior to your application of Bensulide. Do not apply Bensulide (weedgrass preventor) for four months prior to seeding nor until the seedlings have been mowed three times. As for the type of seed to select, bluegrass seems to be the most suited although some ryes are being used. A combination of both is acceptable, however, too much rye, more than 20 percent by seed count, may end up all ryegrass, as rye is very aggressive. Not only does it germinate much quicker than bluegrass, it grows much faster.

Don't forget weed and insect control. Although you must postpone weed control during seeding, broadleaf can be controlled any time seedlings have reached the three-leaf stage. Since we're having more and more grub problems, insect control in August is strongly recommended.

Since compaction is the enemy, traffic must be controlled. This means, no practice on the game field if wet, no band practice at all (those marching feet are much worse than cleats), no shot put, no discus. Traffic should be kept to a minimum as much as possible.

Finally, put someone in charge who is conscientious, not just available. It does no good to make the necessary plans and investments if no one cares. Applications must be timely and properly done and followed through. The Steelers were the result of planning, personnel and follow through. Athletic turf is no different.

SPORTS TURF - PRIORITY MAINTENANCE

Ted Sokolis, The Village Links
Glen Ellyn, Illinois

Before I begin to explain our athletic fields, I feel that it would be pertinent to provide an overview of our entire facility. Glen Ellyn, Illinois, is a village of 25,000 residents, and is located approximately 25 miles due west of downtown Chicago. The village consists primarily of single family homes with a small but thriving central business district containing pleasant shops and boutiques. Glen Ellyn has virtually no industry of any kind. Our residents are mainly business professionals with occupations ranging from mid to upper management positions within Chicagoland firms. We also have our share of medical doctors and attorneys.

My employer is the Village of Glen Ellyn, my position is Department Head, and I am responsible for the operation of the Village of Glen Ellyn Recreation Department. We answer to the Village Administrator and ultimately to the President and Board of Trustees. The Recreation Department levies no tax dollars for operations, maintenance or purchase of capital expenditures. We operate solely within an established budget based upon Department sales and fees. In fact, we earn revenue for the Village. Through a "profit sharing" plan devised in 1977, we have provided the Village of Glen Ellyn with a total of $100,000.00 from that year through 1981.

We operate and maintain a 320-acre complex whose primary staple is golf. We have an 18 hole championship course and a full length 9 hole course. The golf courses occupy about 240 acres, and the remaining property is divided between six athletic fields (35 acres), one park and one nature preserve with lakes stocked for fishing (45 acres).

Our complex includes five baseball fields and one soccer or multi-purpose field. In the fall we overlay the baseball outfields with three football fields and one additional soccer field. The fields were constructed over a five-year period. The three larger fields were completed in 1974, the smaller fields in '75, and the soccer field in 1977. All fields have excellent surface drainage including a two foot pitch from center field to the foul lines. Construction was

accomplished by grading the sub-base, installing six to eight inches of good field topsoil followed by fine grading and seeding. We also installed an infield and sideline tile drainage system. The three larger ballfields have an automatic system of irrigation, and the smaller fields have a semi-automatic system. The soccer field has a single row snap valve system running through the center of the field. A 25 percent blend of Adelphi, Fylking, Nugget, and Newport bluegrass, and later a 20 percent mixture of Majestic, Adelphi, Touchdown, Baron and Glade was seeded at a rate of 75 pounds per acre. In design, we adopted a core concept whereby a spectator may stand on the elevated center section between the three backstops of the larger fields and watch three games simultaneously. Parking is provided for 250-275 cars, and the lot is frequently full, expecially on weekends.

Features and capabilities - Fields 1 and 2 are equipped with fifty 1,000 watt metal halide lights on 75 foot poles. Field #1 includes 60, 80 and 90 foot base paths, 350 foot foul lines and center field. An 80-yard football field can be overlaid in the outfield. Primary activities here involve Little League baseball, men's 12-inch softball, women's high school or college 12-inch softball, and flag football.

Field #2 has 90 foot base paths. Major users include high school varsity, semi-pro and Colt league teams. During baseball season, hard ball only is played here. The outfield can be overlaid with a regulation football field used mainly by area youth football programs. The football field takes a severe beating due to day and night games.

Field #3 is identical in construction with the exception of the lights. Activities are much the same with the addition of soccer.

Fields #4 and #5 are the smaller fields with 60 foot base paths and 180-200 yard foul lines. The younger Little Leaguers share these fields with women's college softball.

The soccer or multi-purpose field involves a 300 foot by 600 foot playing area and can accommodate one large and one small field. We have sufficient room here to move the large field back and forth to spread or reduce turf wear. Users include Park District soccer programs, high school soccer and various business sponsored teams.

A brief overview of field use in 1979 will give you an idea of the heavy play we experienced:

Field	Games or Practices	
#1	420	(100 under lights)
#2	370	(95 under lights)
#3	390	
#4	250	
#5	220	
Soccer	150	
	1800	

Maintenance Practices - The Recreation Department employs a Grounds Superintendent whose primary job involves maintaing the golf courses. He is also responsible for athletic field and park maintenance. The maintenance program is the area which best demonstrates the good marriage of athletic fields to golf course, and in which this association really pays off. Both facilities benefit from the expertise of a skilled professional turf manager leading trained staff and scheduling a full complement of sophisticated maintenance equipment. After grooming the golf courses for play in the early morning, personnel will perform mid-morning and early afternoon maintenance at the athletic fields. Weekday field use generally begins after 2:00 p.m., but weekend players arrive at about 9:00 a.m. so crews are scheduled for early work on Saturday and Sunday. During the season, the infields are raked on a daily basis with a golf course hydraulic sand trap rake as well as hand rakes where needed. Litter is removed every day. Mowing is accomplished with 7-gang, tractor drawn mowers set at a two-inch height of cut. The fields are mowed two to three times weekly during the season and accompanying trim work is done with triplex reel units or rotary mowers.

Fertilization - A combination of 19-5-9, 12-12-12 and 0-0-60 fertilizer formulas are used so that applications total 3-2-3 per 1,000 square feet each season. Additionally, the heavily used or worn areas such as infield side lines, football or soccer field center portions receive an added 2-1-2 to encourage turf recovery.

Herbicides - These are applied every fall for weed control. We use a combination of 2,4-D and MCPP.

Overseeding - We overseed the center portions of football fields and other isolated wear areas regularly using a mixture of elite bluegrasses and perennial ryegrasses.

Miscellaneous Maintenance Projects - Infield mix is added periodically and we re-shape the infields or base paths as needed. Worn areas are occasionally sodded and we use a tiller rake to break up the hard or compacted infield mix when necessary.

Irrigation - Field turf is irrigated according to need and weather conditions. We normally water during the early or mid-morning hours in order to keep the turf green and encourage growth. We also activiate the system to rinse in fertilizer applications.

Our athletic field maintenance program truly benefits from the use of specialized golf course equipment. Units such as the hydraulic 7-gang, hydraulic sand trap rake, turf truckster, spray rig, trencher and sod cutter, to identify a few key pieces, can be regularly scheduled to keep the field properly groomed.

Finance and Budget - The athletic field complex has several revenue sources of its own, but these do not generate sufficient income to accommodate maintenance expenses and the fields/parks portion of our operation is subsidized by golf. Fees are $5.00 per practice or game with junior rates of $2.00 per activity. We do operate a refreshment stand at the athletic fields, and charge for both field and lighting use. During 1980, field income totaled $16,620.00, expenses came in at $22,744.00, leaving a deficit of $6,124.00 which was offset by golf course earnings.

Our 1980 net profit for golf was just over $100,00.00 - our best year ever. We try to operate on a cost accounting basis and we use a cash profit and loss statement tailored after those in private enterprise. I have never seen a publicly owned recreational agency keep books in this fashion.

In conclusion, I feel that well maintained public athletic fields with top quality turf can be provided and used by the public for a variety of sports activities. In order to accomplish this objective, several basic steps are required:

1. Good planning, design and construction of new facilities or well planned renovation of existing facilities,

2. Provide good financial and field scheduling management,

3. Employ a professional turf manager in order to encourage the best possible maintenance practices. This manager should pay for him or herself in the long run.

Our Sports Complex works well for us, and I would recommend its adoption to either private enterprise or governmental agencies who might consider construction of athletic facilities in the future. The marriage of golf courses, athletic fields and passive recreational areas is an asset to Glen Ellyn and a benefit to its residents.
