MIDWEST REGIONAL TURF CONFERENCE

March 4 - 6, 1985

Purdue University

PROCEEDINGS OF THE
1985
MIDWEST REGIONAL TURF CONFERENCE

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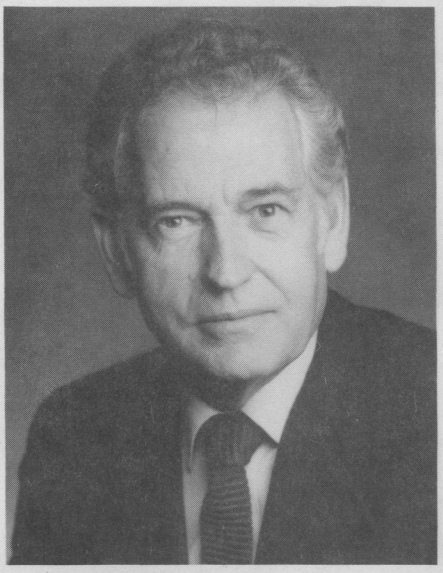

William H. Daniel
Turfgrass Education and Research, Purdue University, 1950-1985

William H. Daniel, dedicated teacher, counselor, researcher and consultant has contributed in countless ways to the growth and development of the turf industry. He has been responsible for the creation or improvement of many agronomic programs, practices and products.

The honors that his peers have conferred upon him help testify to the esteem in which they hold him. His crowning achievement, however, is his well deserved reputation as a generous, kind and helpful friend and associate.

The following is a thumbnail sketch of Dr. Daniel's academic and professional career:

Degrees:
B.A. - Ouchita College, 1941
B.S. - University of Arkansas, 1947
M.S. - Michigan State University, 1948
PhD = Michigan State University, 1950
Purdue University, Department of Agronomy
Assistant Professor, 1950
Associate Professor, 1954
Professor, 1957

Time and space do not allow a listing of every activity, accomplishment and honor associated with Bill Daniel, but the following includes a representative few:
- Executive Secretary, Midwest Regional Turf Foundation
- Developer of Evansville bentgrass, Midwest zoysiagarss, Sodco bluegrass
- Purr-Wick rootzone
- Prescription Athletic Turf (PAT) System
- 50-60 trips each year as guest lecturer on a wide variety of turfgrass subjects
- Co-author of Turf Managers' Handbook and many extension leaflets on lawn care
- Fellow in American Society of Agronomy
- Agronomic Service Award from American Society of Agronomy

- Distinguished Service Award from Golf Course Superintendents Association of America
- Honorary member, American Sod Producers Association
- Green Section Award, U. S. Golf Association, in recognition of distinguished service to golf through work in turfgrass
- Indiana Golf Hall of Fame
- Alpha Zeta, Sigma Xi, Omicron Delta
- Listed in Who's Who in the Midwest

When Dr.Daniel retires from his position at Purdue he leaves behind a tradition of service, accomplishment and humanity that will be difficult to emulate.

In his honor, a fund has been established within the Purdue Agricultural Alumni Association to support the education and training of turf students as well as turf research at Purdue. It is identified as "The Daniel Fund". Contributions are tax deductible and can be sent c/o Midwest Regional Turf Foundation
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West Lafayette, IN 47907

Turf Graduates

PhD

Dr. Norman Goetze - 1960
Dr. James B. Beard - 1961
Dr. William C. LeCroy - 1963
Dr. C. William Lobenstein - 1964
Dr. Hayden Watkins - 1967
Dr. David S. Ralston - 1970
Dr. Terrance Riordan - 1971
Dr. Raymond P. Freeborg - 1972
Dr. John Thorne - 1973
Dr. James McAfee - 1973
Dr. John M. Roberts - 1977
Dr. Dean K. Mosdell - 1985

MS

James W. Brandt - 1950
Don Likes - 1951
L. J. Munzenmaier - 1953
Bill Amick - 1955
Edward Jordan - 1959
James B. Beard - 1959
Mel Hansen - 1959
Stephen Frazier - 1960
R. H. Montgomery - 1962
Howard Gaskill - 1963
Eric K. Melkerson - 1963
Charles Berry - 1964
David S. Ralston - 1967
Terrance Riordan - 1968
David Bingaman - 1969
Melvin Robey - 1971
John M. Roberts - 1973
Paul Granger - 1975
Nick Rush - 1975
Jeff Kollenkark - 1976
Jose Eguiarte - 1977

BS Graduates - 234
Ex Students - 9

Ideas: Old and New

Fred V. Grau
Retired Agronomist, College Park, Maryland

Note: Dr. Grau is currently 83 years olf and still quite active. His contribution has special merit and his efforts to attend are appreciated.

The reason for assigning this title to me seems a bit obscure but it may have been related to the fact that I was NEW in this business when I started my turfgrass career nearly sixty years ago. Now some people think of me as OLD just because I was born in 1902. NEW ideas continually come to mind to replace the OLD ideas that are obsolete.

It was a great idea to bring together so many of Bill Daniel's students, friends and fellow workers to wish Bill well upon his retirement which I prefer to term "A NEW beginning". Bill has done so much for so many with his NEW ideas about Safer Sports Turf achieved with his PAT System, developed from an older idea called Purr-Wick. There is no need to elaborate on the good that these ideas have done when put into practice.

For one to teach another is an old idea that conjures up visions of Socrates and other ancient scholars. It was a NEW idea to teach young men and women the science of turfgrass before the science actually formulated. Today we honor one who, with his new ideas, helped to develop the science of turfgrass. He taught others who have beome some of the world's leaders in turfgrass science.

The need to aerate compacted soils is an old idea. At first we used a spading fork. New ideas helped to create tools with solid tines. Then came the hollow tines that removed a cone of soil, thatch and grass. Machines followed which did the job more quickly and efficiently. Today a new idea has resulted in a new machine that does a superior job yet has no moving parts. The end result of these new machines when used right will be Better Turf. On sports fields there will be fewer bumps and bruises.

Let's take a quick look at a few old ideas and see how they have endured. Seventy years ago the first book on Turf was being written. That was a NEW idea. Many of the ideas in it were old because turf management then was an art. Here are a few of the ideas that were promoted.

To kill dandelions, dip an ice pick in sulfuric acid, then plunge it into the heart of the weed.

To get rid of earthworms, drench the turf with a solution of salt and bichloride of mercury (corrosive sublimate). Scoop up the worms that come to the surface, put them in a wheel barrow and haul them away. Mowrah meal will accomplish the same purpose.

For a turf cover on unwatered tees, plant yarrow and crested dogstail.

To make topdressing for greens, build a compost pile with layers of sod, manure and lime. When well rotted run it through a shredder and a rotary screen.

Here is an old idea that is as good as new. Turf watered in the morning will have less brown patch than that which is watered in the evening.

An old idea was to fertilize turf with manure water. Then came a newer idea - use sewage sludge. This gave rise to activated (processed) sludge that carried a familiar name. These ideas gave rise to composting sludge which creates a safe useful product.

An old idea was to combine urea and formaldehyde to make buttons and piano keys. A brilliant scientist had a new idea. Change the mol ratio and develop a slow-release nitrogen fertilizer that wouldn't burn and would last a long time. New ideas for different ureaform products kept emerging. Today there are many on the market, each one different, each needing to be understood in order to be used effectively.

One of the old ideas in building putting greens was to use a 1-1-1 mixture of soil, sand and humus with no subsurface drainage. Almost all such greens have been rebuilt, some within two to three years after completion. Newer, more advanced ideas led to the use of more sand and expertly designed subdrainage.

Here is an old idea that set education in turf back a few ideas. Professor Musser and I met with a group of greenkeepers to introduce the new idea of a short course to train young men to be better greenkeepers. This was nearly fifty years ago. We came close to being booted out of the meeting. They said, in effect, "We don't want you training some whipper-snappers to come in and take our jobs. We have our own secrets." New ideas led to two-year courses, then four-year courses and on to graduate studies. At the first turf conference in Texas I met Jim Watson who was a candidate for graduate school. I called Professor Musser and asked him if he would take a graduate student. He said, "Yes! Send him up. Where's the money?" Soon after that I became involved with helping to finance Bill Daniel at Michigan State University. Both Jim and our Bill have become world-class leaders in the turfgrass field.

A new idea was developed when Professor Musser died in 1968. A group of his friends gathered at the funeral home agreed to establish a memorial to this pioneer educator/researcher. Thus the Musser Foundation was born, established to help finance struggling graduate students in turfgrass science.

Another new idea gathered form and substance just fifty years ago when crownvetch was discovered growing wild on a rundown farm in Berks County, Pennsylvania. The idea arose from seeing how the plant eliminated erosion and held me spellbound with its beauty. Today the plant covers thousands of miles of slopes and stands as a living memorial to its discoverer and developer.

An old idea is the hole cutter for putting greens. From that came a new idea - cutting plugs of sod to sell to homeowners. The grass was Meyer zoysia, released just thirty-five years ago.

A new idea, coming from an old idea of punching holes in turf was the aerifier, conceived on my desk at Beltsville,Maryland, and developed by the Mascaros. This idea has been indispensable to golf courses and, later, to athletic fields.

One of the greatest gifts that God has given to mankind is the ability to think and to reason. This leads to ideas which, by themselves, mean little. Only when someone does something about them do they become a part of progress. Some ideas are good - some are bad.

An old idea was to make selections of promisng strains of bentgrass, increase them vegetatively, then plant the stolons to make a putting green. Professor Musser developed the idea of growing three compatable strains side by side so they would polycross. The result - Penncross bent seed! Every golf club, every superintendent that uses Penncross owes something to Professor Musser.

An old idea was to hand plant potted rooted cuttings of Hall's honeysuckle on highway slopes. A new idea developed when Doc Keyser and I put together a Rube Goldberg machine that mixed fertilizer,lime, seed, soil and organic matter (called FLOSS), mixed in with water and spewed it on slopes. That was the first Hydroseeder (1939). That idea resulted in several companies building hydroseeders which plant crownvetch and grasses hydraulically at low cost.

An older idea was to see how much water one could throw on a golf course in one night. The new idea is to see how little water we can use and still keep good playable turf.

The old idea was for each turfgrass group to operate independently. The new idea is for all groups to work together for the common good through a state-wide turfgrass council or association. Everyone wins when people work together.

A great new idea resulted in the Turf Managers' Handbook, one of the fine contributions to the industry.

An old idea of setting zoysia plugs will give way to the new idea of planting zoysia seed that has been treated to induce high germination. The seed will be planted in hot weather for best results.

In 1920 a new idea was born. The U.S.G.A. formed the Green Section. In sixty-five years there have been some changes, but it has been a vital force in the development of golf turf.

Ladies and gentlemen, I say to you, "Let your ideas flow and let your imagination soar. One good new idea out of one hundred tries is worth the effort." How many times did the spider rebuild her web when Robert the Bruce destroyed it in his English prison cell? Her persistence gave Bruce the idea to escape, to build an army, and to defeat the enemy.

The 1980's - A Decade Of Challenge For The Turfgrass Industry[1]

Dr. James B. Beard
Texas A&M University, College Station, Texas

It is approriate at the start of a new decade to pause and reflect on our past before projecting into the future. In 1980 we celebrated the historic 150th anniversary of a major event in the evolution of turfgrass culture. Mr. Edwin Budding invented the first lawn mower in 1830. It was a reel design with catcher which was built in a shed and tested on a nearby grassy area at night in order to maintain secrecy before patenting. The manufacturing rights were obtained by Ransomes Manufacturing, which sold 1,000 units by 1850. The next benchmark was 50 years later in 1880, when the first powered mower was developed. It cut a very narrow swath and was steam-driven, but unfortunately weighed one and one-half tons. Then in 1900, the internal combustion engine was introduced in a powered mower. The electric mower was introduced in 1925. During this period in the development of the turfgrass industry, most approaches to turfgrass culture evolved as an art through trial and error methds.

The year 1950 marked the start of our greatest advances in the science of turfgrass culture. Both land grant universities and private industry devoted major research efforts toward solving the problems of turfgrass culture and developing a set of scientifically based principles. As a result, the 1960's and 1970's have been a Golden Era in the use of quality turfs, the development of professional turf managers, and the generation of research information concerning the science of turfgrass culture. We can be proud of these accomplishments. However, many of these advances in turfgrass culture were based on cheap, abundant resource inputs. This is a trend which cannot continue.

What can we anticipate in the 1980's? Projecting into the future is a risky occupation, but it can serve as a useful guide so that we can prepare for the future - even if the projections are not entirely correct. The remainder of this paper will address the six major areas of concern for the 1980's: energy, water, pesticides, nutrients, equipment and manpower.

Energy

The news media bombard us daily with the energy problems of our country. They are real, but I am confident that man has the capability, through the ingenuity of the human mind, to develop alternate energy sources which will replace many of the roles now fulfilled by oil. However, these future energy sources will be available at a higher cost. As a result, energy conservation will be a high priority for the turfgrass industry in the 1980's. What are the trends?

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[1]Published with the permission of the Texas Agricultural Experiment Station as Journal article No. TA-16856.

1. Mowing - Increased use of reelmowers as they are cheaper to power than rotary units. A trend towards larger, more mobile mowing equipment.

2. Fertilization - Lower rates of nitrogen application, coupled with the acceptance of a less green color.

3. Irrigation - Increased pumping costs could lead to a trend towards more efficient, lower pressure heads.

4. Equipment - There is also the impact of higher energy costs on the basic purchase price of equipment, pesticides, and fertilizers, which is further amplified by our current high inflation rate. A partial solution is continuing emphasis on increased efficiency, which translates to cost control.

Water

I believe that water is the greatest problem facing the turfgrass industry. Energy will be available at a price. Water availability will not be limited to the more arid regions, but will also be a problem facing the urban areas in the more humid, high rainfall regions during periods of extended drought. There is also concern for water quality as well as actual availability. Salinity is an increasing problem where effluent water is used, in arid regions, and along coastal areas such as Florida where salt water encroachment is occurring as ground water supplies are pumped out.

Far too many intensively maintained, high quality turfs are now over-watered. Studies have indicated that as much as 50% savings in water use could be achieved by simply applying the cultural practices now known. Over-watering not only wastes water, but also leads to increased disease, soil compaction, weed, and nutrient leaching problems. The good turf manager of the future will have the capability of making the very difficult decisions involved in proper irrigation practices. The turf manager who maintains a green, high quality turf by a philosophy of maintaining constant water supplies in the soil through over-watering will become obsolete. In summary, what are the trends that can be anticipated?

1. Less water available for turf use.
2. Higher costs both for water and pumping.
3. Increased use of effluent water.
4. Declining water quality.
5. Water allocation, as has already occurred in certain areas of California, even with landowners who possess private wells.

Again, the solution is conservation. It involves better designed and installed irrigation systems as well as the implementation of more efficient watering practices by the turfgrass manager. In the future, research will hopefully be able to develop improved turfgrass cultivars which will have lower water use rates, improved drought tolerance, and a better ability to grow in saline soils.

Professionalism, Whose Turf?

Norman Goetze
Associate Director, Cooperative Extension Service
Oregon State University, Corvallis, Oregon

Being a professional is a very personal obligation to one's chosen field of endeavor. The professional recognizes the obligation of his particular assignment, the opportunity for his own self-improvement, and how he can best share his strengths with others to contribute to the success of the group.

Every position in society has both responsibilties and opportunities. Successful career development is first dependent upon one's ability to honestly assess his individual goals and to realize which strengths and contributions will be most helpful in reaching those goals. Making short term decisions primarily upon early opportunities frequently leads to blind alleys. If you don't know where you are going, every road you take will get you there. Most professionals change positions several times during their careers. However, career changes are less frequent. Choices of career result from early exposures, family association, and mass media hero imaging. Outstanding teachers, clergy, and society leaders also have significant effects upon early career choices.

Within a given career, most professionals enter at the lower position levels. Their rate of advancement is dependent upon magnitude of successful performance in each successive professional step. Lateral promotions rarely occur until the middle management layers. Even there lateral transfers are looked upon with suspicion by those immediately below.

A most serious problem with advancing within a narrow position career path is that little latitude is normally present to allow for major career changes. Secondly, most everyone eventually reaches his maximum proficiency level. A promotion beyond that level would benefit neither the profession nor the over-promoted professional. It is often difficult for many professionals to realize and admit that they are performing at their optimum level and that further advancement would be detrimental to both his career and the profession.

More than ninety-nine percent of professional workers are honestly attempting to perform well in their positions. Or conversely, less than one percent are deliberately avoiding efforts to reach maximum output levels. Why then is there so much job dissatisfaction and strife among and between professional workers in America? I will offer several major causes and suggest some possible methods of self improvement for professionals.

A major cause of professional inefficiency is the professional's lack of knowedge of his own career wishes and of his strengths and weaknesses. He has not honestly done a good job of self-appraisal or has not listened well to constructive appraisal by his peers or superiors. He doesn't know or doesn't want to admit where he stands in relation to normal performance expectations. The obvious solution lies in seeking honest peer and supervisory evaluation and weighing often conflicting evaluations honestly by himself in relation to his own career goals.

A major problem of communication arises when several different agencies or disciplines are working collaboratively on the same problem or within the same career goals. Professionals who don't communicate their goals and their intended outputs for the mutual benefit of the society or community goal are quickly misunderstood and lose interest in the project. This disinterest is followed by mistrust and ultimately by lack of involvement. The resulting lower performance then lowers the efficiency of the group and seriously impairs the non-communicating professional's future growth. The solution is a deliberate cooperative mode of communication by all. This can most frequently be in a non-authorative attitude.

Jurisdictional disputes among employees or agencies who should be cooperating often leads to serious loss of professionalism and impair the strength of cooperative programs. Even though agencies may agree to cooperate, lack of professional cooperation by just one member of a group can lead to turf battles which are very disruptive of cooperative programs. These problems are not easily alleviated by a simple single solution. First each agency must want to cooperate in the solution of a particular problem and must want to contribute significantly thereto. This willingness must be accompanied by administrative leadership which will contribute to the motivation of each member of the group to this goal. An internal reward mechanism for constructive support to the program can elimiante many serious problems but to be effective must be accompanied by strict periodic administrative evaluation.

Many professional turf battles arise because the combatants have the mistaken idea that they are superior or at least equal to their competitors in every criterion. Yet every outsider knows that a team is made up of specialists,each of whom has superior attributes and some qualities which are below the median of the team. The most successful team is the one which can play to the advantage of its strengths and the one which can avoid putting pressures on its weaknesses. Teams of individuals and agencies by the same manner can be most effective by recognizing individual and agency strengths and playing to them. A simplistic example is two teachers of the same subject; one is a fantastic lecturer,and the other is a good motivator and counselor. The teaching team gets a lot further by having the good lecturer prepare and deliver class materials while the counselor motivates student performance in an informal manner.

No professional remains static in his profession. He either continues to improve or he falls behind those who are improving. Professions are very competitive. Therefore every motivated professional must develop and execute a professional self improvement program. It can take on one or more of a variety of forms. Perhaps the single common purpose of all self improvement programs is to allow a change of pace to stimulate better self-evaluation. In-depth programs to concentrate on improving one's already excellent skills may be beneficial to a basic research scientist. Most team players,however, can best avoid future professional turf battles by improving their personal communcation skills and by improving the skills required in their profession for which their current proficiency is low. They most also note their career goals and develop the skills necessary for one or two steps up the ladder.

Self-improvement programs can be intensively sporadic or at a steady lower level. Most importantly they must be a part of a deliberate long term plan which is changed only as the interests of the professional change. Agencies and disciplines suggest different levels of total mid-career self-improvement levels ranging from 1 percent to 20 percent of total employment. Obviously, society demands that jet pilots and heart surgeons have as much professional improvement as possible. Yet other non-critical professions could receive equal use of state-of-the-art techniques by better self-improvement programs. My agency suggests an average of 9 percent self-improvement activities, yet we have many, including a high percentage of administrators, who have much less than that.

In order to have a balanced outlook on life every professional needs time for his family, friends, community, and hobbies. He must schedule time away from his profession to enjoy his family and his friends and to avoid the traumatic stresses of workaholism. We all know far too many of our peers who have permanently ruined their careers by this mistaken idea that they had to perform never-ending Herculean tasks to be successful. Correcting this problem for high achievers among the professionals is often very difficult. Encouraging these individuals to realize that every professional is replaceable and that the profession continues after each of us completes our service to it is perhaps a good start. If we could make better use of the parable of teaching more people to fish instead of providing fish for those potential fishermen to eat in one day, better professional accomplishments would result.

Twenty-five years after completing my formal professional training I most highly respect those Purdue faculty and turf profssionals who were "complete" professionals. Though I was a somewhat reluctant student, they finally convinced me to develop career goals, to have a continuously positive attitude, to openly communicate, to cooperate with others, to play to my strengths, and to continue to improve my professional competence. I wish to repay this lifelong debt of gratitude by helping others in their professions and by recognizing that I should have a good time with my family and friends. (Which I am doing).

Serving Turf Managers

Eugene Johanningsmeier
Turfgrass, Inc., South Lyon, Michigan

Bald is beautiful!

Cheer up - the less you have the more there is to go.

SERVING: According to Thorndike Barnhart

Supply, Furnish. Supply with something needed. What can we serve you with?

Help, Aid: Let me know if I can serve you in any way.

Be useful; be what is needed; be of use.
Be useful to: fulfill
Be favorable or suitable.

Laws of Success:

- Do you want something? Will you pay the price?
- The great sin -- Gossip
- The great crippler -- Fear
- The greatest mistake -- Giving up
- The most satisfying experience -- Doing your duty first
- The best action -- Keep the mind clear and the judgment good
- The greatest blessing -- Good health
- The biggest fool -- The man who lies to himself
- The most certain thing in life -- Change
- The greatest joy -- Being needed
- The cleverest man -- The one who does what he thinks is right
- The most potent force -- Positive thinking
- The greatest opportunity -- The next one
- The greatest thought -- God
- The greatest victory -- Victory over self
- The best play -- Successful work
- The greatest handicap -- Egotism
- The most expensive indulgence -- Hate
- The most dangerous man -- The liar
- The most ridiculous trait -- False pride
- The greatest loss -- Loss of self confidence
- The greatest need -- Common sense
- The most important trait -- Listening

Wise Words: "My son Bernard?" old Simon Baruch once said, "No wonder he's such a success. He had all the advantages I lacked as a boy. I was a rich boy, but luckily for Bernard we didn't have anything left after the war. He learned you have to work for what you get. I spent many years in colleges; Bernard had to go to work much earlier. So he went to work and got a real education in life. With all those advantages who wouldn't be a success?"

A noted food industry executive once said, "The most exciting dimension in our industry is not a square foot of selling space. It is not the illimitable miles of the outer universe, 93 million miles to the sun or 1,800 light years to Arcturus. The most exciting dimension in the world is the few inches from your lips to another person's ear. If you can conquer that space nothing is impossible to you."

Communication: Listen to customer needs and anticipate his wants. Work as hard to keep his business as you did to get it and the competitor will do the worrying. My customer is my competitor's prospect.

The learned skill of listening: Sales people must talk; certainly it goes with the territory. But with talking goes listening. Dr. Edward Wakin, professor of communications at Fordham University, offers some suggestions for better listening:

1. Be interested and show it.
2. Tune into the viewpoint of the other person.
3. Notice nonverbal language such as a smile, a nervous laugh, or body positions.
4. Give the other person the benefit of the doubt instead of entering the conversation with your mind made up.
5. Get feedback. Ask a question, and confirm with the speaker what he or she has actually said.

Take Time

Take time to WORK - it is the price of Success

Take time to THINK - it is the Source of Power

Take time to PLAY - it is the secret of Perpetual Youth

Take time to WORSHIP - it is the Highway to Reverence

Take time to be FRIENDLY - it is the Road to Happiness

Take time to LAUGH - it is the Music of the Soul

Take time to DREAM - it is Hitching your Wagon to a Star

Take time to LIVE

Author Unknown

Proposed Fertilizer Program For General Lawn Areas

Class of Lawn	Mowing Height	Date	Material	Rate/Acre	Cost/Acre	
Unirrigated	inches					
D	3-4	5/15	Trexsan	1.5 qts.	$15.	
						$15.00
C	2-3	5/15	Trexsan	1.5 qts.	$15	
		5/25	29-3-5	150#	$42	
		9/15	29-3-5	150#	$42	
						$99.00
B	2-3	5/15	Trexsan	1.5 qts	$15	
		5/15	Oftanol	1 bag	$68	
		5/25	18-5-9	200#	$54	
		7/25	18-5-9	150#	$40	
		9/15	18-5-9	250#	$67	
						$255.00
Irrigated						
B	1.5-2	4/1	8/4/24	200#	$49	
		5/15	Oftanol	1 bag	$68	
		5/15	Trexsan	1.5 qts.	$15	
		5/25	18-5-9	200#	$54	
		6/25	18-5-9	150#	$40	
		7/25	18-5-9	150#	$40	
		8/25	18-5-9	200#	$54	
						$322.00
A		4/1	8-4-24	200#	$49	
		4/15	Actidione RZ	1.5#	$15	
		4/25	Actidione RZ	1.5#	$15	
		5/15	Oftanol	1 bag	$68	
		5/15	Trexsan	1.5 qts.	$15	
		5/25	18-5-9	200#	$54	
		6/25	18-5-9	200#	$54	
		7/25	18-5-9	200#	$54	
		8/25	18-5-9	200#	$54	
		9/25	8-4-24	200#	$54	
						$437.00
		* 6/25	Bayleton	11#	$350	

*Needed only if Fusarum has been a problem in prior years

Repeat applications may be necessary about 7/25

If crabgrass has been a problem use 18-5-9 5/15. Add $14 to cost.

Managing People

Ken Girt, Grounds Department
University of West Virginia, Morgantown, West Virginia

Before we start, let's define people, manage, and manager. Webster's Dictionary defines as:

People — Human beings making up a group or assembly and linked by a common interest. The members of a family and kinship.

Manage — Handle - contol - to make and keep submissive - to succeed with care - to alter by manipulation.

Manager — One who conducts business affairs with economy and care.

I am only going to refer to turf and grounds maintenance in passing because of the similarity in managing people in all types of work. In this field we have a wider spectrum of backgrounds and training than in other facilities. At one end of the spectrum there may be a landscape architect or college educated turf manager and at the other end a part-time high school student.

Between these two extremes are employees with skills and knowledge to cultivate and maintain grass, trees, shrubs, drainage, irrigation lines and grounds equipment.

How important are people, workers, and employees? Well, we spend more money on salaries than we do on any other part of our budget. Most probably about two-thirds of the money spent is on people. This is our highest cost and yet we spend less time on planning what kind of people and about the care of these people to see that they fulfill their jobs or duties than we do in maintaining our equipment, turf, roads, etc.

Sure, we spent the money but was it planned? Was it spent wisely? Did we really get our top dollar value from this item which is so large in our budget?

I would like to make one comparison. Say we need a new seven gang mower. We know we have to plan on how we can come up with the money. We do not go out to buy this machine with only $5,000 and barely the amount to buy a National. Think about it.

So, maybe we can work with what we have. It will take more work but we don't mind, do we?

I am only going to try to hit on some of the high points since time and space is important here as it is in our own little world. Following are seven very important items that affect one's job, business or profession.

- Organization
- Standards & Objectives
- Training of Employees
- Communication
- Morale
- Attitudes
- Leadership

Organization

What can good organization do for us?

1. Little or no duplicaiton of effort
2. Defined lines of communication
3. Established lines of decision making authority
4. Clear, logical and definite allocation of responsibilities with corresponding authority

Good organization relationship will avoid management by crisis.

The lack of planning and prior scheduling means lost production time as employees rush from one job to another. The result is usually a high backlog of work and frustrated workers, supervisors, and clients.

Standards & Objectives

Know what you want and expect from your workers. Make sure the time that is spent on setting up the job standards is well spent. Do you really know what you expect from your workers? Do they know what is expected from them?

Job standards will make you and your employees more comfortable. They also should be set up so that they can be adjusted from time to time according to season changes, weather, location, or other special needs. Of course, an inventory of your facilities and equipment will be necessary when setting up your standards, such as number of square feet of turf, the kinds and number of trees, shrubs, and pavement, etc.

Training of Employees

"You can't teach old dogs new tricks, but you are never to old to learn." Proverbs and wise sayings offer little help when it comes to training. Employee training is an effective management tool when used in a planned, purposeful manner.

Trained personnel will be able to provide quality work and increase their productivity.

When planning a training program you need to answer such questions as:

1. What should be done
2. In what sequence
3. When
4. How
5. For whom
6. At what cost
7. What specific result can be expected
8. What constraints are present
9. What problems must be resolved

Communication

There have been volumes of books and papers, etc. that have been written, spoken and talked about on this subject, yet it seems the most difficult to master.

Wars are fought, people divorce one another, friendships are broken, jobs are lost, and parents and children do not understand each other because for some reason there is a communication breakdown. Why? Again, volumes have been written on this. I believe we need to work on communicating. We communicate by talking, looking, writing, walking, showing, reading and, most of all, by listening.

Practice communicating. Tell someone something then ask for a feedback of what you just said. You may be surprised!

Morale

You never will be able to please all your employees all the time and it would be a mistake to try. It's fair to ask, though, just how good can you expect morale to get.

Studies by the University of Chicago Industrial Research Center of over a half million workers show that two to four out of every ten employees are usually less than satisfied with their lot. This dissatisfaction will be all the more with some things like pay than with other things such as working conditions. Morale can change, and often you may say in some people it may change as the weather changes. In fact, weather can be a factor as well as job assignments, whom one is working with, and home life.

Attitude

An attitude is a person's point of view. It's that person's way of looking at something. Even more important, an attitude is a person's readiness to react and to react in a predetermined way. Your attitude towards lateness will determine how much emphasis you place on tardiness as a measure of employee performance. Basically, we have two types of attitudes - positive and negative. "Is the glass half full or is it half empty?"

People who are positive in their thinking look for the good things in other people and in their own work. People who have negative attitudes tend to see only the bad side. They dwell on their own misfortunes and those of others. Unfortunately, negative attitudes, like positive ones, are contagious.

Leadership

It may be an art. Are leaders born? Are leaders made? Leadership carries responsibility. There are willing leaders and unwilling leaders. Any time you have more than one person on a job, there is a leader.

The boss, supervisor, or manager may be the formal leader but not necessarily the leader of the group of workers. It is not always necessary for the boss to be the sole leader. He should be sure, if he is not the leader, to know who is and work through that person to get what he wants done.

If there is one thing that I teach my foremen, it is that "they can lead or pull a rope from here to eternity, but they probably won't get across the street if all they can do is push."

In order to gain a broader and more comprehensive view of individuality in human relationships, the following readings are recommended:

Bittel, Lester R.: Nine Master Keys of Management, McGraw-Hill Book Co., New York, 1972. Chap. 7, "Confidence in Others, and Chap. 9, "Knowledge of Yourself"

Davis, Keith: Human Relations in Business. McGraw-Hill Book Co., New York, 1957. pp. 12-55

Dowling, William F and Leonad B Sayles: How Managers Motivate. McGraw-Hill Book Co., New York, 1971.

Famularo, Joseph J: Supervisors in Action: Developing Your Skills In Managing People. McGraw-Hill Book Co., New York, 1961.

Likert, Rensis: New Patterns of Management, McGraw-Hill Book Co., New York, 1961.

Uris, Auren, The Manager's Job. Lincoln Extension Institute, Inc., Cleveland, 1962, Chap 9, "Working With People".

Winning With Turfgrass Growth Regulators

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The title of this article implies that there are chances of something less than winning. In fact, many users have found unexpected results with turf growth regulators and are hesitant about using them further. This article addresses certain physiological processes of turfgrass growth and development that were obscured during the revolution of turfgrass science and management that occurred in the 1950's. Briefly, development of efficient mechanical mowers and fertilizers designed specifically for turfgrass resulted in a rapid improvement in the ease of maintaining aesthetic quality in large acreages of turf. Turfgrass research on the life cycle of cool season grasses, particularly on the seedhead or reproductive phase, more or less ended at that time as these processes could be rather easily obscured through mowing and other management practices.

For years researchers have said that mowing results in a series of developmental and physiological processes in the plant such as synthesis of the growth hormone ethylene at the cut end of leaf blades and subsequent stimulation of tiller development. It is believed that these processes currently associated with mowing are again altered when the practice of mowing is reduced or eliminated. It is further believed these processes are important in describing a large part of the erratic turfgrass response to growth regulators both in turfgrass quality alterations and in growth suppression.

Turfgrass quality reductions during chemical growth suppression can result from a myriad of factors. Certainly chemical injury is one of them. Some regulators are quite safe on the turf sward while others are very difficult to apply without injury. Consult the label directions to determine relative safety of each product. However, the turfgrass quality issues emphasized in this article are those that appear at certain times with all regulators and are a result of natural leaf aging, senesence and death.

Growth regulators work. Some work differently than others. Achieving consistent, uniform results is easy when the right product is applied correctly in the proper situation. This article will also examine basic application techniques and will compare some basic technical properties of current commercial and experimental growth regulators so that successful use of each can be optimized.

Why use growth regulators?

Turf managers who have used growth regulators successfully indicate that growth regulators help them gain control over their operation in the spring when all the consumers have spring fever, the boss wants all the spring clean-up work and all the new projects done right now,the crew is short because the summer students are still in school, the grass grows fast, and you can't get out to work half the time because its' raining. Most managers agree that growth

regulators do not replace mowing, but can successfully be used to regulate mowing and thus provide for more uniform season mowing practices. The most effective method of determining where to use a growth regulator is to identify the acres of turf that: 1) need to be mowed on a frequent basis, 2) are slightly away from the "showcase" areas that build the image of the operation and 3) for one reason or another are difficult to get mowed on a timely basis each spring.

Timing the application.

Plant growth regulators (PRG's) for turfgrasses have usually been recommended for application at specific times of the year. Spring is the most common time of the year for application because cool season grasses exhibit up to 50 percent of their total annual vertical growth during a six week period that usually begins sometime in April and ends sometime in June. Naturally, the preferred time to apply a growth suppressing chemical is just prior to the peak period.

In the summer, PGR's are not widely recommended for use because warmer temperatures have already slowed growth, and little benefit can be derived from further reducing mowing frequency. In addition, summer is usually the period of highest traffic on turf and growth regulators have been shown to slow recuperation from wear stresses.

The fall represents an alternative application period to spring. Because of short days and cool temperatures in the fall, cool season grasses grow horizontally in preference to vertically. Much of the growth results in tiller and rhizome development. Thus, mowing frequency in the fall is not as great as in the spring and the need for a growth suppressor may not be as great. Further, the horizontal growth habit of the plant is important for improving density of thin turfs and PGR's may slow that development.

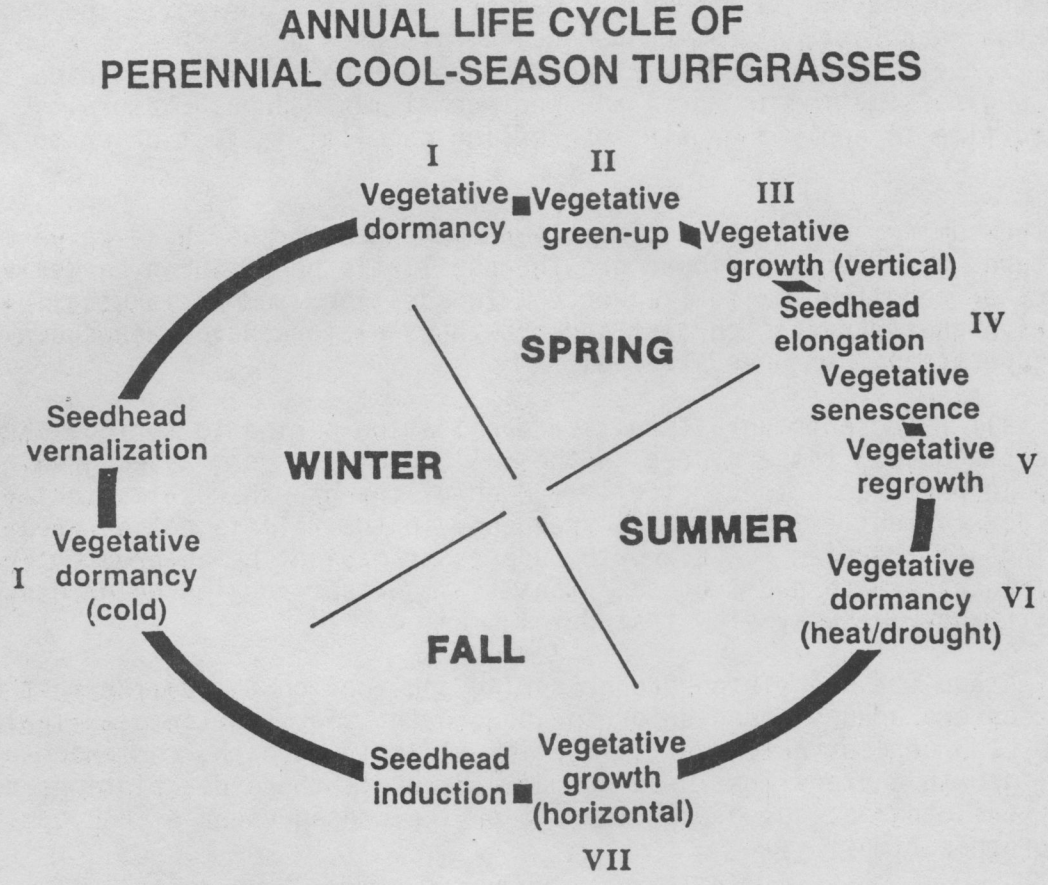
The method for describing proper spring application timing for most PGR's usually centers around green-up or spring growth. Terms often used include full green-up, 100 percent green-up, initiation of active growth, commencement of vertical growth and/or first need to mow. However, these descriptions do not identify the other stages of development or the consequences of PGR application at those other times.

It is proposed that descriptive stages of spring development be identified to provide for better markers of proper application timing of PGR's. Research and observations at Monsanto have led to conclusions presented in this article indicating that the response of grasses to PGR's can vary from excellent growth suppression with little or no turf quality loss to poor growth suppression with severe turf quality loss.

Stages of spring growth.

Figure 1 outlines the annual life cycle of cool season grasses and identifies proposed growth stages: I) Cold dormancy, II) Green-up, III) Rapid vertical growth, IV) Reproductive physiology, V) Revegetation, VI) Heat and drought dormancy and VII) Fall revegetation. Since spring is the preferred time of application, only the first five stages are discussed in this article.

FIGURE 1



Stage I. Dormancy of Pre-Greenup.

Pre-greenup is the appearance of the turf immediately following loss of snow cover. The appearance varies according to the kind of grass, the quality (color) of the turf the previous fall and the severity of winter effects. Within days after the snow melts and under full sun, existing leaves that were not excessively

damaged from winter effects will green up through chlorophyll synthesis. Leaves damaged beyond repair remain brown and fully visible until warmer temperatures hasten their degradation.

In certain areas along the west coast of the U.S. and mid-Atlantic east coast, winter temperatures are mild and cool season grasses only partially brown off. In this case the pre-greenup stage does not occur.

Stage II. Greenup and initial growth.

As temperatures begin to warm, new leaves grow from the crown apex (growing point) within existing leaves. Older leaves degrade and are replaced by new leaves. This process, known as greenup, may occur over a period of several weeks depending on how fast soil temperatures rise.

Late fall or early spring nitrogen applications promote grass growth and hasten the greenup process. Initial growth of spring-fall disease organisms such as leafspot begins at this time although infections usually do not appear on the leaves.

Stage III. Rapid vertical growth.

The beginning of Stage III is most easily characterized by the need to mow. The grass is beginning to grow so fast that weekly mowings often remove much more than the recommended 1/3 to 1/2 of the existing leaf height. If spring season temperatures warm rapidly and consistently, this stage can be entered before 100 percent greenup, and more than one mowing may be required before complete greenup has been achieved. At the onset of this stage, development of spring-fall diseases is greatly reduced by warm temperatures but some leaf symptoms may still develop. Rapid turfgrass growth masks the disease symptoms.

Near the end of this stage, the seedhead forms at the stem apex. The developing seedhead can be felt as a bulge at the base of the leaves. A number of plants need to be examined since not all will develop a seedhead each year. For verification, the leaves can be stripped exposing the young seedhead approximately 1/8 inch in diameter and 1/2 inch long. Stage III ends when the first young, short seedheads appear in the turf area. While it is too late to control those seedheads, a high number of later forming seedheads can still be controlled. The duration of Stage III appears to vary according to climate and weather, but usually lasts two to three weeks.

Stage IV. Reproductive physiology

In this stage, the seedstalk below the seedhead has begun to elongate. In many cool season grass species, about the time the seedhead becomes visible in a mowed turf, a natural plant hormone (signal) causes the leaves on the tiller that bears the seedstalk to stop growing and provide nutrients and energy to the developing seedstalk. Thus the plant is under the effect of a natural, internal plant growth inhibitor.

At this time a signal (perhaps the same one) causes the lateral buds to start developing into tillers at a faster rate and to form a new crown apex. The aging leaves associated with the seedstalk discolor, senesce and die as the young tillers grow and expand.

Stage V. Revegetation

The turfgrass sward eventually replaces all the original plants through rapid growth of new tillers. The dead plants degrade and fall into the thatch. Thus, the green color of the lawn is maintained through development of new crown apices and new leaves.

Life-cycle variation among species and varieties

Normally this transition (life-cycle) occurs in a lawn with minimal disruption of turfgrass quality. Grass varieties or species that have difficulty maintaining quality during transition are referred to as the "stemmy" types.

In the cool season region, May and June are known as the stemmy months for the stemmy varieties. Turfgrass researchers have known that the grasses are not attractive during the stemmy phase and many turf managers have also recognized that certain varieties have stemmy characteristics in May or June. However, while stemmyness seems to be well known, it has not been well researched.

For many years turfgrass researchers have suggested that the key improvement of the Kentucky bluegrass varieties is improved resistance to Drecshlera (Helminthosporium) leafspot diseases. Leaf infections in the spring are thought to translate into the severe "melting-out" turf losses which become most evident in the common varieties.

However, university researchers and turfgrass seed company researchers have also known that one of the major differences between improved and common Kentucky bluegrass varieties is the ability to produce seed. Common varieties produce copious amounts of seed and many of the improved varieties are very poor seed producers. As an example, the variety Sodco was very attractive in the vegetative state in the lawn, but failed to produce enough seed for marketing. It is proposed that the severe turfgrass quality losses from the melting out phase in common Kentucky bluegrass are primarily a result of reproductive senescence of the leaves associated with the seedstalk and the leafspot organism invades an already weakened plant.

Variation among species and varieties, in relative ease or difficulty living through reproductive transition appears to be associated with two factors: 1) the overall tendency of the species or variety to produce seedheads (percentage of the plant apices with potential to flower) and 2) the tendency of those plants to follow through with the flowering physiological state in spite of the mowing regime imposed on them (seedheads regularly mowed off).

It is recongized that the more recently developed varieties, such as Baron, are both "improved" and have excellent seed production. It is suggested that the mowing regime is quite effective in preventing these varieties from going through the destructive flowering physiology state.

As a cool season species, tall fescue is best adapted to the transition zone of the United States largely due to summer survival. Yet unmowed tall fescue develops a seedhead, matures and browns off while mowed tall fescue remains green. It is suggested that a major contribution to summer "tolerance" of tall fescue is the fact that frequent mowing removes the seedhead before natural hormones kill the leaves and a portion of the roots.

Characterizing the growth regulators

Growth is often defined as irreversible enlargement in size while development is transformation of apparently identical cells into diversified cells and plant organs. Based on these definitions, the current turf growth regulators can be divided into two types. Type I are those that affect both growth and development (Figure 2). Development not only includes the transformations from a seed to a mature plant in an annual species,but also includes the stages of the annual life cycle within a perennial plant as shown in Figure 1.

FIGURE 2

TYPE I GROWTH REGULATORS
Growth and development suppression (1)/inhibition (2,3,4)

1. **Amidochlor - Limit™**
2. **Mefluidide - Embark™**
3. **Chlorflurenol - Maintain CF-125™**
4. **Maleic hydrazide - MH-30™**

Within the Type I group, Amidochlor, the proposed common name for Limit, is a suppressor while the others are usually labelled inhibitors. The inhibitors usually stop growth immediately after application while the suppressors allow for some growth. This may be partially due to the time it takes for Limit to be absorbed by the roots and partially due to its mechanism of action. Regardless, the end result is a gradual reduction of growth that eventually approaches inhibition. The concept of a suppressor is not to stop growth and mowing, but to permit slow replenishment of turfgrass leaf tissue and utilize trim mowings as needed.

Other chemicals known to inhibit growth and development of cool season grasses are shown in Figure 3. These are defined as the herbicide type because all have a primary use as a herbicide. The herbicide types are characterized as having a very narrow margin of safety on cool season grasses and accidental overdoses can quickly and easily kill turf. However, the sulfonyl ureas will likely find use along roadsides as a grass growth inhibitor but the primary benefit is long term broadleaf weed control.

FIGURE 3

Herbicide TYPE I GROWTH REGULATORS
Growth and development inhibition/kill

1. **Non-selective herbicides**
   Example: Glyphosate - Roundup™
2. **Selective broadleaf herbicides**
   Examples: Sulfonyl ureas - Telar,™ Oust™
3. **Selective narrowleaf herbicides**
   Example: Sethoxydim - Poast™

Type II turf growth regulators are those that suppress growth only (Figure 4). The developmenaL sequence of the plant continues, however new plant organs develop in miniature size. Examples of this type include paclobutrazol or PP-333 and flurprimidol also known as EL-500 or Cutless. These compounds are often referred to as the anti-gibberellins and are effective internode elongation suppressors.

FIGURE 4

TYPE II GROWTH REGULATORS
Growth suppression only

1. Paclobutrazol - PP-333

2. Flurprimidol - Cutless™

Life cycle responses to the regulators.

If a Type I PGR is applied at Stage I, the most noticeable effect is a delay of spring green-up. Since development is slowed as well as growth, the rate of appearance of new green leaves is slowed and the size of the leaves is diminshed. Root active growth regulators are effective in reducing growth when applied at this stage while foliarly active compounds require green leaves to absorb the product.

For the root active product, research has shown that applications made in Stage II from 70 to 100 percent green-up, have not shown excessive delay of green-up, especially where a fertilizer application was made at the same time. Applications at this time often result in slightly longer vegetative growth control compared to 5-6 weeks normally found at optimum timing. Seedhead control levels may be less than optimum when applications are made this early but usually remain at an acceptable 80 percent or higher.

As discussed previously, development of spring-fall diseases is more noticeable when grasses are growing slowly and further growth suppression with all PGR's during Stages I and II can result in increased visibility of disease symptoms.

The following has been helpful in avoiding disease problems: 1) apply PGR's during Stage III where higher temperatures reduce disease development, 2) avoid applications to areas where common Kentucky bluegrass is under intense management, 3) avoid applications to areas having a history of spring disease problems and 4) use the products on areas other than the "showcase" turfs where diseases cannot be tolerated.

Stage III is considered the optimum time for application of Type I PGR's to provide good turfgrass quality and the normal 5-6 week duration of vegetative suppression or inhibition. Often there is a slight loss of turf quality from the second to the fourth week and enhanced dark green colof from the seventh to the tenth week or longer. Seedhead control is usually greater than 90 percent for applications made during this stage.

Rapid vertical vegetative growth signals the beginning of Stage III. Seedhead elongation signals the end of the stage which is the latest application time for optimum results. As soon as the first seedhead is visible above the boot leaf, the application time is over, especialy if a root absorbed product cannot be watered in immediately after application.

Applications of any Type I growth regulator at Stage IV can be detrimental to the appearance of the turfgrass areas especialy if the grass is a stemmy type. Growth regulators do not reverse the effects of the hormonal signal and in effect, work cooperatively with the signal to completely inhibit growth of existing leaves. Likewise they do not reverse the signal for tiller initiation but do greatly slow tiller development, at least for a time. Event lly one or more lateral buds, deep in the thatch and not having sufficient product, receive the signal. When that occurs these buds rapidly grow and develop into tillers.

Thus application of Type I PGR's at Stage IV result in undesirable turfgrass responses: 1) excessive growth inhibition for a short period, 2) severe losses of turfgrass quality as leaves senesce and die, and 3) early termination of activity due to rapid growth of escaped tillers not affected by the product.

Turf quality enhancements resulting from proper Type I use.

The significance of this signal reinforces the fact that Stage III is the preferred time for application. Since developmental inhibitors applied during Stage III prevent seedheads from developing, they also prevent the signal from being sent and prevent the negative turfgrass quality consequences of the signal. Therefore, these PGR applications can actually result in improved turfgrass quality when compared to a nontreated area undergoing the "stemmy" reproductive physiology phase. Further, the effect of preserving leaves seems to be accompanied by a preservation of existing roots. As a result, observations of improved summer growth, color, rooting, and tolerance to summer stresses including heat, drought and diseases have been observed when using some Type I growth regulators.

What about Type II regulators.

Because Type II plant growth regulators do not suppress plant development, applications at any of the stages from I through IV can result in 1) diminutive seedhead expression below the mowing heights, 2) senescence and death of the main tiller and 3) suppression of the size of the new tillers that normally grow large and mask the dying leaves. Therefore no stage of application on stemmy varieties in the spring is acceptable for Type II plant growth regulators.

It is important to state that the Type II regulators do show acceptable results on non-stemmy, highly vegetative species and varieties. For instance, tall fescue seedheads apparently can quite easily be mowed off prior to the signal, even when stunted by a Type II regulator and good results have been achieved. Type II growth regulator use on Baron Kentucky bluegrass, however, has not been as successful. Apparently, stunting the seedhead height does not permit the mower to remove the seedhead soon enough to prevent the natural signal and the leaves usually senesce and brown off rapidly during Stage IV. Finally, it should also be noted that Type II growth regulators have shown excellent performance in the fall season when perennial species do not exhibit the reproductive growth stage.

Roots versus foliar absorption.

Just as it is important to know where a pest lives in the turfgrass biosphere for targeting the pesticide application, the site of uptake of turf growth regulators needs to be identified and the growth regulator properly targeted to that site. The characterization of growth regulators in Figure 5 of soil versus foliar targeting indicates the optimum site of uptake for optimum activity.

FIGURE 5

Type of material	Biosphere targeting	
	Soil	Foliage
PGR	Limit™	
PGR		Embark™
PGR		MH-30™
PGR		Maintain™
PGR	PP-333	
PGR	Cutless™	
Herbicides	Pre-	Post-
Fungicides	Systemic	Contact
Insecticides	Most	

For Limit, PP-333 and Cutless, the products must be targeted to the root system of the plant. This does not mean the products are not absorbed by the leaves. In fact, leaf absorption may reduce product performance. Once inside the leaves, downward movement is not possible. Thus the only way for chemical to reach basal growing points of cool season grasses is by root absorption and upward translocation. In the case of Limit, targeting must be done as soon as possible because it is highly biodegradable with a half-life of one week or less.

For Embark, MH-30 and Maintain, the products must be carefully directed to the foliage. Uniform and complete leaf coverage is important for uniform response from these products. All of these products require a period of time on the leaves for absorption before rainfall occurs or the products can be inactivated. This is especailly true for maleic hydrazide which is slowly absorbed over a period of 24 hours. In addition, high humidities during the 24 hours are preferred to enhance the absorption.

On the other hand, root absorbed products are "weather-proof" in that immediate rainfall hastens and enhances activity. Given the frequency of rain in April, when application should occur over much of the midwestern and northeastern United States, the probability of natural rainfall soon after application is high, especially if the applicator merely avoids the first sunny day after a rainy spell. Many turf managers are applying root active products during the rain and thereby taking advantage of an otherwise "down" day.

Further, research has shown that root absorbed growth regulators have not shown direct chemical burn on turfgrass leaves and may be overlapped without noticeable injury. In other words, any color loss due to improper application timing is not appreciably greater where overlaps occur. However, while overlap activity levels of Type I growth regulators are relatively similar to levels at the recommended rate, overlap activity of Type II growth regulators results in double the amount and length of activity. This results in uneven regulation of growth. Therefore, wherever growth regulator application has a high probability of resulting in overlaps, obvious ease of application advantages exist for root absorbed Type I growth regulators.

Ther herbicide, fungicide and insecticide information in Figure 5 is given to show biosphere targeting similarities only. For example, from a targeting point of view, it makes good sense to tank mix pre-emergent herbicides with root absorbed growth regulators. Both can and should be applied in a rain. On the other hand,post-emergent herbicides tank mixed with root active growth regulators should be applied at least one day before anticipated rain. Always read label directions regarding compatibilities before mixing any chemicals.

Equipment for proper targeting.

It is important to first understand that any equipment designed for uniform coverage can be used effectively for most products. However, certain equipment for soil targeting products is becoming more widely used because of increased flexibility in applicaiton.

Figure 6 shows that for foliar targeted products, finer droplet sizes, higher operating pressures and lower carrier volumes are achieved with flat fan nozzles usually mounted at predetermined intervals on a boom sprayer. The objective is to uniformly apply product to each leaf while minimizing runoff. This same objective can be met with ultra low volume micro-drop units or with mist blowers. The latter two pieces of equipment results in a great potential for drift of airborne particles. Foliage targeting equipment works well for root absorbed products since the next rain is the final carrier to the intended product destination.

However, the turf manager is increasingly utilizing single or multiple, large flood jet nozzles or rain drop nozzles that provide larger droplet sizes at lower operating pressures. These systems usually require higher carrier volumes. The objective is to provide uniform soil coverage while minimizing the amount of product remaining available for leaf absorption. This objective can also be met with the ChemLawn gun or hose end sprayer providing the operator is well trained.

For turf managers who desire to apply liquid forms of nitrogen this targeting objective is of critical importance to minimize leaf burn potential. Increasingly, turf managers are finding that these targeting objectives are also improving performance of soil active products that otherwise may be absorbed by the turfgrass leaves.

FIGURE 6

SPRAY EQUIPMENT	
Soil	**Foliage**
Flood jet nozzle	**Flat fan nozzle**
Rain drop nozzle	**Micro-drop ULV**
Chemlawn gun	**Mist Blower**
Hose end sprayer	

However, the key reason for choosing flood jet nozzles seems to be associated with the possibilities for lateral projection of product. High carrier volumes with large particle sizes can be projected laterally up to 15 feet either side of a single flood jet nozzle. Lateral projection means improved equipment maneuverability among obstacles and easier application under fences. The single nozzle is not subject to the variation of application rates and skips that are common in undulating terrain being treated with a boom sprayer. It is also not as subject to the variation that occurs when one wheel of the sprayer drops in a hole.

This type of equipment can also be used for foliar absorbed products. However, it should be remembered that just as some of the root absorbed materials may be partially absorbed by the leaves and rendered ineffective, this equipment will direct a portion of the foliarly absorbed product past the leaves to the soil which could result in less than optimum activity. In addition, larger droplet sizes will result in reduced ability to uniformly coat each grass leaf blade with the product. This could become important with products such as contact fungicides. Therefore, it is recommended that the turfgrass manager have both equipment types available for proper chemical application.

In summary.

The first and foremost ingredient in winning with turf growth regulators is to read and follow label directions for each product. However, a thorough understanding of the principles of growth and development of turfgrasses and how each product slows or stops grass growth and/or development becomes important in choosing the right product for the right job. Test the various products that are available commercially and experimentally. Winning with turf growth regulators is 1) choosing the right areas for product use, 2) applying the product at the right time, 3) using the right equipment, 4) targeting the materials to the right biosphere and 5) using the right product for the right job.

Disease And Turf Care - Anthracnose

Noel Jackson, Professor of Plant Pathology
University of Rhode Island, Kingston, Rhode Island

Anthracnose diseases associated with the fungus Collectotrichum graminicola occur worldwide on a broad range of cereals and grasses. The symptoms may include blighting of the aerial parts and/or culm, crown and root rots that generally are most apparent as the host matures. Senescing and dead plants of all the turf-forming grasses commonly support the fungus but the number of turf species on which it is aggressively pathogenic appears to be limited. Symptoms warranting attention have been reported primarily in North America. Poa annua is the host species most frequently involved but fine leaved fescues, bentgrasses, perennial ryegrass and bluegrass turf occasionally may be damaged. In general, the fungus is associated with leaf blighting that usually occurs under high temperature

conditions. Turfs are variously affected, the symptoms ranging in severity from slight discoloration and sward thinning through diffuse, indistinct patching to irregularly shaped, reddish to bleached patches of dead grass several feet in diameter. Widespread failure of annual bluegrass turf in this manner during summer is not unusual in North America but whether heat stress, the anthracnose fungus, other fungi or a combination of these factors is the cause, remains a controversial subject! Systemic fungicides offer some relief to this problem and suggest that the fungi play an important role. However, these fungicides have a marked effect on the physiology of the grass and by alleviating stress and/or delaying senescence, they can enhance persistence of the annual bluegrass. Hence the mechanism whereby the fungicides afford a benefit remains unclear.

A second disease complex in turf associated with C. graminicola occurs in cool weather on Poa annua. This basal stem and root rot has been reported from Western Europe, coastal British Columbia and Washington, and New England. Annual bluegrass turf takes on a measly, spotted appearance as individual tillers or whole plants turn a reddish-yellow. Spots develop slowly as the infected plants discolor progressively from the older, outer leaves to the central shoot. Eventually the central leaf turns yellow, orange and finally red. The sheath bases turn black and the whole shoot can be separated easily from the crown. Similar symptoms have been seen in late spring on bentgrass golf greens in New England. The spots or patches are more diffuse and the orange and red leaf coloration is much less pronounced than for annual bluegrass infections. Blackening of the stem bases and stolons is readily discernible. Incidence of this disease declines as seasonal temperatures rise but symptoms of existing outbreaks may persist well into the summer. Damage to bentgrass turf may range from slight to severe and outbreaks of the disease appear to be on the increase.

Several isolates of C. graminicola obtained from turfs with the above symptoms were the subject of pathogenicity studies conducted recently in Rhode Island. Efforts to induce the disease by artificially inoculating annual bluegrass and creeping bentgrass with the fungal isolates under controlled laboratory conditions proved largely unsuccessful. Field trials conducted in 1983-84 demonstrated that fungicide/nematicide combinations were the most effective treatments in combatting the disease. The inference drawn from these investigations was that C. graminicola is not an aggressive pathogen in turf and that additional stress factors, including nematodes and other fungi, contribute in the final expression of typical basal stem and root rot systems.

Lawn Diseases - Problem Patch Diseases of Kentucky Bluegrass

Noel Jackson, Professor of Plant Pathology
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Until recently, Rhizoctonia brown patch and Fusarium blight have figured as the two major patch diseases of Kentucky bluegrass. Both appear in summer, favored by high day temperatures (80-95°) and particularly by extended periods when night temperatures remain above 70°F. In addition, brown patch requires conditions of high humidity and free moisture on the plant surfaces. The water requirements for Fusarium blight incidence were not a subject of general consensus since severe outbreaks following drought stress or excessive rainfall were both on record.

The presence of a "cool temperature brown patch" was a matter of concern in some areas of the U. S. for many years but the widespread occurrence of such a disease in Pennsylvania and New York during the seventies prompted a detailed examination of the problem. A different species of Rhizoctonia, R. cerealis, was determined to be the causal agent and yellow patch is now recognized as a common and widespread disease, active during cool, moist weather. On Kentucky bluegrass, the yellow, tan or straw-colored patches, rings and "frogeyes" closely resemble the symptoms described for Fusarium blight.

Since 1980, similar symptoms have appeared in Kentucky bluegrass turf during the cool periods of fall and spring in New England, Wisconsin and western Washington. R. cerealis could not be implicated as the causal agent. Initially, the take-all patch fungus Gaeumannomyces graminis var. avenae (or perhaps related members in the genus Gaeumannomyces) were considered as incitants, but Leptoshpaeria korrae, a fungus not previously recorded in the U. S., ultimately proved to be the culprit. This root and crown pathogen causes spring dead spot of bermudagrass in Australia and has now been found in a similar role in California. Necrotic ring spot is the common name assigned to this new disease of Kentucky bluegrass.

In New York state, protracted investigations into the etiology of Fusarium blight led inexorably to the conclusion that Fusarium species were not the primary pathogens associated with the typical patch symptoms of Fusarium blight in that region. Two root and crown infecting fungi could be isolated routinely from the patches, L. korrae (the necrotic ring spot pathogen mentioned abvoe) and Phialophora graminicola. The latter is a common fungus on grass roots but at high temperatures (around 85°C), it proved to be an aggressive pathogen on Kentucky bluegrass causing another new disease recently designated summer patch. The Cornell researchers demonstrated that either fungus could be introduced into mature bluegrass turf to produce a patch disease symptom at the site of the inoculation. No one has been able to induce development of patch symptoms using Fusarium species in a similar manner. This calls into question much of our literature on Fusarium blight and suggests that in many instances the Fusarium fungi commonly found, and upon which diagnosis of the disease was determined, were at best secondary invaders. It also offers an explanation for the many

anomalies in cultural and chemical control of Fusarium blight that have cropped up over the years; these fungi respond differently to fungicides and to environmental parameters. Thus it seems likely that three potential pathogens i.e., Fusarium spp., Leptosphaeria and Phialophora, singly or in all possible combinations, may funciton to cause identical patch symptoms in stands of Kentucky bluegrass. It is essential that a correct diagnosis of the causal organism be made before attempting any control measure of these damaging new diseases.

Limit[tm] - A New Turf Regulator

Domingo Riego, Monsanto Company
Carmel, Indiana

Limit[tm] turf regulator by Monsanto reduces growth and suppresses seedhead formation in cool season turfgrasses. An application of Limit in the spring will provide about 50% growth reduction for up to six weeks which allows a turf manager to significantly reduce the number of mowings during this period. Reduced growth rate and mowing allows the flexibility to redeploy labor to take care of a multitude of other jobs required to maintain grounds in the spring. Limit will also help reduce machinery wear and tear and cut back on fuel.

Limit is recommended for use in low to medium managed but frequently mowed cool season turfgrasses in non-residential sites. It is recommended for use on Kentucky bluegrasses, fine fescues, tall fescues, and perennial ryegrasses. It can be sprayed in parks, cemeteries, airports, industrial grounds, office and shopping centers, utilities, golf courses, and roadsides. This product can be used in areas that are normally difficult to mow such as high-grade slopes, hills and ravines, around bases of trees, rocky and rugged terrains, around headstones and monuments in cemeteries, and many others.

The product is easy to use. The application rate for Limit is 2.5 quarts/acre or 1.8 fluid ounces per 1,000 square feet. There is only one rate regardless of turfgrass species and soil type. It can be sprayed in water using a minimum of 15 GPA (1.4 quarts per 1,000 square feet) or in urea-based liquid fertilizer at 100 GPA minimum (2.3 quarts per 1,000 square feet). It is versatile. It can be applied using almost any type of spray equipment, with exception of aerial and irrigation systems, as long as coverage is uniform. No special training is required. Applications can be overlapped without quality loss.

For optimum vegetative growth and seedhead suppression, the best time to apply Limit is in the spring when turf has reached full green-up and has resumed vertical growth, has been mowed to desired height, and prior to seedhead emergence. Depending on the area, the window of application is approximately 3-4 weeks. Treatments made prior to full green-up are effective but may delay color development provide less seedhead suppression, and increase the risk of disease development.

Mowing the turf prior to treatment and occasional trim mowings after treatment is desirable to maintain a uniform appearance. However, scalping and mowing at extremely low heights should be avoided.

Limit is absorbed primarily by the roots and crown of turfgrasses. It is important that the product is washed off the leaves into the soil to be effective. Therefore, a moderate amount of moisture of about 0.25 inch, either from rain or irrigation, is necessary within five days after application. It is recommended and very acceptable to apply Limit in anticipation of rain or during rain. Applying Limit in the rain is an effective way of utilizing down time to a crew because of weather.

Applications of Limit to warm season grasses such as Zoysia and bermudagrass have not been very effective. Even though Limit regulates cool season grasses, its activity on timothy, brome, quackgrass and similar species is very limited and hence is not recommended to regulate these species. Limit does not regulate grasses such as crabgrass and goosegrass or broadleaf weeds such as dandelion, clovers. However, Limit can be applied in conjunction with appropriate grass and broadleaf herbicides if necessary.

Limit, the new turf growth regulator from Monsanto, is a new tool to help a turf manager cut labor from time consuming spring and early summer mowings; it helps cut work hours and cost at the same time.

Intense Fairway Management

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

I feel intensive management should focus on "How do I grow the variety or biotype that I want to predominate? What has to be done management-wise to do everything to favor that particular plant in the turf complex?" It may be that Poa annua is the plant you want to maintain. That management is totally different from that of a bent complex. Also, you may have a Poa-bent complex that again warrants a different management scheme.

Our transformation from Poa-bluegrass to bent fairway turf has been somewhat slower than originally anticipated. During the last few years in the actual growing season, there have been changes in the program. (Hang on, Poa - wait until the last of the tournament schedule is over.) Overall, improvement has been consistent and progress has been steady.

Several years ago the idea of mowing fairways with greens mowers seemed absurd. Now lightweight mowing equipment is becoming commonplace. Mowing heights of less than one-half inch, removal of clippings, more than once a year verticutting, intense aerification, using greens aerifying machines, and the promise of fairway topdressing really seemed to be extraordinary ideas. Intensive bent management reflects several desires of the superintendent and the golfer.

1. Close mowing equipment with the ability to pick up clippings is a means of ridding ourselves of Poa, and creating a competitive ratio.

2. Closely mowed, uniform cross cut fairways are a delight to behold for the golfer.

3. They are firm undefoot - fewer poor lies, and afford a greater distance off the tee.

4. Our experience indicates lesser disease incidence, syringing is not as necessary, and the turf is more resilient to drought and wear.

In mixed turf, Poa is more competitive when mowed at 1/2" to 7/8" than is bluegrass or creeping bentgrass. In fairway situations, creeping bentgrass mowed at 3/8" to 1/2" is more competitive than Poa and bluegrass starts to wane. This past summer we mowed at a height of 7/16" and collected clippings throughout the entire season except when we were aerifying.

When creeping bentgrass is mowed too high (above 1/2") the turf becomes matty and fluffy. Consequently, a very shallow root system develops. Any adversity can cause a problem. Also, playing conditions are less than favorable. You develop a 'Catch 22' situation.

Cost and time allocations for close mowing at first seem prohibitive. Once the program is initiated the results are so dramatic you'll find a way to get the job done.

During the terribly hot summer of '83, we showed constant improvement increasing the percentage of bent in our fairways. We ended the season with more good bent than we ever had in the past. This did take tremendous effort during June through September using three GM III's and one HF5 to mow 38 acres of fairway.

We used very little nitrogen fertilizer last year and were maybe drawing down from previous reserves. Our fertilizer program for this coming year will be one of using 1-1/2 lb. to 2 lb. N, 3/4 lb. P_2O_5, and 3 lbs. to 4 lbs. of K_2O for the season, with light frequent applications of N starting after Poa seedhead has developed.

Since Banol and Subdue have been available we have not experienced any Pythium pressure. We will pursue an active preventative program and may include an application of Koban or SP to relieve any possibility of resistance. We did not use any Bayleton on fairways last summer and encouraged the Anthracnose to help weaken the Poa.

We would like to increase the verticutting or thinning of the turf. I feel the more you can abuse bent the younger the turf will remain. We may employ the use of the Furest drag - tines down - to help bring up debris and get down into the mat and thatch on a regular basis. We virtually eliminated thatch in greens when we lightly thin cut or verticut once a week.

I feel we will continue for one more year with the greens aerification eqipment on fairways. The amount of soil that is brought to the surface is very important in the overall program. We alternate using the Dedoes and Grasslyn aerifiers.

PGR's will become an important tool in our overall grooming program in the future, and we will continue monitoring Cutless this next season.

We will not water this spring until it is absolutely necessary - June 5 or so - and will try not to over-use the syringing capability of our irrigation system.

We have focused on our prograsm in the light of what can we do to grow bent and not Poa. A predominant bent population seems to be more predictable and manageable.

Employee Benefits and Relations

Brian Swingle
Nice-N-Green Enterprises, Romeoville, Illinois

Introduction

- Dr. Daniel's philosophy - nothing ventured, nothing gained.
- Has it been done before? Yes, no, maybe - let's try it.

I. A good beginning

A. Interview

1. Complete job description, the good and the bad
2. Employee must know what is expected
3. Company policy

B. Employee handbook

1. Leave nothing to question
2. Clearly outline reprimand process

a. Oral warning
b. Written warning
c. Termination of employee - exit interview
d. Part company on good terms

3. Personnel file

a. Record all employee reprimands

II. Relations

A. Manager's presence and attitude - create a motivational atmosphere

1. Direct relation to employee's performance
2. Smile
3. Employee's problems at home

a. Show concern; lend an ear
b. Don't include yourself in his/her problems
c. Be consistent with all employees

III. Benefits and relations

A. Goal - to keep good employees

B. Increase his/her productivity

C. Make his/her job more enjoyable

D. Help him/her learn to set goals

E. What is a good incentive and benefit program?

1. One that works for your particular situation

a. Medical and life insurance
b. Share in the profits
c. Vehicle - gasoline
d. Awards for achieving goals
e. Picnics, ballgames, extra-curricular activities
f. Trade your services for employee perks
g. Personal day, sick day

2. Positive reinforcement

a. Follow up - manager must keep control
b. Setting goals - important in making incentive plans effective

IV. Close - Incentive plan in my youth.

I was fifteen years old, anxious to drive a car. My father, a religious man, told me, "Brian, there are three things I want you to do before you can have a car: Increase your grade point average, read the Bible every day, cut your hair." Two months later: "Dad, I've increased my grades and I'm reading the Bible daily, but in the Bible it says that Jesus had long hair." My father replied, "Well, son, you're right -- but Jesus walked everywhere,didn't he?"

Industrial Grounds Maintenance Using Handicapped Labor

Nick Rush
Cummins Engine Company, Columbus, Indiana

In 1976, after seven years at Purdue Gounds Department and having just completed my Master's Degree, I accepted a job with Cummins Engine Co., in Columbus, Indiana. To explain why a diesel engine company would need the services of an agronomist one has to understand both Cummins and Columbus.

In order to entice talented young executives to a small midwestern town, there has to be something special about both the company and community. Then Board Chairman, J. Irwin Miller, made a commitment that Cummins Engine Foundation would pay the architectural fees for any public structure designed by a distinguished architect. Because of the program there are no fewer than 43 modern buildings designed by nationally and internationally famed architects in Columbus.

Mr. Miller also had a deep appreciation for landscape architecture. Dan Kiley, a world renowned landscape architect, was commissioned to develop a master plan for all Cummins Columbus Facilities. From that plan five facilities were actually implemented: the Main Engine Plant, General Office Building, Columbus Occupational Health Center, Cummins Technical Center, and Walesboro Component Plant. During Kiley's tenure, some 2000 trees and 7000 shrubs were planted on 87 acres of lawn areas.

Unfortunately, the company didn't realize that there are three pieces to the landscape puzzle: the architect, the contractor and the maintenance people. We had a renowned architect, and in most cases planted quality material. Maintenance, however, was tied to the economy. If diesel engines were selling the company put a lot of emphasis on maintenance, but if times were tough, maintenance was almost non-existant. After the 1975 recession with maintenance at an all-time low, our chairman said, "Never again. There shall be a full time agronomist hired."

That's when I entered the Cummins picture. Initially my job was strictly landscape maintenance using run down requipment on atrociously maintained grounds.

I developed a program using only contractors for all facets of grounds maintenance like snow removal and sweeping of parking lots, interior pest control and some landscape maintenance. The daily maintenance is done through a unique program using mentally and/or physically disadvantaged individuals. They contracted through an agency called DSI (Developmental Services, Inc.). They mow our lawns, weed shrub beds, prune, pick up debris, and remove snow on sidewalks.

Advantages of hiring the handicappted:

Cost:

-- Union labor figured on productive time is $20.00/hr.
   (benefit package included)
-- Contracted labor $9-15/hr. range
-- DSI is $5.60/hr.

Flexibility:

-- Pay for productive hours only
-- Crews can be expanded or reduced

Supervision:

-- Agency provides trained supervisors
-- Good supervision is the key to the whole program

Dedication:

-- Once selected for lawn crew they don't want to lose that privilege

Capable:

-- Considered 100% rehabilitated
-- Somewhat limited in their abilities
-- They like repetitive tasks
-- Keep programs simple

We are currently finishing our new International Corporate Office Building and maintenance will begin in the spring of '85. Our planting list included over 400 trees (4"-10" caliper), 1800 shrubs,15,000 vines and groundcover plants, 29,000 bulbs, and 6 acres of sod. Since this building represents a new standard of excellence, it should be quite exciting to maintain. Here again, our DSI client (employees) will be instrumental in the maintnance.

Nitrogen Research

Dean Mosdell, PhD Candidate 1985
Department of Agronomy, Purdue University

Nitrogen content of turfgrass tissue ranges from 2-6% of its dry weight. Turfgrass requires nitrogen in the largest amount of all the essential elements except for carbon, hydrogen and oxygen. Turf responses to nitrogen fertilization are dramatic. Nitrogen fertilization affects the growth of roots and shoots, color, stand, density and recuperative potential and more. It is used in the plant to form pyrole rings, the backbone of chlorophyll, amino acids and nucleic acids which are building blocks for new growth and is a constituent of many enzymes involved in necessary transformations.

Turfgrasses can utilize nitrogen in either the nitrate (NO_{3-N}) or the ammonium form (NH_{4-N}). With soil temperatures above 50°F. and adequate soil aeration NH_{4-N} is rapidly converted to NO_{3-N} so most of the nitrogen is taken up in the NO_{3-N} form. This process is called nitrification. Soil microorganisms of the genera nitrosommons and nitrobactor extract enery from this process as NH_{4-N} is oxidized to NO_{3-N}. Once plants take up NO_{3-N} it must be converted back to NO_{4-N} before being incorporated into amino acids. Plants must expend a lot of energy to reduce NO_{3-N} back to NO_{4-N}.

All forms of nitrogen fertilizers must be converted to the inorganic forms (NH_{4-N} and NO_{3-N}) for plant uptake. Slow release turf fertilizers, as the name implies, slow down the conversion to the inorganic forms of nitrogen. Most are complex organic molecules or coated particles that must be broken down by soil microbial activity and/or hydrolysis to release plant available nitrogen.

In the NO_{3-N} form, soil N is subject to losses due to leaching, gaseous losses mainly through denitrification and uptake and conversion to organic forms by soil microbes. During periods when rainfall exceeds evapo-transpiration considerable soil NO_{3-N} can be lost due to leaching, especially with sandy textured rootzones. Denitrification occurs when the supply of oxygen in the soil becomes limiting. Microbes then use the combined oxygen in NO_{3-N} and convert the N to gases such as N_2 or N_2O. Leaching losses have been reported to be as high as 30% of the applied N in turf situations under ideal conditions. Only recently have attempts been made to measure denitrification in turf situations. Considerable amounts of N (75%) can be lost as gases, especially in early spring when soil temepratures are warm, organic carbon and NO_{3-N} are available and rains reduce the oxygen in the soil.

Slow release N sources have been developed to reduce the amount of N lost, reduce burn potential, and get a more uniform turf response. One such compound we have tested is melamine, a nitrogen substituted triazine. This compound is 67% nitrogen and release of the N is by microbial degredation. However in our tests significant release of N from both granular and powdered material was not evident after four months. Turf response to melamine urea combinations increased as the percent of urea increased, but after hydrolysis of the urea, little response to the melamine occurred. We observed significant increase in response to ammeline (one less ring substituted nitrogen) over a similar rate of melamine. Apparently microbes can break down ammeline faster than melamine. However, average turf quality ratings for the ammiline and melamine were below minimal acceptability, even at 4 lbs. N per 1,000 ft.^{2}. Obviously, melamine or ammeline could not be the sole source of N in a turf fertility program.

Another compound we have looked at as a slow release source is oxamide, 32% N, an oxide of oxalic acid. Release of N from this compound is by the breaking of the carbon bonds in the structure, so release is dependant upon microbial activity and particle size. The release of N increases as particle size decreases. We have observed a response lag of 21-28 days with the granular material and 7-10 days with the 20-mesh particles applied in a suspension with applications other than late fall.

Oxamide structure is very similar to urea. In fact, as oxamide breaks down it forms some of the same intermediates as urea, of which some are volatile. Some N may be lost as ammonia (NH_3) volatilization, however concentrations of NH_3 in the soil and thatch would not approach that expected with urea application. Volatilization losses increase rapidly with NH_3 concentrations in the soil.

Turf responses to the oxamide granular material have been similar to the five IBDU plots with the exception of our late fall treatment. Soil temperatures in the winter reduce the N release from oxamide, so winter color and early spring greenup with late fall oxamide treatments were inferior to IBDU treatments. By grinding the oxamide particles to a 20-mesh size, we can decrease the lag resposne period, however we also reduce the residual N release. We have also mixed oxamide with urea at a ratio of 7/3 with good results.

Another product we have tested is dicyandimide (DCD), a nitrification inhibitor. As previously mentioned, considerable amounts of N can be lost in the NO_3-N form. Nitrification inhibitors disrupt the microbial transformation of NH_4-N to NO_3-N. In the NH_4-N form, N may be adsorbed to soil colloids reducing losses, and be taken up by the plant. Also, plants do not have to utilize stored energy to reduce NO_3- back to NH_4- before assimilation of the N. This increased efficiency may improve the plant's ability to tolerate or recover from stress.

In our studies DCD was coated onto granules of urea and ammonium sulfate so that 10% of the N applied was derived from DCD. Responses to DCD application were similar to the soluble N fertilizers, although at times turf quality of DCD treatments was higher. This is not unexpected. Periods when the greatest losses of N on poorly drained soils in this area occur over winter and in early spring. Consequently, a favorable response occurred one year when DCD was applied in early fall when soil temperatures were warm enough for nitrification to occur. The DCD prevented NO_3-N formation, and more N was available for spring greenup. This response did not occur when applications were delayed until late fall when temperatures were not favorable for nitrification. Under our conditions, DCD has limited use in a turf fertility program.

Geotextile Use In Turf

John M. Roberts, Extension Specialist, Turf
University of New Hampshire, Durham, New Hampshire

First, as a former student of Dr. Daniel, I would like to express my gratitude for his guidance. Needless to say, some of the lessons he taught me (not found in textbooks) will never be forgotten!

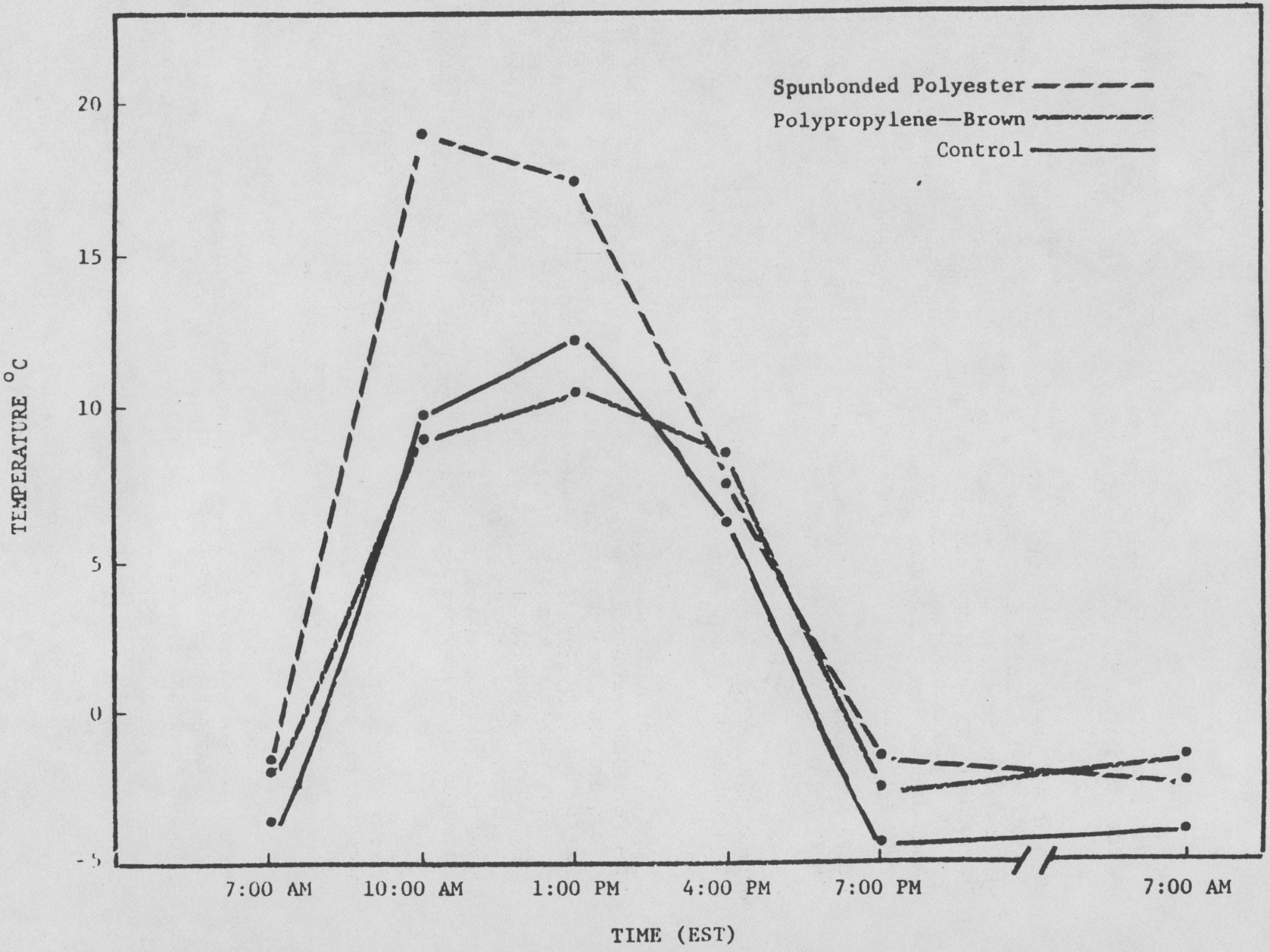
The interest in geotextiles for use in turf management has certainly increased in recent years. Fortunately, lightweight and porous fabrics are now designed and produced specifically for the turf market. Research results and field use have shown that geotextiles can accomplish some beneficial functions including:

- Reduced turf desiccation
- Hasten germination, survival of small seedlings, and regrowth rates
- Increase of soil temperatures,reduces effects of repeated freeze and thaw
- Release of late fall nitrogen earlier in the spring
- Keeps traffic off

Considering the above, it's easy to see how geotextiles have been successfully used on golf course putting greens, athletic fields and in the landscape industry. But perhaps some "not so obvious" uses have also been found including use underneath cart paths and roadways (even fairways!) to improve stabilization, in drainage ditches to reduce clogging of the pipe, on hillsides to reduce erosion, and with ornamental plantings to suppress weed competition. The uses extend.

Today there are some very diverse types of geotextiles on the market. Among other things, they vary in their ability to protect the turf from desiccation, allow light to penetrate and alter surface temperatures. Notice, for example, a typical temperature profile recorded underneath two distinct types of geotextiles in Figure 1. These surface temperatures were obtained over a 24-hour period on a sunny day in early spring. By mid-day the lightweight (1.0 oz/m^2)spunbonded polyester blanket increased the surface temperature by 10° C. compared to the uncovered control. However, the denser (7.0 oz/m^2) less light-permeable, polypropylene blanket actually lowered the temperature by 4° C. compared to the control. Other comparisons could be made; suffice it to say geotextiles are a welcome addition to the turf market, and can be a tool to help you in the future.

Figure 1. Heat retention and capture underneath protective covers as reported over a 24-hour period.



A Review Of Professional Lawn Care Services

Steve Derrick
Bulkem, Normal, Illinois

A review of the lawn care industry creates little or no nostalgia such as a journey through the automotive giants might. It is a young industry. The initial service has gone through a few changes and the original pioneers in the market have yet to become indefinable conglomerates. Yet, there have been changes. Not just changes, but improvements.

These improvements have been subtle to someone outside the industry and as a whole, little recognized by our customers. Nevertheless, these changes have made it possible for our industry to grow and maintain a strong image as well as remaining good environmental citizens.

For example, equipment has changed. Gone are the old tanks with products dripping off the edges. Our equipment is multi-compartmented, clean, and very professional in appearance and function. Applicators no longer wear cut off Levis and sweat bands. They have company uniforms. These changes are apparent. The public sees these improvements. Unfortunately, the more important ones are hidden. We now have a national organization - the PLCAA. This organization has done much to raise the level of concern for pesticide competence and professionalism in our industry. We have graduated from a group who suspected each other to an organization made up of businessmen willing to share ideas in a common cause.

We have improved our personnel also. Much has gone into training and licensing of applicators. The job of applicator has become a reliable job, not a summertime fill in.

Let us not forget the marketing. This has certainly improved. Television, billboards, and slick door hangers all have improved market acceptance and respect.

The most important changes, however, are more behind the scenes. The overall concern for safety in application and handling is where I feel we have made the biggest improvements and perhaps saved ourselves. Manufacturers have developed products with lower LD 50's. The industry has gravitated to an approach of using either liquid or granular products, basing their decision on effectiveness and safety, not how they position their company against competition. We are also looking to better handling methods. Bulk handling has taken the problem of spills and container disposal to a minimum risk.

The industry is changing. Not as outwardly apparent as other industries, but with great importance. If we as an industry do not continue to make these changes, we may not have anything to change.

Professional Lawn Care Concerns

Jerry Faulring, President, Hydro Lawn, Inc.
Gaithersburg, Maryland

There are dozens of typical concerns to be faced by any industry. In truth, I don't think the lawn care industry is too atypical of any industry when positioned as a function of age and its service orientation.

Industries go through cycles from birth to maturation and often to decline. Oftentimes the decline phase results in a rebirth that takes an old idea and with significant change results in added value. I think our industry will cycle through its life span rather quickly. A rebirth will occur within the next ten years. The reason is that so far, very few real value additions have been achieved by way of technology. The application of technological change that could flow from plant breeding and bioengineering may threaten us 'old-timers' and, at the same time, create opportunities for those who take advantage of it.

At this point in time I see our industry just entering the maturation phase and this may consume another ten years. Then something will happen. What might we be talking about when this conference convenes in the year 2000?

Is it conceivable that by that time we will have disease-free, no-growth bluegrass, five year slow release fertilizer sources, and long term residual root-absorbed systemic herbicides and insecticides that take care of all weed and insect problems on a genetically engineered basis? What if only half of that comes true? Maybe we will be focusing our discussions on snow removal and what to do with our staffs during the summer slow season.

Next year the dynamics of business may cause us to focus on different issues. What are today's concerns?

1. Staffing
2. The pesticide controversy
3. Financial management
4. Marketing

Staffing. Staffing is emerging as a critical problem for the industry as a whole. I know of one large organization that, in February, still needed to locate 75% of its production staff for 1985. This particular problem is not typical of how this organization wants to operate. That is, they employ on a year-round basis and just flat had terribly high turnover last winter. They are trying just about everything to locate applicants, with little success.

What is this situation going to turn into over the next five years? Assume the chemical lawn application industry generates $1,600,000 in 1985 sales with average sales per full time staff person of $55,000. That means there are roughly 30,000 full time positions in the industry. On a seasonal basis the number may swell to 40,000. Let's also assume that the industry will grow 20% per year for the next five years as it has for the last five years. On that basis, the industry will require nearly 80,000 full time positions in 1990.

From what I have seen in current trends regarding the industry's ability to attract and keep employees,some things will have to change before we can expect to fill the 50,000 new positions.

Until recently, the problem went relatively unnoticed. Anyone with a college degree in one of the life sciences under the age of 25 was a prospective staff person. Pay ranges have kept pace with most other employment opportunities and the career opportunities created an atmosphere of excitement for everyone. I think some of the excitement has gone and many companies have been forced to put a cap on escalating salary costs because competitive pressure has kept prices down. Further, anyone with their head on straight knows we can't expect someone to spread or spray lawns for 30 to 40 years. It's demanding work for which few are suited to long term success.

Socially, our country does not foster the labor work ethic anymore, and it's getting worse. Children who grow up in a white collar setting have no understanding of the physical work ethic.

What are the choices? We will have to increase productivity, reduce the hours, increase the pay and increase the social status of the positions. Otherwise we will find demand for our services surpassing our ability to provide them. I also think the industry would be well advised to encourage the development of curriculum design for the lawn and landscape technician at the high school and college level.

Pesticide Controversy. On this date, just about everyone in the pesticide user industries has at least a moderate awareness of the fact that continued pesticide use is under serious attack, particularly what some will define as discretionary use in the urban-suburban setting. I know, however, that the lack of interest by the industry as a whole to do something about it could be devastating.

Just about everyone is assuming that no one is going to take pesticides away from us...maybe a little more regulation, but certainly we will still have our cherished chemicals. Many people are a little scared about the issue but believe deep down that someone else is going to take care of the problem. We are a young group of people. We have never really lived through a period in American history when much was taken away from us.

My point is that as an industry we must recognize that no one will secure our place in society for us. We may not win our battles with those who sit on the other side of the table, but then if we don't at least put up a fight a significant decline in pesticide use is inevitable and faster coming.

Clearly, no one can exactly predict the ultimate outcome of the pesticide controversy. The society is going to proceed with a review of how we deal with chemicals. Further regulation is going to be implemented. How severe it is, whether or not we are segregated from agriculture,and when it comes will be very much affected by our current actions. We must support education and counter adverse publicity by others.

Financial Management. Few of us who own businesses in this industry came from a background of practical or academic business management. Our businesses prosper and look successful because of inherent pyramidal growth characteristics, inflation, and historical increasing demand.

I see a large number of business failures and/or distress sales coming in the next five years because their managers are so busy working on daily details that they never figure out where they have been, where they are going, and that long term success mandates an intimate knowledge of financial management.

It's still easy to get into this business on a shoestring of capital investment. But working capital and expansion capital requirements cause us to be a very capital intensive and high debt service cost industry. Most people don't realize it, but to experience revenue growth requires investment of on-average about twenty cents for each increased dollar worth of sales. Once an organization has been in business for three to five years, it consumes about fifteen cents of each repeat sales dollar to replace capital items. Short term working capital requirements generally run to 15% or 20% of sales. A typical $400,000 operation expecting to grow 20% in the current year then needs to have combined long and short term borrowing capacity totaling about $175,000, or 35% of current year sa forecasts. Most businesses of that size won't have a balance sheet to support the debt load without personal guarantees and a track record of profitability which is hard to earn in conjunction with the growth pattern.

The above comments are just the tip of the iceberg. There are dozens of finance related issues that require regular analysis and a more than casual understanding. Very few people I have talked with, for example, have any idea what the fixed cost associated with providing a single lawn treatment is. I am positive that many companies are providing services at below cost and don't even know it!

My concern lies in the fact that there are thousands of really great people who own businesses in this industry, are great operations managers, and are going to get badly hurt because they have little understanding that their survival relies equally on good operations expertise and financial management. They would be very well advised to secure ongoing outside financial management expertise or else become self-educated in financial management and delegate operations to another staff person.

Ultimately, history shows that success requires profitability and that there is a direct relationship between the degree of profitability and overall organizational success. Failure results from unprofitable operations by way of two avenues:

1. The most obvious is that a lack of financial resources has a direct result which can lead to termination.

2. The more subtle and yet greater factor is rooted in the relationship that exists between a financially weak organization and its clientele. A financially weak company acts defensively on just about every issue. The result is a weak staff and product with an attendant decline in attitude toward the client.

Marketing. Who or what should lead the industry? Never does a product or service survive without its provider recognizing the consumer's want and needs. Do we as an industry recognize the consumer's needs? In my opinion, not very well.

Why is it just about an accepted norm for many businesses to allow 15-50% of their clients to seek another vendor every year for reasons of dissatisfaction? Easy resonse is, "You can't please all the people all the time." True enough, but a 50-85% success rate is not much to talk about.

I know operators who can tell you the first and last name of every 1984 exit, from memory... Sure, they are small companies, but what a record!

Do they provide a better product? Doubtful, on average. They are not successful because they are big, engage heavy duty research, use only the latest product offerings and have the most sophisticated machinery money can buy. They do not contract for major market research studies.

What's the secret then? They listen. They can't afford to lose a client. They sell relationships . They compete on service, not on price. They are owner-operators. They do the most sophisticated marketing of all - on-site, in person.

I also know of smaller firms who experience high customer turnover when this issue should not be a concern for them.

Can the larger firms be more successful in customer retention? Clearly, smallness affords many inherent opportunities and resources that one can excuse oneself from for a lack of smallness. But that kind or rationalization punishes profits, growth, staff retention, client retention and societal attitudes towards the industry.

Who should lead the industry? The consumer. I believe that as an industry we are making progress in this area of concern, but currently it's still at a snail's pace. We are guilty of not being good listeners. Maybe a 10% cancellation rate due to dissatisfaction is the best the industry can expect to achieve. But we are a long way from that goal as a group and will find the total market shrinking for the industry if we don't implement change.

Advising on Turf Management

James McAfee, Regional Agronomist
ChemLawn, Richardson, Texas

The job of agronomist for a lawn care service is, in reality, very similar to that of a turf specialist-agronomist working for the extension service of a university. While the job responsibilities may differ some, one of the main goals is to advise people on how best to manage turfgrass. Most extension agronomists advise individuals on turf management through public meetings, media, and, in some cases, direct contact with turfgrass managers. On the other hand, an agronomist for a lawn care service works with a smaller, more select group of people. Mostly we work to train our own people on proper turfgrass management principles, as well as to educate our customers.

A large part of the work of a professional lawn care service is in advising its customers on proper cultural practices and in making accurate diagnoses of turfgrass problems. This is usually accomplished through customer handouts and, most importantly, through personal communications with the customer.

In recent years the Sunbelt has experienced a tremendous growth, with most of it coming from people moving into that area. This has led to a great boom for the lawn business in the south, but at the same time has led to some problems. Most newcomers to this area come from a region of the country that had bluegrass and are usually disappointed when they first experience trying to maintain a lawn with St. Augustine or common bermudagrass. A large part of my time is spent in educating these indviduals.

Fortunately, one of the cool season turfgrasses, tall fescue, can be grown in the northern portions of the Sunbelt. With the new improved tall fescue varieties such as Falcon, Rebel, Olympia, etc. it is now possible to have a darker, greener lawn essentially year-round.

It is very difficult to get homeowners to change their cultural practices no matter how much information is given to them. It seems that everyone has a neighbor who is an expert in growing grass.

Some of the most difficult turf problems are caused by disease. One of these is St. Augustine Decline, a virus disease attacking lawns in Texas, Arkansas and Mississippi. Since it is a virus, there is no chemical control for this problem. Through experience and research we have developed a program that will enable a St. Augustine lawn to survive longer once it has the disease. Also, there are three new varieties of St. Augustine on the market that have resistance to this virus and we again advise customers on which variety will do best in their area.

A second disease problem is spring deadspot on bermudagrass. Again, there is no cure for this problem at this time. Recently, pathologists have isolated the fungus Leptosphaeria Korrea from these areas and suspect this may be the main pathogen. This is the same pathogen that has also been recently associated with a disease on bluegrass known as necrotic ring spot. While there are other disease problems on lawns in the south, these two are the most serious since they have no known cure.

Insects can also be a major problem. Chinch bugs attack St. Augustine only and with proper timing of treatment can usually be controlled very easily. Two species of white grub, the May-June beetle and Southern Masked Chaffer, attack all turfgrasses and are more difficult to control. Advising customers on how to properly water in treatments is necessary for effective control. Other insects, including bermuda mites, scales and ground pearl are of minor concern.

While chemical weed control is a major part of good programs, we also advise customers that the best weed control technique is to maintain a healthy, dense turf. Also, a lawn care program is designed to control weeds and not to eradicate them. This concept is hard for many customers to understand.

In summary the ultimate goal of a lawn care service is to produce an attractive, healthy turf.

Lawn Insects

Jeff Lefton, Agronomist
ChemLawn Services, Carmel, Indiana

Aphids (Green Bug)

Aphids are very small, soft bodied, somewhat pear-shaped insects. They are green in color and generally wingless. The aphid that feeds on grasses is commonly referred to as the green bug aphid and should not be confused with aphids that feed on trees.

Aphids damage the leaf blade by sucking the juices (soluble sugars) out of the leaf blade and by injecting saliva into the leaf blade that alters cellular structure and contents, eventually killing the living tissue. Generally, damaged turfgrass areas will recover after the aphids are controlled.

Life Cycle. The overwintering stage is the egg. Optimum temperature for reproduction is approximately 70-75 degrees F, but they can reproduce at temperatures between 55 degrees and 95 degrees F. Under ideal weather conditions they can produce three or four generations per month. Severe infestations are subject to injury during wet or damp weather. After heavy rainfalls, severe reductions of population can occur.

Diagnosis. The aphids feed on the more succulent grasses first such as *Poa trivialis* and *Poa annua* before feeding on Kentucky bluegrass and other grasses. The damaged areas impart a rather distinct brownish-orange color to the turf areas. A natural control of aphids are lady beetles. If the aphid population is high, both the adult and larval stages of lady beetles will be present. Aphids will feed under trees and in open fields.

Winter Grain Mite

High infestations of the winter grain mite have been reported to cause damage to turf in the Northeast. Recently, areas in the Midwest have also reported damage as a result of this mite.

Life Cycle. The mite overwinters as an adult. Populations of adults are found in greatest numbers in December through April. Eggs are resistant to desiccation over summer in lawn areas and other areas of organic accumulation. The nymphs are vulnerable to excessive moisture in October and November.

Diagnosis. Both the nymph and the adult feed throughout the winter. Bluegrass and fescue are the predominate hosts, while bentgrass is seldom attacked. Populations have reached several hundred per square foot. As the population increases, grass blades first show a silvered appearance where the mite has been feeding due to the removal of chlorphyll from the leaf blade. It has been suggested that such damage may contribute to winter injury in heavily infested areas, and spring greenup of the lawn will be delayed.

Billbug

There are several species of the billbug, all of which are capable of causing serious damage to turf. Among these species are the hunting billbug on zoysiagrass, the Phenix billbug on Bermudagrass, and the bluegrass billbug on Kentucky bluegrass.

Billbug adults are hard-shelled, grey or black beetles 1/5-3/4 inches long with characteristic long snout. The adult burrows into grass stems near the soil surfaces. The larvae are legless, white, 5/8 inch long and have yellow to brown head. The tail end of the larvae is often about twice the size of the head end. Larvae feed near the crown, on roots, crown and stems. This feeding results in the turf detaching easily at the crown when the top is pulled.

Life Cycle. (Figure 1) Billbugs pass the winter as adults in the lawn and in sheltered areas nearby. As the weather becomes warmer, the adults begin to move about and are commonly observed wandering around on driveways and sidewalks during May. During the first half of May, adults lay eggs in cells cut in the grass stems. These eggs hatch in about two weeks. The larvae feed within the grass stem for a short time before burrowing down the stem into the soil. Larvae are abundant during mid-June to the first week in August. They exist in the larval stage for approximately five instars. After completing their development, the larvae change to pupae in small cells which they construct in the soil. In a few days the new adult emerges. Adults are abundant during early September and October when they are frequently found in considerable numbers on driveways, sidewalks, etc. As winter approaches, the adults seek shelter in turf, hedgerows, and other protected places.

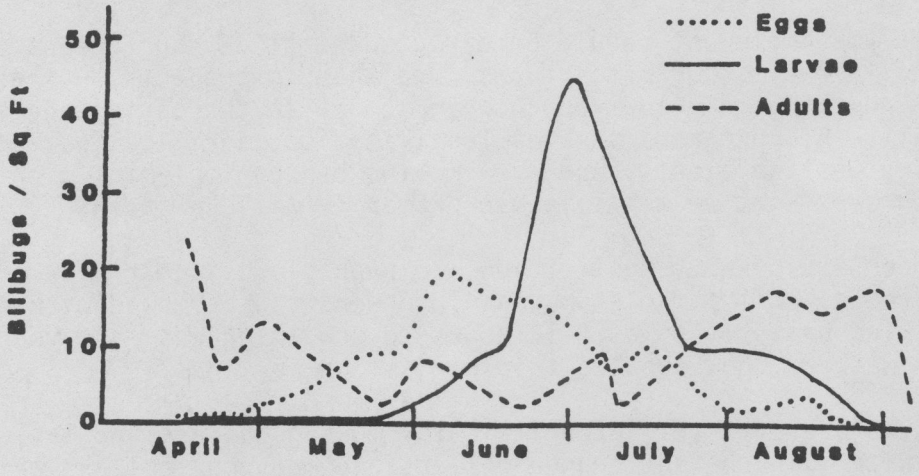


Figure 1. Graph outlines the life history and season occurrence of the bluegrass billbug.

Diagnosis. The wandering nature of billbug adults during May and June and again during September and October is good indication that a billbug problem may develop. If small patches of turf appear to be dying from June to September, the best way to determine if billbug is the problem is by carefully examining the damaged turf Look for evidence of adult feeding at the base of the stem and use a knife to probe among the roots to look for lravae. Turf damaged by larvae. Turf damanged by larvae is easily pulled out by hand with the stems breaking off at the base of the plant. A good indicator of adult feeding is the presence of fine sawdust-like material produced by feeding adults. Examine both the damaged turf and also the undamaged turf nearby for the presence of the adult beetles. When handled, the adults usually feign death. A general infestation guideline is 6 larvae/square foot before treatment is warranted. About 15 adult billbugs/ square foot may also indicate a problem.

Selling Ideas For Turf

Matthew Lindner
S. V. Moffett Co., Rochester, New York

Money: the key to success or failure of any public golf course. How can you, as a public golf course owner or superintendent, make more money for the course, cut back on labor, keep the course in excellent shape, and get as many golfers as possible to play your course? Hopefully, I'll be able to suggest some ideas and maybe give you some insight into new techniques that are working for many golf courses in New York State.

The basic ideas I wish to focus on throughout the talk are: use the proper equipment for the job, diversify that equipment whenever possible, and maintain that equipment the best you can, and, of course, make money.

The programs you implement should be directed first at your greens, secondly to tees, third to fairways,fourth to roughs, and then to projects such as drainage and cart paths - anything to allow you to open sooner in the spring and stay open longer in the fall. All programs such as fertilization, aerification, topdressing, watering, applying wetting agents, and even mowing can be implemented on all four areas of your course. What we will discuss primarily will be greens.

Use the proper equipment. Most of you are probably using triplex greens mowers on your greens. With triplex mowing 18 greens can be mowed within three hours. With walking units it takes 8-10 hours to mow 18 greens. If you have the manpower and use walkers, how about a triplex just on weekends?

A second advantage of a triplex unit is for mowing collars and tees. Set your triplex up with quick height change rollers and mow your collars while you are at the green. It saves the expense of sending a second machine back at a later time and might even save the cost of owning that second machine.

Combine operations where you can. A greens mower can be used for verticutting and dragging topdressing in at the same time. If you desire, you can put the catchers on the mower and collect the debris in one operation.

Aerify your greens and tees with a truck mounted aerifeir that collects the cores. There are many advantages to this type of operation. First of all, you can aerify and clean up the cores in one process. You don't have to close the green to golfers. If a group is playing, just pull off to the side of the green and wait until they putt out. If you close the green you lose revenue. Second, how many times to you start to aerify and it rains? If the plugs are on the green you have a muddy mess. With a drum type aerifier, if it rains you could even continue to aerify because no cores are on the green; no mess. Third, with this type of unit one man can aerify eighteen greens in eight hours generally. With a greensaire unit you can average three to four greens in a day with at least three men.

If you still prefer the greensaire method over the utility truck consider aerifying one-half of each green at one time and keeping the second one-half open to play. Maybe aerify six greens one year with the greensaire and the remaining twelve greens with the drum type unit. Maybe you can't beat the greensaire for the amount of soil it brings to the surface; however aerify more often with the drum type unit. If one green is giving you trouble and needs to be aerified get the truckster out and in twenty minutes the job is done.

Topdressers are available for utility trucks. They will spread sand topdressing and can be used as fertilizer spreaders also - one piece of equipment that can be used for more than one job.

Sprayers can be mounted to utility trucks. This is one area that people often overlook and can either be a very costly operation or a money saving and time saving operation. Sprayers can be custom made to your needs. Decide what you want to spray - greens, tees, fairways and roughs, or do you want to spray 60' trees also? Then purchase a unit designed to do the job. A sprayer with a centrifugal pump, for example, can't spray 60' trees but it does an excellent job for turf application with little investment in purchase and repair as compared to a four piston pump that would be used for tree spraying.

Consider using controlled droplet applicators,or CDA's,instead of conventional boom type units. With CDA's I have customers applying 9 gallons of water per acre and using one-half rate of 2,4-D or one-fourth rate of Trimec and getting the same results as they would if they were using the conventional booms. Now instead of using 300 gallons of water to spray 18 greens you can use 75 gallons. Time savings in fill time alone can pay for the CDA's real quick, let alone the savings in chemicals.

When purchasing pesticides compare cost per 1,000 sq.ft. per application. Just because brand X costs $250.00 and brand Y costs $80.00, you may end up applying twice the rate of brand Y and applying it three times to get the same coverage and results as with brand X.

Consider spraying your roughs if you are not doing so already. 2,4-D costs $2.90 per acre for material to eliminate dandelions, buckhorn plantain and other tall weeds. If you don't spray your roughs how many times do you cut them just to cut the dandelions? Also, how much time is lost by golfers?

Another use for a utility truck is in fairway aerification. Aerification can be one of the best tools you can use. Anything you can do to enhance root growth will save watering time, fertilizer cost, and improve quality turf. The longer the roots, the longer you can go before the plant wilts and water needs to be applied. The less compacted the soil is,the better fertilizers can move and be absorbed by the plant. Also, the less compaction, the sooner the soil dries in the spring and is playable. Once again, more money.

Consider using a tractor with mowers mounted on it instead of pull-behind gangs for mowing roughs. More golf courses are going to smaller units to mow fairways and want to trade in their larger units. Put the larger unit in the rough. With a 7 gang tractor mounted unit you mow from 8-15" by simply raising or lowering units. With a 7 gang tow-behind unit you mow only 15' and in the rough you have the trim work left . If you do have a lot of trim work, consider either a front mounted rotary as well as a total kill around trees. Both methods save a great deal of labor and time when compared to the 20" push rotary or string trimmer.

Once you acquire the proper equipment it must be maintained. Spend the time to do an overhaul of a gang mower, for example. Don't wait until it breaks or you go to use it in the spring and find out it doesn't move because of a broken gear you forgot to fix. Train your people in the proper operation of each and every piece of equipment. Insist they take pride in the equipment and themselves. If your personnel take an interest in your course, your customers will too.

When purchasing equipment make sure it does the job. Determine if any changes are going to take place. If they are will the equipment meet the changes? Should you buy, lease or rent equipment? With a lease arrangement you have a fixed payment from 1-12 month a year for a period of 1-5 years. You know what the outlay will be. Also, with leasing all tax credits return to the club. If you need a backhoe for only one project you wouldn't purchase one, but would rent the equipment for that situation.

When do you purchase equipment? There are three thoughts on this matter: 1) replace it after a certain number of years, 2) replace it when the maintenance cost is more than 30% of the original cost, 3) replace it when the baling wire breaks. A good thing to remember is that one hour on a smaller engine is equal to 60 miles on a car. A greens mower with 2500 hours on it is equal to a car with 150,000 miles. How many of you drive a car with 150,000 miles? Consider the use of the equipment. If you are going to operate it all day consider a diesel engine over a gas engine or water cooled over air cooled. Compare equipment costs when purchasing. For example, a large 300 gal. tow-behind sprayer may cost $5,000.00 A sprayer mounted on a truckster costs $2,000.00. Both units could do the job, but with a truck mounted sprayer you same $3,000.00 which could be applied towards a truckster, and you would be purchasing a diversified machine.

No matter what you do, use the proper equipment, maintain it, compare costs, and remember, the whole idea is to get Joe Golfer to play your course.

Selling Turf Improvement

Dave Fearis
O. M. Scott & Sons, Peoria, Illinois

Selling Turf Improvement is a somewhat ambiguous title. it can be interpreted in many different ways. My interpretation is going to be divided into two parts in this talk: the first being the salesperson-client relationship, and the second, observations about athletic grounds which I have seen while in the field.

I was a golf course superintendent for fourteen years before going with Scotts three years ago. So I have seen both sides of the fence. I had definite opinions of what constitutes a good salesperson then and have added to these since being in sales. Obviously, the final goal of any salesperson is to sell a product to a client. However, how a salesperson reaches this goal varies greatly. You in sports field management are often ignored by salespersons. Why? Because they feel you are a small volume account. You might have only two to three acres in baseball, football or soccer fields which might only relate to $1,000-2,000 in annual sales. So my first prerequisite for a good salesperson is that they call on you. Also that they follow up after the initial call. I know that when I was a superintendent some companies would call on me only at budget time. I wouldn't see them the rest of the year. A salesperson should realize that you are not going to order something on every call. Many times I will make a call and the grounds manager will ask me a lot of questions regarding his maintenance practices or about our products. Often we will tour the grounds or take soil tests. If I average four to five calls a year to a client, I would say that only one of these results in a sales transaction.

Many salespeople are in a hurry. They don't ever seem to have time to talk with you or tour your grounds. I had one company whose secretary would call and tell me what day their representative was coming. I appreciated this because everyone's time is valuable. (I still send appointment cards to all my clients 5-7 days in advance of my visit). One day I knew this salesperson was supposed to come. It was raining, but I still waited around for him. I did leave the maintenance building for ten minutes to change the irrigation clocks. When I returned I found his card on my office door. He couldn't wait ten minutes for me. Needless to say, I never did any business with him again. So, my second prerequisite is interest in the client.

I feel that many company representatives could be better described as "order-takers" rather than salespersons. They have very little technical knowledge about their products or even the competitors' products. They walk into your maintenance area and see a competitor's products and immediately comment, "My product is cheaper". They sell strictly on price. ATT has a commercial on TV now which shows numerous persons demonstrating their phones and stating how their product is cheaper than ATT's and how it's just as good. The commercial ends with the statement, "You get what you pay for." So, beware of the salesperson who sells on price alone. The third prerequisite is knowledge of products (competitors' also).

The ATT commercial also brings up another good point - that is quality. Does this salesperson represent a quality product. Today many companies copy other successful products. They copy them and sell them cheaper. If they sell them cheaper they have to cheapen the product somewhere. So, is the quality there? Will the cheaper product give you the results you desire? Another illustration for this, like the ATT commercial, is the numerous computer advertisement which compare their

product to IBM. They look like the IBM and are advertised to be compatible to the IBM, and yes, they are definitely cheaper than the IBM. Still, IBM's sales continue to grow. Why? Because the name IBM is synonymous with quality. Thus my fourth and last prerequisite - quality products taht relate to desired results.

In summary of this first section there is one word which ties it all together. That is "service". In a recent best selling book titled "In Search of Excellence", the authors, Peters and Waterman, interviewed in depth a number of successful companies. One of the underlying themes of all the successful companies was that they stressed giving excellent service to theri customers. A good salesperson gives you good service.

In this last section I would like to discuss some observations which I feel could make your job easier. The first of these is consistency in maintenance practices. Often I see where fertilizer or herbicide wasn't applied at the right time, or that the field wasn't overseeded or watered. I realize budgets dictate maintenance practices and often you are required to do indoor maintenance. However, if possible, stick to a schedule. Mow on a regular schedule; fertilize and water according to schedule. If possible, use the same person to work on the field day after day. Hopefully that person will take pride in his work and do a little extra for you. A successful athletic field maintenance program can't operate on a hit and miss schedule.

Take advantage of the soil test. Soil tests are inexpensive ($20.00 or less to test a field) and are one of the most efficient tools available when idagnosing problems. Soil testing is a very scientific process and requires expensive equipment. Scotts sends all their soil test to Harris Labs in Lincoln, Nebraska. Different companies use different testing methods which produce different results. I do not consider many farm co-ops to be reputable soil testing companies. Their results are slanted toward farm crops, not turf. Take your soil tests at the same time each year as this gives you consistency and the time of year does have an effect on the results.

Aerify as often as you can. You are managing an area which is very compacted. You have the band, the P.E. classes, the practices, the freshman-sophomore games, the junior varsity games, and then the varsity games. The result is extreme compaction. Relief is spelled A-E-R-I-F-Y. IF you don't have an aerifier, borrow or lease one.

Don't use farm fertilizer. Farm fertilizer usually contains a high percentage pf free urea which results in a surge of top growth. Then the roots suffer. Fertilize for the roots, not for the top. There are plenty of good quality, granular slow release turf fertilizers on the market today.

Buy quality seed. Cheap seed can contain weeds. I called on a colelge in south-central Illinois last year. They had recently renovated an area. In a hurry to establish turf on it, the turf manager purchased some cheap seed. The seed came up along with one type of weed which was prevalent throughout the entire renovated area. The manager had some seed left and germianted it in some pots in the greenhouse. Guess what came up? The same weed foudn in the renovated area. So, buy quality seed from quality companies. Scotts, Lofts, Northrup-King, Jacklin are just a few which come to mind. True, you'll pay more initially but quality seed is weed-free, more vigorous, and will produce a stronger, healthier turf.

Use the new improved turfgrasses. Tall fescues are very applicable to athletic fields. Ryegrasses are also being used more and more. Ask salespeople for research results and literature on the new turfgrass varieties. Go to the field days and observe these new varieties.

The goal of any salesperson is sales. The goal, I feel, of any sports turf manager is safety. That might sound a little strange, but a field that has a healthy, dense turf is a safe one. It doesn't allow loose footings which result in sprained or broken ankles and knees. It doesn't have clumps or voids of turf which allow a ground ball to take those strange hops and bounces. Believe me; it is a lot easier to sell your boss or the school board on a good maintenance program on the premise of safety and less injuries.

Serving Turf Through Sales

John Turner
Nor-Am Chemical Co., Woodridge, Illinois

The most frequently asked question in my five years of selling is, "Why did you select sales as a career?" The most obvious answer would be representation for a leading corporation; secondly, freedom to be my own territorial manager; and third, personal satisfaction by helping customers. However, sales takes on a multitude of responsibilities that enable our customers to obtain benefits from the products or services we provide. Just as the superintendent or lawn care business manager msut provide perfection in turf care, a manufacturer's representative must also provide product satisfaction and perfection to his customers. That is why we take time to visit our customers and work together for better turf programs. You, the customer, are the most important part of our business!

Turf management has been my whole life. Since the age of twelve, I have been involved with golf course maintenance and upkeep at both public and private courses. The education I received from superintendents has provided a strong background on golf course management philosophy. Further education at Purdue University has allowed opportunities for serving turf professionals and the industry. By combining both background and education with the desire to serve people, my direction was to sales.

In 1980, my selling experince began with the Upjohn Company. Many of you are familiar with the products we sell and have continued to utilize them in your progams. Today our products have obtained a new parent company, Nor-Am Chemical Company. Nor-Am has commitment to the specialty turf division and will continue to market previous Upjohn products to distributors, superintendents and lawn care professionals. My responsibilities will include a seven state network in the Midwest and to our home office in Wilmington, Delaware. This requires advance planning and time management skills to be productive. Our customers in three selling areas include distributors, superintendents and lawn care business managers.

Distributors have yearly contracts for the products and areas they serve. It is important that products are processed according to monthly need schedules and advertisement promotions carried to the end user - you, the customer.

Since many distributors handle a variety of products, the manufacturer must provide assistance on new product developments, label changes, market growth, and follow up on product performance. Frequently distributors allow manufacturers to work with individual salespeople in their territory on a particular product or program with selected turf managers. We must rely on the "multiplier effect" for a distributor salesperson can see more customers and provide continuing reinforcement on a product or program.

In summary, distributors are our link to product "pull-through", innovative market plans, product performance, and provide a barometer to customer satisfaction.

Superintendents represent the largest percentage of our customers. They have relied on our fungicide and insecticide products for tees, greens and fairways. It is important that superintendents be aware of product usage, rates, timing intervals, and the relationship of products to disease and insect management. The superintendents provide feedback on product response which allows evaluation of supportive distribution in a given area. We must work together to obtain better products for tomorrow's turf needs.

The lawn care industry has been a new growth with an expanding market. The larger operations deal with bulk volume while the smaller operations rely on individual units or pallet quantities. The manufacturer provides assistance to product testing and evaluation with educational activities to satellite operations.

With respect to market opportunities within the lawn care industry, our products fulfill needs in controlling the Helminthosporium complex plus white grub and cutworm larvae in integrated pest management programs.

Customers in both lawn care and golf course operations require professional salesmanship for product knowledge, safety, control standards, and cost. For both, customers are selling their services to their customers for creditability and profitability.

Serving turf through sales is a connecting link for successful turf management in all facets of turfgrass operations. Selling only facilitates the transfer of godos and services from one party to another. This is done by helping people solve problems, helping people make more profit, and helping people obtain suitable benefits that increase their personal satisfaction.

My career in turf sales has been challenging and rewarding. Selling has created new friendships and stronger educational selling skills. If I can summarize what salesmanship is in six words it's that "people like to be sold properly". I look forward to serving my peers in the selling years to come.

Becoming A Sales Manager

James Davis
Lawn and Garden Supply Co., Phoenix, Arizona

As a former student it's really a pleasure to be here and to share in the Midwest Regional Turf Conference. My talk slants toward sales and marketing. I am not in the lawn care business, but as a distributor for turf products, I think the relationships are similar.

When Doc called and asked me if I would like to talk at the Conference I was really excited because even though I have given a couple of dozen speeches in the last two years, this time I have a really new crowd - superintendents, lawn care people, and so on. So I will go over some ideas and hope it will mean something to each of you.

For the first time I get to talk about myself just a little bit. I was born and raised in Kendallville, IN. My first job was throwing fries at Burger Chef, but I could see that people weren't really making a career out of that, so I went to work in a factory that made auto parts for GM, and they went on strike so I talked to my brother who worked at Limberlost Golf Club. He was going to quit, so I started when I was in high school. I kept working there in the summers and that made me decide to go to Purdue to study turf management.

About six years ago at the Midwest Conference I ran into a guy named Larry Runyon who's been a superintendent all over the nation, I think. Larry did a talk about Atenius beetle damage when he was superintendent at Lake of the Ozarks. He moved from there and wound up at The Inn Of The Mountain Gods Golf Club in New Mexico. I wanted to go west, and he offered me a job, and I started learning from Larry Runyon. My wife, who had never been out of Kendallville in her life, and I lived in a little log cabin in a box canyon nine miles out of town where we couldn t get radio or TV reception. Well, after three months I decided this wasn't working. I called Doc and he said, "Don't you like it out there?" and I told him I liked the west but I didn't like what I was doing. I just wanted to be working with people. So Doc said I should call Earl Cain who has been in Phoenix about thirty-five years selling Jacobsen products, blending fertilizers and chemicals and so on. Now I have been with him for six years.

Has anyone in here been called a Yuppie? Someone called me that a short time ago and I didn't know what it meant so I didn't know whether to swing at him or not. Then I found out that YUP means Young Upward Professional, and I thought that sounded like something out of the sixties.

The first time I had a chance to speak like this Earl Cain pulled a Dr. Daniel and scheduled himself and then called me to do it. It was for the Phoenix Rose Society. I don't know anything about roses, and some of those people had been growing roses for fifty years. So I went in and said, "How many of you know the sixteen macro and micro elements for plants?" And I asked them how they would like to be able to memorize them and recite them like this: carbon, hydrogen, oxygen, potassium, sulfur, iron, magnesium, manganese, boron, copper, zinc, molybdenum, and calcium. So I taught them to remember: C. Hopkins Cafe Managed By Mine Cousin Moe Clark.

Now to sales and marketing. Two percent of the people in the U. S. make $35,000 or more per year. Now, 80% of that 2% are in sales and marketing, so you can see where the money is. I remember a seminar in my senior year given by Carl Stevens to an Ag. Econ. class. He said sales is persuading someone to your way of thinking , whether it's a product or an idea. You may not think of yourself like this, but when you were growing up, how many times did you sell your parents? Didn't you come up with all kinds of features and benefits for staying out late or borrowing the car? That's selling. And parents do it to kids. I say to my three year old son, "Nicholas, eat those lima beans. They are so good. If you don't eat them quick Daddy's going to eat them." More formal presentations are made to your boss and to customers, but it's all the same philosophy of persuading someone to your way of thinking. Avoid putting someone in a position before all the facts are in because if a person makes an early decision he won't change his mind. When people make up their minds they don't change. You may try to argue with someone to change his mind, but he won't; not in front of you.

Stay away from self-tacklezation. So many times you can blow everything in just one phone call. The best phone call is: "How are you? I have something important to tell you (and that's the key line). Is ten in the morning OK? Thanks. I'll be there."

Now you are in possession of what I think is the most important sales tool. So let's talk from there to some other things you can do in sales. Objections. People are scared to death of objections. One of the best things you can do is use the Feel, Felt, Found Rule. The guy says, "Those Snapper mowers won't sell. They didn't sell last year and they won't sell this year." I say, I know how you feel. I felt that way once, but I've found that..." So when someone has an objection, just say I know you feel that way, I felt that way once, but I have found...

Right along with attitude comes a thing called objectivity. To me that means don't let something go by. If you're not paying attention you're going to miss things.

In sales and marketing avoid selling what you like. People from salesmen right up to the president of the company get caught in that rut. They get caught in selling what they like. A real life story about that we should all be familiar with is when George Balas put together the first weed eater no one in the world thought that would sell. No one! I have talked to major buyers and they said when they first came in the door, I laughed! I never thought string trimmers would ever sell. And they'll admit it because it is a phenomenon.

I'd like to make just one more point. Usually you are talking about a change in yourself. Get out of your comfort zone. I get a lot of people who say, "I just don't have time." You can do anything you want to do if you decide you really want to do it. Make a plan to do it and then go after it. In your lawn care service you really can do more for customers. As a superintendent, you really can take on more responsibility. In the beginning it is hard, but you can do it. You think you have this going pretty good and so then you throw in the next responsibility. All the responsibilities have to flow together, but once you get it going, it's great!

Upgrading Golf Courses

Don Clemans
Olive Glenn Golf Course, Cody, Wyoming

At the dawning of our professional agronomic lives we have visions of great scenic beauty in our lives ahead. Part of our desire is the hope to be able to copy the Master Architect and create great scenic beauty for the game of golf.

Then the reality of agronomic life confronts us and such things as knotweed, crabgrass, goosegrass, Poa annua, and bare ground become a real part of life. The question becomes, "Can we take these undesirable conditions and transform them into desirable and useful golf turf areas?" Yes - with the use of the proper understanding and tools.

In the July, 1926, issue of "The National Greenskeeper", John Morley, then president of the National Association of Greenskeepers of America, wrote an article entitled, "Is Poa annua Good or Bad?" In his article he made reference to the water-soil-air relationship: "I am of the opinion, especially during extremely hot weather, that air in the soil is more important than water. For if deprived of water in hot weather for a long period the roots of old grass will frequently survive, although the leaves and stems in a drought may turn completely brown, while if deprived of air and completely immersed in water in hot weather, they will die in a few days."

Dr. Daniel has constantly reminded us to manage the top inch. Dr. Beard (and others) decided to look below the surface and observe. For if we can't grow roots, we won't grow grass.

As turf specialists we know the soil is made up of sand, silt and clay and have an appreciation for the part each plays in the growing medium. The "perfect soil medium" is most often described as being one-half solids and one-half voids, with one-half of the voids filled with water and the other one-half filled with air. A granular soil is desirable because it most nearly provides the ideal conditions for a plant growth medium. If we abuse soil structure during construction - improper maintenance techniques, watering practices - or by any other means, the desirable crop, turf, begins to deteriorate in quality.

Since water plays such an important part in the scheme of turf management - how much is required, how often - the answer is related to the soil texture we are watering. The difference between field capacity and wilting point in a foot of sand is less than one inch of available water. By comparison, a loam will hold over two inches of available water per foot of depth. Water as a management tool is most easily abused.

Not all water is applied by man. Nature's water can cause even more concern, for we have little or no control over its application or effect on our turf, or do we? Old drainage systems can be relocated and their efficiency checked. Trees planted near or over drainage systems have a way of destroying drainage efficiency.

Sometimes we don't have time for surface water to percolate to subsurface drainage systems. Surface inlets are effective means to rapidly move water to a subsurface drain.

If puddling occurs on putting surfaces, wet-dry vacuums can be used to help reduce scald potentials.

Surface renovation and overseeding is an upgrading procedure. Keep in mind that only the seed which makes good soil contact will establish.

Modification in rootzones in conjunction with aerification and the application of sand , calcined clay, and other amendments help upgrade existing problem areas. Intensive rootzone modification has moved from just putting greens and tees to approaches and even entire fairways.

Which returns us to the importance of remembering the principles set up by the Master Architect and the realization that we are in fact mere environmental manipulators.

Drainage, Streams and Gabions

Charles Tadge
Mayfield Country Club, South Euclid, Ohio

This is an all-encompassing title which covers a great range of problems. In actuality, they might be better included under the broad title of water management. Good turfgrass management is synonymous with good water management, and drainage is one of the keys to good water management. Drainage might be defined as the removal of excess water and it can be divided into two categories: surface and subsurface.

Surface drainage systems primarily remove water that is on the surface and has not entered the soil profile. This is done by developing the slope of the land so that excess water will flow by gravity into streams, ponds or storm sewer pipes.

Subsurface drainage removes water that has already entered the soil profile. This is basically the type of drainage to which I will be referring. Actually, most drainage problems are a combination of surface and subsurface water removal.

There are three basic steps that should be considered in improving the drainage on a golf course: 1) identify the problem, 2) develop a plan of attack, 3) implement the plan.

Identify the problem.

It is usually easy to locate the place where a drainage problem exists. You need to find out why it is a problem. Sometimes we must 'live with' and study a course before we really know the true extent of the drainage problems. At Mayfield, we found that the problems were extensive and were generally due to a very heavy clay soil with inadequate or non-functioning tile lines.

Develop a plan of attack.

In developing a proper plan of attack, there are countless aspects to consider. Can existing tile be made functional or should new tile be installed? Will French drains or gravel-filled slit trenches suffice without drain tile? Does the problem exist in only a few isolated spots or is it extensive? Should the work be done by the maintenance staff or by an outside contractor? Who will plan and design the drainage system?

A source of expert planning assistance is the Soil Conservation Service. The SCS provided us with a soils map and a description of each major soil type. They provided a comprehensive design of a drainage system for the entire course. They produced a design that would drain every square foot of fairway without consideration for actual conditions on the course. We, therefore, had to modify the plan to fit our needs. At first we followed the modified version rather closely. As we gained experience with installation and knowledge of the course under varying moisture conditions, we began to develop a plan on the site to custom-fit the situation.

A very important decision has to be made about who will do the job. Will it be contracted out or performed by the golf course staff? We decided to do the work ourselves with the hiring of additional personnel. We felt that it was absolutely necessary that we not borrow personnel from the regular maintenance operation and sacrifice routine course maintenance.

Since our soil was a very heavy clay and impervious to water movement, we decided to remove all soil and to backfill to the surface with gravel. This would also provide for removal of excess surface water.

Implement the plan .

The first step of implementation is to lay out a part of the system on the ground where it is to be installed. Start at the outlet where the water is to terminate. The proposed pattern should be marked with stakes or paint. If there is any question about grade, shoot some points with a transit level. Decide the depth of the drain needed. The average depth that we used was close to three feet. We try never to be less than two feet deep. We provided additional surface drainage by putting surface risers with grates in many low spots. These risers provide good visual checkpoints.

When the installation requires removal of the soil, it means a tremendous amount of material handling. Soil spoilage must be hauled away and gravel hauled in. Disposal of the soil can sometimes be a problem. Proper equipment is necessary to make the operation as efficient as possible. We purchased a large trencher with a conveyor to move the soil away from the ditch. Another conveyor was added which would then take the soil up into a dump truck. We also experimented with conveyor attachments on the dump truck for backfilling the gravel, but found that dumping from small trucksters was just as fast. It was found that laying 1/2" plywood along the ground before trenching would make final cleanup much easier and keep turf damage to a minimum.

A tool that we have found to be very useful is a cast iron pipe and tile cutter which helps to cut clay tile risers to the correct heights. We also built a gadget that we call a "ditching frame". It is a wooden frame eight feet long with two horizontal surfaces that are 3/16" out of parallel from one end to the other. This provides 2.34 inches of fall per 100 feet. By setting it on the bottom of a ditch or on the tile in a ditch and checking with a carpenter's level, it can be readily determined if minimum grade has been obtained.

Since beginning our program in 1969, we have installed nearly eight miles of drain lines. Most of these lines required drain pipe. We found that short lateral lines of under twenty feet worked satisfactorily with gravel backfill only. We have mainly used the perforated-corrugated plastic pipe.

Installing a drainage system is no simple task. It requires a great amount of supervision. It may be the messiest and dirtiest job on the golf course. This can create morale problems, and it takes constant effort to instill a sense of pride of accomplishment among those involved.

Once the drainage system has been installed, it will require periodic maintenance. Grass and debris must be cleaned off of riser grates. Traps at the bottom of risers must be inspected and cleaned as sediment deposits accumulate. It should also be understood that even though an area seems to be thoroughly drained at a given time, underground water flow patterns are subject to change and new wet spots can always develop.

Drainage water from your golf course probably has little effect upon the banks of the streams that run through the golf course, but water coming from other areas upstream may very likely create erosion problems on your creek banks.

Creek bank erosion problems at Mayfield Country Club probably existed 75 years ago when the golf course was built. At that time, the watershed of over 2,000 acres was made up of woodlands and farms. Today, "progress" has changed all of that. Much of the area has been developed into residential subdivision, apartment complexes, interstate highways and shopping centers.

Runoff from roofs, streets, parking lots, driveways, etc. was conveniently dumped into the existing creeks. Needless to say, nearly every heavy rain storm sends torrents of water cascading down through Mayfield's streams. Flash floods have accelerated the eroding of banks, the disldoging of bridges and the flooding of greens, tees and fairways. There are two streams that flow through the property converging slightly before exiting at the lower end of the course. The stream channels average about twenty feet in width and about four feet in depth.

It was decided that we must protect the stream banks from the erosion of the rapidly flowing water at least in certain critical areas. The solution was not simple because of the soil strata. The base of the strata is shale. Creek bottoms were solid shale with periodic deposits of eroded materials. As you move up the exposed profile, you find soft shale then a heavy clay soil with a thin layer of topsoil.

The major problem in bank retention at Mayfield is due to the shale sides of the banks. Shale under water, or otherwise not exposed to the air, remains hard and solid, but when exposed to air it becomes soft, readily flakes off and is easily eroded.

Over the years, different attempts were made at building retention walls of natural stone, concrete blocks or bricks. These walls were mortared and quite solid which proved to be their downfall. Few, if any, drains or weep holes were provided to allow water seepage from behind to get out. Hydrostatic pressure soon cracked the walls. Sections bulged out and broke away. In other places the shale beneath the base eroded away and sections of the walls broke away and fell into the stream. Once the process started, the walls did not last long.

In contemplating a solution to our problems, we investigated several different approaches that had worked in other situations. We needed something that would work under our conditions and was within reason costwise.

Stone walls properly built could be made to stand for many years, but the cost would be prohibitive. Some very fine walls made with railroad ties have been observed. When properly installed, they can also be very expensive. Even treated wood might not be expected to last as long as some of the other materials.

Another type of wall that has been used with some success is made by driving steel "H" beams into the base of the creek edge. The beams are spaced a few feet apart and into the gaps between them are placed precast concrete slabs. These walls should have a long life and cost is not out of reason, but the beams could not be driven into the solid shale bottom at Mayfield without considerable cost.

Finally we investigated a structure known as a Gabion. The Gabion is basically a wire basked filled with stones. The word Gabion seems to date from the Roman era but the Gabion principle is much older. Gabion type structures were used in Egypt along the Nile about 5000 B.C. The modern Gabion, as we know it today, has been manufactured since 1893. The use of Gabions has been growing in popularity in the U.S. and Canada during the past fifteen to twenty years. Gabions are one of the most economical methods of solving erosion problems because they do not require skilled laborers. They can be filled by machines or by low cost laborers.

Gabions had all of the features that we needed in a retaining wall. They were free-standing, that is, they did not require anchoring to the base or the bank. They provide for natural seepage of ground water to eliminate the buildup of hydrostatic pressure. Their flexibility allows settling into any erosion from underneath which might weaken the overall structure. Installation was something which could be performed by a golf course crew. However, we decided that the project was going to be larger than we should try to handle, so a contractor, experienced in Gabion installation, was engaged.

About two thousand lineal feet of Gabion walls were installed during a period of several years. The oldest ones have been in place for about eleven years. They are holding up very well. Everyone is very pleased with their appearance and feel that they have added to the general aesthetics of the golf course.

A layer of soil was placed on top of the Gabions and a turf cover was established. This makes the walls blend in very nicely with the golf course landscape. This soil layer has been our only problem to date. Over a period of time the soil will settle down into the voids between the stones creating small sink holes in the turf cover. Also, rodents like to go between the stones in the baskets and then make vertical holes to the surface. This problem could be solved by using some of the new spun polyester matting material as a barrier between the soil layer and the Gabions.

Decade of Sand Topdressing

Ray Knapp
Tuckaway Country Club, Franklin, Wisconsin

In a decade we have come from only a few clubs sand topdressing to a majority doing so. In some areas nearly one hundred percent of the clubs are either using pure sands or dirty sands. Milwaukee is an area where this is true. In this period we have accumulated over 2-1/2 inches of sand.

The programs are becoming more refined. We can find some answers while we are still looking for other answers. The greens have changed in a decade. This is partly because of the demands of the golfer. But these demands were made possible by top-dressing programs.

Two years ago I said that it would not be necessary to lower the height of cut below its level at that time. This last season I lowered my height twice during the season. I did this somewhat reluctantly, but I didn't think there would be any long term damaging effects. I got caught in a phenomenon of district tournament golf. Club X greens are faster than yours. You have the slowest greens in the district. The vocal element of my club likes the greens with a stemp meter reading of 8'2" to 8'10". A speed of 7'6" is considered too slow, while that of above 9'4" would be considered too fast.

Table 1. Tuckaway Country club - Green Height, inches

Year	Early Spring	Regular	Tournament
1973	.18	.165	
74	.18	.168	.151
75	.18	.156	.141
76	.18	.156	.139
77	.18	.153	.135
78	.18	.155	.129
79	.18	.150	.119
80	.15	.125	.120
81	.14	.125	.115
82	.14	.110	.110
83	.12	.110	.100
84	.125	.100	.100

Looking back on the 1984 season there were a couple things that I could have changed that would have allowed me to maintain my height of cut the same as the 1982 and 1983 seasons. I topdressed greens only six times. Each application was between 250 and 370 pounds of sand per 1000 sq.ft. It takes four to six days to get the mowers operating normally after these heavy topdressings. A program of weekly light topdressings of 40-120 lbs. per 1000 sq.ft. similar to what Pete Ferguson uses in St.Louis might have given me better results. The second thing was that I was using more nitrogen than other clubs in my area. Last spring I had many thin spots on greens. The extra nitrogen was used to get these areas filled back. If the greens had come through the winter in excellent condition I could have cut back on nitrogen usage.

Table 2. Tuckaway Country Club - Greens Sand & Fertilizer/Season

Year	Sand	Fertilizer		
	Cu.Ft./1000 ft.^{2}	N	P_2O_5	K_2O
1975	22	5.8	1.1	5.8
76	23	5.7	2.3	3.5
77	21	4.8	.7	0
78	16	4.4	1.3	5.4
79	22	4.2	1.9	4.6
80	15	3.2	1.2	1.7
81	17	3.0	.6	2.7
82	21	3.8	5.0	4.5
83	17	4.9	1.1	8.4
84	19	3.0	1.0	2.5

Strange things have been observed on my greens during cool periods since 1981. Blue spots or areas are seen in the spring and sometimes in the fall. Looking closely at the individual leaf blades, part of the leaf appears to be red or blue. Looking at the samples under a microscope, no disease appears to be present. If you bring a sample in to a heated area the spots disappear in a few days. When soil temperatures warm up the condition disappears. Talking to other superintendents at the GCSAA meetings in D.C. this year we concluded there are two things we can do to eliminate this - either wait until the soils warm up or apply phosphorus.

It is hard to believe that, despite high levels of phosphorus when repeated soil tests were taken, phosphorus deficiencies can occur. For years we were told phosphorus encourages or stimualtes Poa annua. We were told phosphorus does not leach in sandy soil; however, this is not true. The phosphorus passes out of the sand area in a solution because the cation exchange capacity is so low. I don't know any exact way of attacking this unsettled question. However, here are some suggestions: 1) Regardless of soil test results, if observed, apply 1 lb. P_2O_5/ 1,000 ft.^{2} in early spring. A good source for this phosphorus may be monoammonium or diammonium phosphate which could be applied dry or sprayed. If sprayed, use more than one application to get total amount. 2) To prove a deficiency exists, have a clipping sample tissue tested. 3) Don't do anything. If the greens are in good condition the blue color will disappear when the soil warms up in June.

Many of our university educators have been warning us that we can expect to have more nutrient problems using sand because of its characteristic of low cation exchange capacity. We are discovering this to be true. Our management programs can be altered to meet these problems. The advantage of the use of sand or high sand topdressing will far out-weigh its disadvantages.

Some observations after ten years: 1) No thatch, 2) organic matter, 3) wetting agent, 4) balanced N-P-K, 5) Rubigan.

Thatch. Ten years ago we thought we needed 1/4" or more of thatch to give the green resiliency to cut down on the effect of ball marks. (When talking about no thatch I'm referring to 1/8" or less of thatch). Thin layers of thatch are difficult to measure. After topdressing for three years I was getting close to a no-thatch condition. I talked to a PGA tournament official, Gordon Glenz, and asked him for advice on low thatch greens. This was the fifth PGA tournament that he was officiating at Tuckaway. He said, "Whatever you are doing, don't change." After this I accepted the no thatch idea.

Organic matter. An academic question before starting is - what amounts of organic matter would be in a sand topdressed surface? Some thought the O.M. would be broken down by microbial action and there would be little nutrient holding capacity. We now know that this laeyr contains 4-9% organic matter. This makes a dark colored sand which gives a somewhat higher nutrient holding capability.

Table 3. Data on Nos. 6 and 9 Greens - Tuckaway Country Club

Year	pH		P		K		O.M.%		
	#6	#9	#6	#9	#6	#9	#6	#9	
1-24-80	6.7	6.9	155	225	330	430	5.6	12	(2" depth)
1-24-80	6.6	6.8	125	175	420	455	4.1	12.5	(1" depth)
1- 5-82	6.0	7.1	70	68	370	405	5.2	6.8	
1-13-83	6.8	6.8	250	300	280	285	4.1	4.1	
4-25-84	6.8	7.2	198	203	220	240	8.1	9.2	

Wetting Agents. Two years ago I observed that Hydrowet was doing a good job to eliminate localized dry spots. I still feel it does a better job than other materials I have used. In cold weather it is easier to mix. In all conditions it is less phytotoxic to the grass plant.

Rates of Hydrowet vary among clubs in our area from 25-60 oz. per 1,000 ft.^{2}/ season. I feel the lower amounts are adequate for my course. Single applications of 12-15 oz. per 1,000 ft.^{2} are common in spring. I feel good results can be obtained when most of the total amount is put on in the spring. Any application above two ounces should be watered into the turf.

Balance N-P-K. We commonly use a N-P-K ratio of 3-1-4 to maintain the balance. Once a problem occurs with phosphorus this ratio may be changed for a couple of years to a 3-2-4 ratio. It will probably be desirable to use more frequent light rates of fertilizer materials than was necessary ten years ago.

Rubigan. I've used Rubigan course-wide on greens and tees for two years. After using Rubigan for the first year I was encouraged by what was happening. I browned out some Poa annua, but its effect was not too bad. Last spring I had more bare areas on greens that I would have liked. Consequently, I was very cautious. I avoided two applications during mid-summer. I'm now a little discouraged. However, to be fair to Rubigan I did not follow the program as planned last year. This year I plan on continuing with its use.

From Superintendent To General Manager

James W. Brandt
Danville Country Club, Danville, Illinois

I can only cite my personal experience of going from being a golf course superintendent to that of being a general manager. The club president called, asking me to have a meeting with him and the executive commitee of the board of directors.

It came as a complete surprise to me when the committee asked if I would consent to becoming general manager of the club. My immediate response was, "Who, me?" (After a few months in the posiiton I was beginning to ask myself, "Why, me?") I then asked the committee why they felt I would succeed in this position. They were well prepared for this question. They gave me the following qualification they thought I possessed after having observed me at work as their golf course superintendent for a period of twelve years: 1) honesty, 2) dedication, 3) ability to manage people, 4) ability to manage budgets, 5) the membership will want you to succeed.

I told the board that I was honored that they would consider me for this most important position in the club, but that I would need three or four weeks to consider the offer. On the negative side, I had to consider that I had an offer pending my acceptance to take over as superintendet of a major golf course in the midwest. Also, I was in my third year as a director of the GCSAA. I felt that taking such a position would seriously impair my chances of being elected vice-president of the GCSAA. On the positive side, I had the following points to consider: My family wanted to stay in Danville and were supportive of my taking the position, I felt as though I was at the top of my salary range at the club. The golf course had such great potential and the inadequate budget was the limiting factor. In the twelve years I had been at the club we had ten different club managers.

My thoughts were that this would really be a great challenge. I was confident that I could bring the weakened financial posiiton of the club to that of a positive nature. After much soul searching I decided that I would take the position providing the board would agree to what I thought were necessary conditions for the proper management of the club. These conditions were:

1. I would remain as golf course superintendent.

2. The golf course professional would be responsible to me in matters pertaining to club related activities.

3. Complete authority would be given to me to hire and fire any employee, with the exception of the golf professional who had two years remaining on a three year contract.

4. The house committee would become an advisory committee rather than becoming involved in management decisions.

5. The hours spent in the club house would be at my discretion.

The board agreed to my requests and I was named general manager in March of 1965. My first official duty was to call a meeting of all employees. The club president was requested to attend the first portion of the meeting. He, at my request, told all employees that I was the new general manager and had the complete backing of the board of directors in all decisions regarding personnel or management policies. My first statement was that, "You will all have your jobs until your performance or attitude indicate that you are not working for the best interests of the Danville Country Club."

My first initial purchase was that of a time clock. Shift hours were established for all non-salaried employees. Some rather stringent rules were posted as regarded to the use of the time clock. Any deviations from the regular schedule had to have the approval of the general manager. The installation of the time clock and the constant monitoring of the help led to a 32 percent reduction in the labor costs for the dining room and kitchen over a period of one year.

The club had a cook who was not really a qualified chef by education or experience. He agreed to stay as the number two man provided I would hire a competent chef. With the hiring of the new chef and the notification to the membership that we had in our employ a chef who could plan any type of party menu, our dining room sales increased dramatically.

The next major decision was to departmentalize the club in all facets of operation. In most cases existing personnel were moved into these more responsible positions. Job descriptions were written for each department head. In these their areas of responsibility and authority were enumerated. Very briefly, department heads and their scope of responsibility are described:

Head chef - Responsible for all food purchases, preparation, and direction of all kitchen help.

Head bartender - Responsible for purchase of all spirits. Responsible for directing other bar personnel such as cocktail waitresses, day bartenders.

Hostess- Schedule and train waitresses and bus boys. Seat diners, take dinner reservations, and see that food service areas were ready for business before the opening of dining areas.

Office manager - Responsible for all club records and disbursements, payrolls, accounts payable and receivable.

Supervisor of club house maintenance - Responsible for all of the physical plant as well as cleanliness.

Golf course foreman - Responsible for directing the crew after our discussion as to the work program for the day.

One of the most important decisions I made was to budget my time. My usual work schedule on a typical day would be as follows:

Be at the course approximately thirty minutes before the crew. Make visual checks of course, then assign crew its first tasks.

The foreman reported approximately two hours later than the crew. I would meet with him and program the rest of the day's activities.

I would then go home, have breakfast with the family, do any small tasks at home, then shave, shower, and return to work about 11:00.

From about 11:00 until 1:30, I would be in the club house. I would again make my routine checks of the golf course. In the event we had a special party of any sort, I would be at the club during the evening dinner hour, often remaining until the conclusion of the party.

The average week would require my being at the club about three of the six nights we were open.

How did the system work with my serving in the dual capacity? The membership seemed to be exceedingly happy with the club operation as we went from an average loss of $12,000 for the previous five years to an average profit of $16,000 per year for the next eight years. I found that the demands on my time were not excessive. I was also elected Vice-President, then President of the GCSAA while serving in the dual capacity. This was done without an assistant in the club house while the foreman on the golf course continued to serve as my valued assistant.

More important to me was the fact that with the club making a profit I was able to upgrade our equipment and upgrade our maintenance practices.

In that eight year period we were able to do the following on the golf course:

1. Install a completely automatic two-row irrigation system
2. Purchase three F-10 tractors with 7 gang mowers
3. Build a new 112 x 56 foot maintenance building
4. Purchase two riding greens mowers
5. Purchase Sand Pro
6. Purchase three Cushman trucksters

After thirteen years in the dual role capacity, the board felt we had the need for a full time person in golf course maintenance and club house management. I was given the option of choosing my area of service. As I am speaking to you you are well aware of my decision to stay in my chosen field - that of being a Certified Golf Course Sueprintendent.

Fairway Renovation At Woodmar Country Club, Fall 1983

Steve Biggers
Highland Country Club, Indianapolis, Indiana

First I would like to thank Dr. Daniel for giving me the opportunity to speak here today and thank him for all his contributions to the world of turf management. I was lucky to be a student at Purdue with Dr. Daniel and will always cherish our time spent together.

After graduating from Purdue in the spring of 1980, I took the position of assistant superintendent at Prestwick Country club, Frankfort, Illinois, with Dick Trevarthan. My aspirations were to train for two years, and so in October 1982 I was hired at Woodmar Country Club in Hammond, Indiana, as superintendent of grounds.

Woodmar was developed in 1926 on a 110 acre tract of farmland next to a small river in the country. Today the surrounding neighborhoods, business districts and interstate have engulfed the once peaceful area. The progress of roads, neighborhoods, building construction, and business districts have created a surface runoff and drainage problem through storm sewers runoff into surrounding rivers, tributaries, and drainage ditches.

This being my first year at Woodmar and first as superintendent, I was very excited about the future. Beginning work the previous fall gave me the opportunity to learn the golf course and all of the work that would be required to help re-establish the playing and operating conditions of the golf course. Our main goals were to manicure and groom, using good sound cultural management practices, common sense, and a little imagination. By the end of June the golf course was in good condition and the membership was happy. Through first hand experience we were seeing the needs and temperament of the golf course and could begin to plan objectives and future projects. The only uncontrollable factor was Mother Nature.

In the fall of 1982, greens, tees and fairways on the south side of the golf course were elevated to minimize damage from future flooding. And in 1982, an extensive drainage system was installed on the north side of the course with laterals and mains interconnected and feeding into a preexisting wetwell next to the river. As water from the system enters, two 15 hp submersible pumps discharge through a levy back into the river. The system, in theory, would be adequate if it were not on an area of essentially zero slope. It simply took too long for water to enter the many catch basins and drain tile throughout the course. During the period of December 3-5, 1982, I had experienced my first flood at Woodmar. The Little Calumet River had overrun its banks on the south side and rainwater collected to flood the north side of the course. However, due to turf dormancy and hardened soils, we experienced no damage.

As July rolled around we experienced the second flood. Over eight inches of rain in a period of one and one half days left at least 80% of the course under water and we experienced appreciable damage. We had heavily compacted soils, extreme thatch layer, a high percentage of Poa annua. Another three and one half inches of rain, along with high humidity, extreme temperatures, and saturated soils one week later caused most of the damage. At least 70% of the bentgrass and Poa population in the fairways had died. However, the blue and perennial ryegrass roughs survived unscathed.

This was the first time this had happened and it would surely strike again. For a month there was a lot of speculation and suggestions around the club as to what should and would be done to alleviate the problem. The membership did not want to experience the course under construction for the third year in a row, but at the same time, did not want to experience the loss of the course again. Most comments were directed at turf renovation and dealt not with the true issue at hand, which was increasing surface drainage efficiency utilizing the existing drainage system. Should we simply reseed all dead areas, or should we take the opportunity to use Roundup on living areas and reestablish the fairways with improved varieties on bentgrasses? The biggest problem here was seed availability. After a meeting with Stan Zontek of the USGA Green Section and weeks of deliberation, the board was convinced to take the opportunity to properly rebuild to adapt to community, location, and weather pressures. At the beginning of August a contractor was established and agreed to all terms of construction on 45 acres of fairway and primary rough to begin on August 29.

Working with the Ken Killian Design Group out of Chicago, we decided how all work was to be performed, agreed on all design principles, and recognized long term effects. The contractor was taken around the course and shown all facets of operation and construction. Before work was done, each individaul area was outlined with marker paint and all sprinkler heads, valve boxes, and drainage structures located. Next the turf areas were broken up with a Rolm Disc assuring us that there would not be a debris problem as the project evolved. Next, the areas were plowed to a depth of 10-12 inches with a four bottom Moldboard plow behind an Oliver 1855 tractor starting in the middle of the fairway and working towards the outside. By doing this we would maximize aeration, and get rid of compaction, thatch, weed and Poa seed, which would be turned under. After this, the area was once again disced to break up the soil in preparation for grading. Next the area was surveyed and grade stakes placed locating all cuts and fills.

An area of the golf course was found to possess a large amount of usable sand for fill where needed. An International E200 paddlewheel bellyscraper was used to remove soil from this borrow pit and deposit it in fill areas while also helping to make minor cuts on the fairways. This enabled us to work without the use of a large number of trucks and loaders for moving the soils around. This saved us a lot of time and was certainly efficient. A 955 Cat along with a Galion road grader would then begin to work out from the catch basins into the fairways creating drainage swales and a one degree grade from one side of the fairway to the other. After each hole was finished a John Deere Cultipacker was pulled over the entire area with the Oliver tractor to finish and prepare the final seedbed. After this operation the grounds crew began to remove and clean out all debris, raise and level sprinklers and valves, and prepare all approach areas using a five foot pto driven rotovater and Ryan mataway. Because these areas were so small and tight we stayed away from unnecessary equipment damage to the turf by doing the approaches ourselves.

On September 18, all contracted work was finished. We had reconstructed 45 acres of fairway and primary rough, built four new fairway bunkers, three ladies tees, raised and leveled 172 sprinklers, installed six new catch basins and 484 feet

of six inch solid pvc drain pipe, lowered 19 existing catch basins, and removed a number of trees in areas of construction. Two seedings were done on each fairway with a Brillion seeder in two different directions. The first seeding consisted of a four-way blend of Adelphi, Glade, Touchdown and Baron bluegrasses. We felt this mixture would provide a good quality polystand with excellent low growth habits, good color, good disease resistance, and excellent aggressiveness. The second seeding consisted of 50% Pennfine and 50% Fiesta perennial ryegrass for quick establishment and to be a nursery for the bluegrass seed. This rye-bluegrass mixture was easily accessible (whereas bent seed was virtually impossible to get in the fall of '83), there were areas in the fairways that had survived the flood in July that were nothing but ryegrass and bluegrass (once the membership saw this they wanted it because of its survivability), and it was cost efficient, it would be easier to repair than bent, it would be easy to convert to bent once all of the little bugs were worked out on each fairway, and we wanted to see the system at work to make sure of its success prior to converting to bent.

We used 3400 pounds of bluegrass and 2850 pounds of ryegrass, giving us a 70% bluegrass to 30% ryegrass by seed count mixture. We also applied three tons of starter fertilizer at the rate of 1#/M P_2O_5 and 1#/M K_2O. After complete emergence the areas were cut at a height of three inches to encourage root development and carbohydrate storage for the young plants entering their first winter. The following season we began to see an early predomination of ryegrass. And, as the year progressed, we saw an aggressive move by the bluegrasses to predominate.

During the construction period we also installed a 12 inch gate valve in the wet well along with two additional 15 hp submersible pumps complete with discharge lines, new control panels, and a new transformer to further facilitate drainage at a maximum output of 5600 gpm.

The total cost of construction was $140,000.00. Actual fairway construction was $96,528, excluding additions, drainage work, repairs, travel time, permits, and moving costs. All work at the wet well came to approximately $25,000.

When the project was completed we experienced a much drier golf course. The membership could see its money at work whenever it rained. What once would have been closed after a light rain was now open even after a three inch rain. However, not all water was removed from the course. Some of it would move to deeper areas of the rough that would later be removed with the installation of four inch drain tile leading to existing catch basins. Another problem we encountered was the settling of many of our sprinklers that had been raised. We also saw some surface sealing and thin areas on some of the approaches.

After the spring of '84, all fairways were contour mowed as designed by Ken Killian and height was lowered to 1-1/4". In '85 these will be cut at 7/8" with a primary rough for detail and improved playability. We feel that this project was a big success and the club is happy to once again have its golf course to play on.

Improving My Course

Dwight Ladd
Mooresville Country Club, Mooresville, Indiana

On June 1, 1980, my wife and I purchased a nine hole golf course in Mooresville, Indiana. The term "mom and pop" really applies to us. My wife handles the club house duties while I maintain the golf course. We have one full-time employee. He spends all his time on the course, thus allowing me to spend time helping my wife inside the club house during busy times and evenings.

Improving our course has been a very slow process. We spent our first year learning the operation and the people. After the initial year we both made up our own lists of improvements. Changes in our operation were made to improve our efficiency. We consider the club house a very important part of our course. Every golfer has to pass through the club house at least twice to play nine holes. First and last impressions are very important.

From our joint lists of improvements we organized them from necessary to dreaming. We have tried to budget our improvements over a period of five year increments. Every improvement must be of immediate as well as long range value.

One of the first major improvements needed was our golf cart fleet. A replacement program was started and a goal of four cars a year was set. With a fleet of 25 cars for a nine hole course the entire fleet needs to be replaced every six years. By keeping newer cars, we feel the down time and repair cost will be greatly reduced. The value of renting a clean, well maintained golf cart can be measured by the comments about now nice our golf cars are.

A major course improvement has been to improve drainage. Not only will better turf result, but this also allows the use of golf cars several more days a year, which is a major improvement to the yearly balance sheet.

There have been many other improvements one of which was new carpet and paneling inside the club house. Also, an addition to the maintenance building was done by a club member. His business was slow at the time so he put the addition up for me just to keep his crew busy. The total cost worked out to be what I figured the materials cost to be.

Long range improvements have been started. Tree plantings have been fifteen plus a year. Basic native trees are being supplemented with flowering trees and shrubs. Trees from a nursery that was established our first year are now being transplanted to the golf course.

As dollars allow, maintenance equipment is being replaced. We have been very fortunate to have been able to purchase some good used equipment. Hopefully we will be able to continue to upgrade with newer and more efficient equipment.

Improvements in a golf course are never ending. Simple tree planting requires better leaf removal at some later date. Improving your course takes much time and planning. But realization of your deeds is very rewarding, provided you can look over your shoulder long enough to enjoy them.

Promotion Of Public Golf

Randy Ballinger
Walnut Creek Golf Course, Upland, Indiana

I was asked to update a little about our progress in forming an organization for public golf in Indiana and also to share with you any ideas in the direct promotion of public golf.

I became involved in the formation of a statewide organization in 1980. This was during the last reassessment of personal property. It seemed that many golf course properties had an increase in assessed valuation at many times their previous valuation - some as high as 300%. This was the first time that the Indiana Appraisor's handbook contained anything specific about golf course properties.

To make a long story short, there was a lot of interest stimulated by a common problem. Many golf course owners did benefit from sharing our experiences with each other. However, as the crises faded, so did interest in the organization. The organization had some real management problems to overcome also. Indiana is a large area to try to coordinate meeting sites. We were able to identify approximately 160 privately owned public golf courses, many of which never responded to any of our mailings. There were four main geographically separated areas - Indianapolis, Fort Wayne, South Bend, and the organizational nucleus in Marion. It seemed that the meeting locations in Indianapolis or Marion areas worked best. This may be due to the cooperative attitude already prevailing with the courses in these areas.

Turnover and poor selection of some leadership personnel also has been a stumbling block. One selected board member never did attend a meeting. Two board members were moderately active and one key person sold his course. Each person had his own business to attend to, and often specially close attention is necessary. Most of the persons involved are the single most important person in the business. Most had moderately small operations, such as myself. All of this has made continuity a problem.

The most important thing accomplished was a better relationship and cooperative attitude established among the owners involved. The more involved I became, the more I gained.

Where are we now? We have no specific date for our next meeting; however, there will be at least one meeting this year. But more importantly, we do have a framework in place in case we do need a meeting for an acute problem that might arise.

I was also asked to share some ideas as to the direct promotion of public golf. I don't have any exciting revelations or guaranteed success plans, but maybe a few thoughts might stimulate ideas.

Here are three important attitudes:

1. Treat people fair
2. Run a clean, attractive operation
3. Be sincere

Here are some ideas:

1. Let people know you appreciate their business
   - Customer Appreciation Tournament
   - Cookout
   - Golf trip to another course
   - Or just tell them you appreciate their business

2. Invest in consumer enjoyment
   - Planned additional improvement to course, let people see that you are spending money and not just pocketing it
   - Take time out to visit other courses and open your eyes as to what people like at other courses
   - Don't be afraid to try a new idea
   - Educate your employees to be courteous and interested in the golfer

3. Target your operation; know your crowd
   - You can't be everything to everyone. Do you want:
     Duffers delight or hustlers haven
     Seniors
     Women
     Juniors
     Weekend warriors
     Non-tournament players or tournament players

   Sacrifices as to personal preference may have to be made to accommodate your target golfer.

4. You know who you want so go get them! A variety of ways:
   - Yellow pages
   - Road signs, directional
   - Newspapers
   - Radio
   - Direct mail
   - Coordination with other courses
   - Specific tournaments:
     Red/White/Blue
     Hole-in-One Promotion
   - Specific leagues
     Junior
     Senior
     Women
   - Take care of your juniors and they will take care of you!

5. Get involved
   - With your business
   - With your community

Managing Public Golf

Howard Gaskill
Department of Recreation and Parks, Baltimore, Maryland

I am the Golf Course Superintendent for the Department of Recreation and Parks, Baltimore County, Maryland. We have three 18-hole municipal golf courses.

Our golf courses share the challenges that are standard operating procedure at most muni courses: heavy play, tight budgets, and an abundance of governmental red tape and paper work.

The heavy play (our golf courses average 55,000 rounds each per year) is a bad news/good news situation. The bad news is excessive wear and tear on our turf, combined with a difficultry in finding a time to perform necessary maintenance. The good news is the golfers are showing their appreciation of our work by coming back again and again, and they are helping us to pay our bills. Our three courses are showing a combined profit of $200,000 in 1984.

I would like to describe briefly three maintenance procedures that have improved the golfers' satisfaction levels at our golf courses:

Flower Beds. Each year we do more and more to brighten up our golf courses with flowers, particularly the front entrances and the clubhouse areas so our golfers can begin and end their games with a good impression of us. With the good preemergence herbicides available it really doesn't require many man hours to maintain our flower beds through the summer. By investing a minimal amount of our crew's time we are able to create and maintain landscaped accent areas that have a significant, beneficial visual impact.

Putting Green Mowing Heighht. We mow our greens at 7/32". I think that height is necessary for our greens to hold up under the feet of 55,000 muni golfers each year. Even at 7/32" our greens cannot be considered "slow". Other maintenance practices keep our greens fast enough to make our golfers happy. We use the brushes on our greensmowers lightly two or three times every week, lightly topdress monthly, and lightly verticut bi-weekly. Our greens are about as grain-free as it's possible to get them so they are fast enough for 98 percent of our golfers, they roll true, and they hold up well throughout the season. I think a lot of golf courses would be better off if they would speed up their greens by reducing the grain instead of just concentrating on lowering the height of cut.

Fairway Aerification. I don't think it's possible to over-aerify a fairway. Because of the goosegrass that grows so well in our area we do all our fairway aerification in the fall. We'll start in early September and keep it up until the ground freezes in December. A program that produces good, dense fairway turf in our area is to run a tractor-drawn fairway aerifier over the turf three or four times, use a Lely-type broadcast spreader to apply perennial ryegrass seed, drag the fairway to crumble the plugs, then wait for nature to do the rest. The ryegrass turf reduced the goosegrass infestation and survived.

Turf Management in California

Dr. Kent W. Kurtz
California State Polytechnic University, Pomona, California

The turfgrass industry in California is estimated as a 1.2 billion dollar per year business. California's populaiton is approximately 24 million and over one-half reside in three metroplitan areas - Los Angeles, 8 million, San Francisco, 3.5 million, and San Diego, 2 million. From the northern to the southern boundaries the state is 800 miles long with climatic zones from sub-tropical to subartic. Annual rainfall varies from over 100 inches (northwestern) to 2 inches (Imperial Valley) and elevation changes from 282 feet below sea level (Death Valley) to the high Sierras and Mt. Whitney (14,949).

Due to the variability and diversity in climate both the warm season and cool season grasses are grown. Warm season grasses include the bermudas, common (Cynodon dactylon) and hybrid (Cynodon dactylon x Cynodon transvalensis). Zoysia (Zoysia japonica, Zoysia matrella, Zoysia tenuifolia and Zoysia japonica x Zoysia tenuifolia), St. Augustine (Stenotaphrum secundatum), Seashore paspalum (Paspalum vaginatum), and Kikuyugrass (Pennisetum clandestinum). Cool season grasses such as Kentucky bluegrass (Poa pratensis), Roughstalk bluegrass (Poa trivialis), perennial ryegrass (Lolium perenne), annual ryegrass (Lolium multiflorum), tall fescue (Festuca arundinaceae) creeping red fescue (Festuca rubra rubra), chewings fescue (Festuca rubra commutata), hard fescue (Festuca ovina diriscula), creeping bentgrass (Agrostris palustris), and a ground cover known as dichondra (Dichondra micrantha) are used in California.

Commercial acreage devoted to production of sod total approximately 4,000 to 5,000 acres. Approximately 60% is planted to Kentucky bluegrass or bluegrass-perennial ryegrass mixtures, 20% is tall fescue, and the remaining 20% are warm season grasses (hybrid bermuda, Zoysia Seashore paspalum, St. Augustine) and dichondra. Sod sells for about $.20/square foot FOB Farm.

California has five major league baseball clubs (Oakland Athletics, San Francisco Giants, California Angels, Los Angeles Dodgers, and San Diego Padres), four National Football League teams (Los Angeles Rams, Los Angeles Raiders, San Diego Chargers, and San Francisco Forty-Niners), and one United States Football League team, the Los Angeles Express. Major university football teams include UCLA, USC, Stanford University, University of California and San Diego State. Several major bowl events are annually held in California and these include the California Bowl (Fresno), Holiday Bowl (San Diego), Freedom Bowl (Anaheim) and the Rose Bowl (Pasadena). The turfgrass utilized at San Diego Jack Murphy Stadium, Anaheim Stadium, the Los Angeles Memorial Coliseum and the Rose Bowl is Santa Ana hybrid bermudagrass. Santa Ana was developed and released by the late Dr. Victor Youngner (University of California, Riverside) and is well adapted to the climatic adversities of southern California such as high temperatures, smog and lower winter temperatures. Due to its smog tolerance and short winter dormancy characteristics it is in great demand for sportsturf use. Dodger Stadium is planted to Tifgreen hybrid bermudagrass. Stadiums in northern California such as Stanford Stadium, the Oakland Coliseum and Candlestick Park use either Kentucky bluegrass or a combination of Kentucky bluegrass and perennial ryegrass.

The golf course industry in California is quite large with approximately 1,300 courses scattered from north to south. The largest concentration is 55 courses located in the low desert area of Palm Springs. These courses are unique because they require special attention during the winter months when bermudagrass goes dormant. Since they cater to the "snow birds" who demand green grass, they are almost totally overseeded with ryegrass primarily for aesthetic reasons. Annual maintenance budgets from $800,000 to $2.5 million are not at all uncommon for courses in the Palm Springs area. The annual cost to overseed these courses varies between $80,00 and $200,000 annually. More and more courses are using the darker colored, finer textured perennial ryegrasses. The putting greens consist of either Penncross creeping bentgrass or Tifgreen bermudagrass depending upon the preference of the club or superintendent and past experience with or without problems. The overseeding process is initiated in October and is generally completed by mid to late November.

Home lawns in California may be either warm or cool season grasses. Whereas in the past the warm season grasses were primarily grown in southern California and the cool season species in northern California, but with the introduction of new and better adapted cultivars of the cool season species more new lawns are being sodded and the preference has been towards grasses with year around color such as tall fescue and Kentucky bluegrass or perennial ryegrass combinations. Home lawns on the average are quite small averaging 2,000 to 4,000 square feet in size. The lawn care industry is just beginning to be noticed and is not as large due to the vast number of residences who traditionally have relied on and use gardening services.

The state of California has numerous private four-year colleges and universities and many community colleges scattered throughout the state. There are 19 state universities and 9 branch campuses for the University of California. Education and research in Turfgrass Science is limited to three schools: Cal Poly at Pomona, Cal Poly at San Luis Obispo and the University of California at Davis. Turfgrass research is conducted at U. C. Riverside.

Turfgrass research is quite diversified but the common bond is water use efficiency and development of more drought tolerant plant material. The extensive use of cool season species, i.e. Kentucky bluegrass, perennial ryegrass and bents may soon be a thing of the past due to their excessive water requirements. Up until this year water from the Colorado River was exclusively used for irrigation in California; however, the Supreme Court ruled that Arizona was entitled to one-half of the available water and beginning in the fall (1985) the Arizona Project will begin diverting their share of the river water.

The following is a brief summary of priority turfgrass research projects currently being initiated or investigated in California:

1. Water use requirements of turfgrasses based upon ET (Evapotranspiration)
2. Cool season variety trials to determine adaptability
3. Kikuyugrass use studies and management requirements
4. Turf covers and their value in turfgrass establishment and winter color
5. Techniques and methods for pre-germinating cool season grass seed for overseeding purposes
6. Evaluation of geotextiles for wear resistance and turf damage in major stadiums
7. Evaluation of new zoysiagrass cultivars for adaptation to sun and shade environments
8. Evaluation of zoysiagrass cultivars for establishment of seeding, plugging or stolonizing
9. Evaluation of iron-efficient and inefficient turfgrass cultivars
10. Evaluation of turfgrass colorants for use on dormant warm season grasses.

From Scotland To Purdue

John Souter, Souter of Stirling
Stirling, Scotland

Like so many of my countrymen I was drawn by the challenge of what I would find in America. Having been brought up in a small but historic country, as far as grass is concerned, I had an open mind as to what might await me. I was not disappointed.

In Geoffrey Cornishe's book The Golf Course , he devotes the first chapter to "Golf Evolves on the Links of Scotland". We take our natural, nature-built courses for granted, not realizing that we had been supplied with the answers to most of the agronomic and soil science problems. Fred Grau wrote to me last year to tell me he had "studied" in Scotland in 1938 and that his findings were exactly as he had expected - "The answer lies in the soil".

Only man makes problems when courses are constructed; nature has left us with guidelines on construction on some of the most famous links in the world - St. Andrews, Muirfield, Troon, Turnberry, Machree and others. The rolling dunes or the Scots word, machir, mean a sandy soil covered with predominantly fine leaved grasses.

Much research on particle analysis has gone into the construciton of golf greens where consistency in the eyes of the USGA and USPGA is of tantamount importance. The "pace" or speed of the greens is uppermost in the thoughts of those harnessed to a career in golf course maintenance. The pros demand it.

I had often wondered why the USGA brought out a greens specification with particle ranges from 125-500 microns specified for the root or the top zone? Why in America the open was played throughout the country on inland and coastal courses, and why in Britain it was played only on coastal or links courses? Maybe Fred found out?

Having taken particle analysis of most of our "famous" courses, the results of the materials tested were striking. They all comprised medium fine sand (125-500 microns) of a percentage varying from 88-95 with in each case less than 2% less than 125 microns. Only where man has added imported soil in the form of topdressings which contained mainly silts or "foreign" materials such as peat did we obtain variable readings. On each occasion the pace was slower, the surface spongier, the density of the Poa annua greater.

The late Jimmy King of Luffness Golf Course, of whom some famous American golfers (including the first winner of the Old Tom Morris Award) said his greens were some of the finest in the world, topdressed only with indigenous materials from his machir, did not kill worms and lifted three greens per year to root prune them and make them "work". Having looked at research throughout the world Jimmy may well have been awarded high honours had he been able to put down on paper andin technical terms what he knew.

By sand dressing he kept the same flow rate through his complete rootzone and subsequently retained his fine leaved grasses.

His greens were "switched" daily to "spread" the topdressing compost manufactured by his worms. Only where we have silt and clay casts do we have a problem and his greens were alive with pore space and root actions. Worms rarely cast during the daytime.

His only problem - too many roots, too deep. Some of us would like that. He knew if he root pruned, dug over the base, relaid the turf and topdressed eight to ten times over three weeks his greens were as good as new. So were his young, white coloured feeding roots - heading downwards.

I am indeed indebted to the worm for introducing me to Purdue and in particular to Bill Daniel. Our first conversation was on this fascinating subject, mainly on athletic fields, in Minneapolis, and I feel sure that at that time he was not too sure whether I was serious or not.

My appreciation of the friendships started at your conference knows no bounds, and I feel I have benefitted greatly from the experiences gained while with you.

Better Turf In Mexico

Alejandro Eguiarte
Guadalajara Country Club, Guadalajara, Mexico

When we start to talk about turf in Mexico, we should talk golf. Most of the Mexican golf is located in its southwest section, somehow triangled by Mexico City on the east, Mazatland on the northwest and Acapulco on the southwest. Both of the latter resort areas are on the Pacific coast.

Also, there are other golf locations such as Cancun off the Caribbean, around Monterrey in the northeast part, and even a small activity in Baja, California, the peninsula that is located south of California.

Golf is the game of the rich people in Mexico, and it is played at 120 private golf courses and at resort areas. I have to mention here that municipal courses do not exist in Mexico.

The devaluation of the Mexican peso has made resort areas a bargain for American tourists but has made costs of properly maintaining the golf courses prohibitive because so many items must be purchased from the U.S.A. By the time something reaches us, whether it is a mower part or some fungicide, its price has more than doubled over what it costs in the United States.

Mexico City, the capital, has some fine private courses. The best course in this city is the Club De Golf Mexico. It has a huge crew of 75 people. Their tees and fairways are Kikuyugrass (Pennisteium clandestinum Hochst ex. Chiov.) and their greens are bentgrass with Poa annua.

At Mazatland there is a wonderful beach, but only one course, the El Cid. It has bermudagrass tees, fairways and greens.

At Acapulco resort golf is confined to the two Princess Hotel courses, the Acapulco Princess and Pierre Marquez. Both have bermudagrass greens and fairways.

Manzanillo, on the west coast, is the location of Mexico's most talked about course, the Las Hadas Resort, designed by Pete Dye. The complete course was opened in 1981. The fairways leap up, down and sideways through a lush tropical setting. Beautiful views can be seen over and around the royal palms that grace the course.

Guadalajara, which is the capital city of the State of Jalisco, is the second largest city in Mexico. It derives its name from a province in Spain, and in Arabic language it means "river that flows over the rocks". It is a city full of flowers, fountains and colonial monuments.

Already discovered by thousand of U.S. citizens who have retired there, Guadalajara has low humidity and temperatures that seldom stray from the 60-80 degree range. It has been described as the most wonderful weather this side of Shangri-La. A visitor in July will find nightly rain, usually when everyone is trying a new tequila drink, so let it rain...

Golfers agree that the Guadalajara area affords the best climate for the game. There are four 18 hole golf courses in the immediate metropolitan area.

Santa Anita golf course was designed by the late Larry Hughes. (He was a disciple of Donald Ross, pioneer architect in the U. S.). It has a crew of 28 people and it has bermuda tees and fairways and their greens are Cohansey bent with Poa annua. A few years ago Santa Anita course had a pythium problem that killed almost eleven greens.

San Isidro Country Club also was designed by Larry Hughes. Bing Corsby was involved in the development of this club. His golf course has Kikuyugrass fairways and Penncross greens. Their crew has 25 people.

The Atlas Golf Club was designed by Joe Finger, an architect from Texas, and it is one of the largest courses in Mexico. The greens are Tifdwarf bermuda and the fairways are common bermuda. It has a crew of 26 people.

Guadalajara Country Club is one of the oldest courses in Mexico. It was founded in 1910 as a tennis club and was moved at its present place in 1942. The course was designed by John Dredemus, but didn't really comt to life until 1957 when Purdue University turf expert Loomis Heston visited and made suggestions to improve the course. The green chairman at the time, Dr. Jorge Romo, is still the chairman. After Mr. Heston two other people from Purdue came to the club to work - Robert Brame, who stayed for a couple of years, and Dwight Ladd, who stayed for one year. I am working there since 1977, so it seems the Guadalajara Country Club is part of Purdue University. Our crew has 23 people. Our fairways are bermuda and Kikuyugrass. This Kikuyu has quickly become the predominant turfgrass on the golf course.

Let me explain something about this grass; it is coarse textured and vigorous. It is useful as a stabilization control and as a deterrent to soil erosion. It is native to eastern central Africa. The most common means of propagation has been by stolons and sod. Its root structure is extremely heavy and deep, and it is not uncommon for its rhizomes to reach 10-inch depths. Many people confuse the Kikuyu flowers with the seed. Within hours after mowing the grass will begin to flower, producing feathery stamens that give a white cast to the turfgrass.

This year we are going to propagate the Kikuyu to all our fairways and tees. It has been a very good grass to us because it withstands golf cart traffic very well, keeps its green color longer than bermuda in wintertime. It really doesn't lose color; a bad lie is rarely experienced; the ball always sits up. Tom Watson said, "Personally, Kikuyugrass is the best playing surface anyone can play."

Some of the requirements for having a good Kikuyu fairway are:

1. Mow as often as you can, usually 4-5 times per week
2. Mow as low as you can, half an inch or less
3. Verticut as often as you can, usually once a month
4. Apply low nitrogen fertilizer
5. Aerify when you can

Our greens are Penncross bent. In the last two years we have been trying to introduce Penneagle also with fairly good results. Because of bad soil structure in our greens we have rebuilt seven since 1977 and have two more to go. We top-dress the greens the old fashioned way every three weeks during the heavy growing season and once a month in the other part of the year.

One of our problems has been infestation of bermuda in our greens. Our best solution has been manual removal and replacement with bentgrass sod. We have a 25,000 sq.ft. sod nursery which is propagated vegetatively and by seed. Usually we have at least 15,000 sq.ft. of good bent in case of repairs or renovation of a green.

Our 19 year old sewage treatment plant produces our water supply for the irrigation system. It works 24 hours a day. The irrigation system is a manual Rain Bird.

We had an aquatic weed problem last year, and we found a fish called Tilapia sp. which keeps the lake free of weeds. It has been a very good solution. The fish have now grown to 12 inches and weigh almost 2 pounds.

We have almost 30,000 trees so if you get into the forest you play the marimba.

We host tournaments every year. In January we host the university girls tournament, and in the second week in March we have the mens intercollegiate tournament with teams like Oklahoma State, Brigham Young, Wake Forest, Texas A&M and UCLA.

I would like to say, in closing, that better turf not only in Mexico but throughout the world has been made possible in part because of people like Dr. Daniel. God bless him!

Turf In Bolivia

Dr. John W. King, Associate Professor
Department of Agronomy, University of Arkansas, Fayetteville, AR

Bolivia is a land of contrasts. The ultra-modern exists side by side with the primitive in all aspects of life. I was called to consult for La Paz Golf Club and found it was also a place of contrasts. Other turf facilities in Bolivia were visited also.

Vivid memories of my trips include flying over mighty Amazon tributaries, seeing the stone piles in the fields on the Alto Plano, that vast highland (the size of California) where Indians have farmed for centuries, riding down (to 11,000 ft. elevation) into the "bowl" that shelters the one million people of La Paz, tin roofs, red tile roofs, adobe walls, walls of many kinds enclosing lawns and gardens, pastel colors, colorful Indiana costumes, modern downtown skyscrapers, the stark beauty of the severely eroded mountainsides, the white eroded beauty of the "Valley of the Moon", meeting bilingual people.

La Paz Golf Club is a tribute to a fine old gentleman, Carlos Ormachea. In 1948, Carlos gave the land for the golf course and land to a village of Araymaira Indians who labor on the course. Carlos went to England and brought back a qualified man who built and maintained the course until his retirement. Luis Patino, a retired university-trained farmer, also worked with me daily. Another key man was Jim Raaf, an ex-patriot successful American businessman who was president of the La Paz Golf Club and invaluable in obtaining modern equipment.

My approach to consulting was to find out as much as possible about how and why maintenance operations were performed (often by demonstration), to remain mindful of the difficulty in importing new equipment, pesticides, and technology, and to carefully tailor any recommendations for changes and improvement to what was feasible. Our success was largely due to Carlos Ormachea's rapid grasp of turfgrass technology and interpreting questions through English, Spanish, and Araymaira languages.

Bumpy, soft greens! The eighteen South German bentgrass greens were mowed about 1.5 cm high. The greens were soft underfoot. The bent was growing over a 7.5 cm layer of well decomposed organic "soil" material (not quite thatch). The underlying soil was a heavy silty clay loam. With only 100 golfers among the 500 members, the greens withstood the traffic. The climate is ideal for irrigated bentgrass. The temperatures rise to 70-75° F in the intense bright sunlight and drop to 45-50° at night. Good Ransomes and Toro greensmowers were available as well as fairway gang mowers and aerifiers. The most important of my recommendations was to improve the topdressing techniques to smooth those bumpy greens.

Topdressing improvement became the first priority of the first week. The old way was demonstrated. First, core aerifying was done with the Ryan Greensaire. Cores were shoveled up, removed, and composted. Topdressing material consisted

of 13 parts animal manure, 10 parts peat, and 4 parts masonry sand, hand mixed, and screened through 2 x 2 cm mesh. Topdressing was transported by pick-up truck or trailer. The Indian laborers placed large scoop shovelsful at about 2 m intervals. The piles were spread with an 80 cm board attached across the end of a 1.5 m limb. The Indian women then brushed the greens with small hand brooms. This sweeping action brushed the low spots as well as the high spots and resulted in an irregular pattern of "bumps". A typical steel dragmat was needed. But a steel dragmat was not available in Bolivia. So I appropriated the 100 x 75 m rubber tire casing strip doormat from the clubhouse. We wired the pro's nine-iron across the front and attached some cord. The pro was impressed. More doormats were purchased and wired together with a pipe and cord across the front. A program of topdressing all greens was started. I taught the laborers how to throw shovelsful of topdressing for more uniform distribution. The topdressing mix was changed to a 1-1-1 ratio of manure, peat and sand and screened through 15 mm screen. Urea and 15-15-15 fertilizer was located (with some difficulty) and used to fertilize the greens lightly at three week intervals. I recommended that the greens be topdressed at a $0.4m^3/100\ m^2$ rate at six week intervals and that mowing be done three times per week at a 6-8 mm height. By October the greens were much smoother and growing more densely.

Surface irrigation was practiced on all fairways and several greens and tees. The remaining greens and tees were watered with hand held hose nozzles fed by gravity head pressure through a pipe system. Although topography was gently rolling, a general 5-10% slope existed diagonally across the golf course. To accomplish this irrigation feat, water (pH 9.0 and high sodium) was channelled down from a spring in a nearby mountainside in small open ditches into reservoirs for silt settling and storage. These ditches were repaired as needed (fairly often) by hand shovel work. Water was allowed into small open ditches (equivalent to about six-inch diameter pipes) by wooden flood gates or siphon tubes. This system of ditches was organized beside fairways, tees and greens. Wherever irrigation was needed, a small opening was shoveled out to allow water to flow into a subsystem of ever narrower ditches created by shovel and mattock. I checked uniformity of water penetration depth with my soil probe and it was remarkably good. This irrigation system was a truly remarkable achievement for an "uneducated, unskilled" labor force. But, of course, the ditches caught a golf ball occasionally.

La Paz Golf Club was also in the process of installing a modern $200,000 irrigation system. A pumping station was built on the Choqueyapu River which flowed out of La Paz. This water contained 1% N, other nutrients, and had a pH of 7.4, high sodium and high silt and clay. Two electric turbine pumps were to pump water through a six-inch aluminum pipe over a 3 km distance and 500 m rise in elevation into the reservoirs at the course. Another two pump station pumped water through a typical underground piping system to quick coupler valves and sprinkler heads located on fairways and beside tees and greens. Many problems and delays had occurred in procuring all the irrigation system parts, with installation techniques, and in obtaining electric power at both stations and I anticipated further problems. My first visit was extended so I could observe the startup of the new system and make appropriate irrigation scheduling recommendations. I strongly advised that the old simpler system be kept operable. Indeed, later pump breakdown and transformer burnout caused weeks of system shutdown.

Resodding of worn areas was done the old fashioned way. Sod was dug by hand shovel and transported to the repair site around collars or walkways by wheelbarrow. The worn sod was dug out by hand and the areas spaded several inches deep. Then the sod chunks were laid in place and pounded down to level with a hand held stone. I suggested improved fertilizing and watering techniques to improve turf density and reduce the need for so much resodding.

The roughs, fairways, tees and collars were kikuyugrass. It is well adapted to equatorial highlands. It forms a dense turf which holds the ball up well. The Indians mowed the fairways about every two to three weeks. The 7-10 cm long clippings from the good growing spots (where cattle had been tethered and fed thirty years earlier) were hand raked and taken home to feed their rabbits. Sheep grazed in the roughs occasionally. A fertilizer and irrigation program was recommended, especially for thin spots. Also, I recommended that fairways be mowed twice a week at a 2 cm height. But I was concerned that I might be seriously interfering with the meat supply of the Indian laborers and their families.

Weeds were not a serious problem. The clover, "rat's ear", and totorillagrass disappeared from the greens as a result of the improved maintenance program. Kikuyugrass stolons invaded the edge of greens and Indian women removed them with 40 cm long forked hand weeding blades. The turf at LaPaz Golf Club was much improved when I returned in October.

The few lawns and soccer fields I observed in La Paz were perennial ryegrass. The golf course at Cochabamba had poor quality bentgrass greens and kikuyugrass fairways. The soccer field at Trinidad was good quality common bermudagrass turf. The nine hole Los Palma Golf Club at Santa Cruz had good quality bermudagrass turf. The lawn at the Holiday Inn in Santa Cruz was mascarenegrass.

Contrasting methods of maintinaing good golf course turf are developed within the confines of different cultures.

Selecting And Using Grasses For Water Conservation

Dr. Terrance P. Riordan
University of Nebraska, Lincoln, NE

At the University of Nebraska, the major effort of our program is the development of grasses that will require less water and energy. Although we are in a period where water has been available, but more expensive, we can't count on this supply for the future. We will have increased demand from population and agriculture, while at the same time we could have either a short or extended drought.

There is a great deal of water wasted through poor management or an improperly designed irrigation system. If there is a major water shortage the turf industry will be the firstto suffer due to our visibility and our link to leisure activities.

The long-term objectives of our breeding and selection projects are the reduction in evaporation, the reduction in water use rate, and the increase in root efficiency necessary to obtain the water in the soil profile. The objectives are being met both through selection and plant breeding procedures. There is optimism that the objectives can be accomplished because of several reasons. For one, only 1% of the water taken up by the plant is used for metabolic processes; the remainder is transpired from the plant. Also, efficient use of water has never been a goal of a turfgrass breeding project. In the past, water was available and cheap; if we wanted to improve turf quality we applied more water and fertilizer. Now we will try to improve turf quality, but without the increase in water, fertilizer, or other energy sources.

There are two terms which must be defined before we discuss grasses for water conservation. The first is water use rate. Water use rate is the total amount of water required for growth plus the quantity lost by transpiration and evaporation from soil and plant surfaces. This is affected by the evapotranspiration rate (E.T. Rate), the length of the growing season, the growth rate of the plant, the species, the cultivar, the intensity of culture and traffic , the soil type, the amount of precipitation and the available soil moisture. Many of these factors we can't control, but species and cultivar we can alter, especially at the time of establishment.

The second term is drought tolerance and it is different than water use rate. Drought tolerance or resistance is the ability to survive moisture stress. This can be accomplished either through dormancy or the plant's ability to obtain the available water in the soil profile and use it efficiently.

The three species which we are working with at Nebraska are Kentucky bluegrass, tall fescue and buffalograss.

Kentucky Bluegrass

Of the three species, Kentucky bluegrass is the grass which has the least drought tolerance and the greatest need for irrigation. It is, however, the major turfgrass in our region and it will probably continue to be so. Research is continuing in an effort to find Kentucky bluegrasses which use less water. Grasses can be chosen that will have the potential to use less water and hopefully survive a drought stress. Research at Colorado State University has indicated that certain cultivars such as Arboretum, Merion, South Dakota Certified and several others withstand a severe drought better than other cultivars. Additional reseach will determine why grasses are tolerant.

Tall Fescue

Although tall fescue has a fairly high water use rate, it is drought tolerant because its root system is extensive and deep. Work with tall fescue is not so much with water conservation, but with an improvement in turf quality and disease tolerance. It is important, however, to make sure that while we are developing a good looking plant, we do not lose its natural drought tolerance.

Presently we are recommending the following tall fescues for use in blends: Rebel, Olympic, Houndog, Falcon, Adventure, Jaguar and Mustang.

Buffalograss

The native buffalograss has true water and energy conserving features and it has the advantages of being native to our area, cold tolerant, heat resistant, drought resistant, adapted to alkaline soils and low fertility, and it requires only infrequent mowing, It is, however, slow to establish, has a short growing season, has a light green color, and it is brown when dormant.

Without considering the necessity of conserving water, buffalograss has some real negatives. But, with the recognition of the need to conserve, we can begin to think about improving buffalograss - minimizing those negatives and maximizing its natural advantages - and ending up with a turfgrass that requires little supplemental moisture, little mowing, yet has good turf quality.

The United States Golf Association is supporting research at Colorado and Nebraska which will allow the breeding and development of native grasses for use in the Great Plains.

Developing Alternative Turf Species For Golf Course Use

Dr. Terrance P. Riordan
University of Nebraska, Lincoln, NE

In the Great Plains we are faced with both short-term and serious long-term droughts, such as the one which occurred during the Dust Bowl of the 20's. Even during these times of above level rainfall we have often had short droughts or very dry periods of 30 to 60 days without precipitation. An even more significant problem is that the Ogallala aquifer level is dropping, and good quality water will become more limiting and more expensive.

Before we had irrigation for lawns and golf courses, the native grasses such as buffalograss and blue grama bluegrass were used for turf areas. However, during the resource rich 60's and 70's there was movement away from these grasses to the high moisture-requiring Kentucky bluegrasses which now comprise 98% of the turf in cities such as Lincoln.

Buffalograss, which is adapted to a large area of the Great Plains, and is being used now in Iowa, Illinois and on the east coast, has had its followers because of its advantages of heat, cold and drought tolerance, adaption to low fertility and alkaline soils, and its very low requirement for mowing. Overall when properly managed, buffalograss will provide a good quality turf with very low requirements of water, fertilizer, pesticides, and mowing.

There are disadvantages, however. There is a high seed cost, a slow establishment rate, a short growing season, a light green color, and brown when dormant. Also, there are really only one or two cultivars available on the market.

This may all change, however, since the initiation of a new project at Nebraska. This project, entitled "Breeding, Evaluation, and Culture of Buffalograss, Blue Grama, and Other Native Turfgrass Species for Golf Course Turf" is funded by the United States Golf Association and the University of Nebraska. The project is a joint effort which includes two plant breeders, two turf physiologists, and a pathologist.

The first objective of this project is to identify and select native grasses from all possible sources. Initially selections have been made in Colorado, Kansas and Nebraska, but grasses have been obtained from Texas A&M, New Mexico State, and Arizona State. During 1985 a major effort will be made to develop a wide gene base of material from around the country.

Selection criteria will include improved color, density, uniformity, growth habit, pest resistance, seed production, recovery, drought and heat tolerance, and lateral growth rate. We have already found one buffalograss which shows good potential for golf course turf. It was found in an unmowed, unwatered rough area on a golf course in Lincoln and it was surrounded by very poor quality turf. We were given a large sample, and it is now being vegetatively propagated and evaluated in our greenhouse.

The second objective of the project is to use accepted plant breeding principles to combine characteristics from the best selected sources. Buffalograss is an interesting plant and also an easy one with which to make intraspecific hybrids, since plants are dioecious, i.e., they are either male or female plants. It is possible to cross a male plant and a female plant with none of the problems associated with apomixis like in the bluegrasses or selfing as in other grasses. In addition, once the cross is made and you obtain a seed, then a plot - you will always be able to maintain that genotype vegetatively. It is also possible to set up seed fields using alternate rows of male and female plants to produce hybrid seed which then could be marketed.

The third objective is to evaluate the best selections over a large geographical area.

The fourth objective will be to study propagation methods with vegetative material. Possible propagation methods would be sod, stolons, sprigs, plugs, and strips, and something new - the pre-rooted plug. All these methods are possible and have been used with stoloniferous, vegetatively propagated grasses in the past. Our initial feeling is that a pre-rooted plug will have a lot of potential for buffalograss.

The pre-rooted plug is a small, approximately two-inch cube of sod, which is placed in a tray and allowed to root. This now hardy plant has the ability to immediately start growing when it is planted in the soil.

The final objective is to investigate cultural systems that would make these native grasses most suitable for golf course turf. This effort would explore the minimal maintenance requirements, the playability, the recuperative potential and the traffic tolerance of these grasses when used under golf course conditions. Work is already underway to evaluate mowing recommendations and preemergence and post emergence weed control recommendations for buffalograss.

As may be seen,this project is fairly extensive, but it also has the potential to provide alternative species for golf course turf. The duration of the project is eight years, but with our initial progress and the support we are receiving from the U.S.G.A. and the University of Nebraska, progress could be very rapid.

Selecting Turfgrasses For Quality Turf

Dr. Terrance P. Riordan
University of Nebraska, Lincoln, NE

The turfgrass manager is responsible for providing a playable turf no matter what the performance requirements are or what environmental conditions he faces. My experience in the turfgrass industry has shown that the best way to acccomplish this is to use the right turfgrass cultivars, blends and/or mixes.

The proper choice is usually the species or cultivar which is best adapted to a geographical area, specific location, or a specific use. Examples would be Kentucky bluegrass in Indiana, buffalograss for unirrigated areas of Nebraska, and Penncross bentgrass for putting green turf.

The turfgrass species which we use all have different rankings for the various characteristics we are concerned with as turfgrass managers. We know the perennial ryegrass will establish faster than Kentucky bluegrass, but that it may not mow as well. We also know that fine fescue will perform better in the shade, that tall fescue will stay greener longer under drought conditions (if there is subsurface moisture) and that there are certain species for certain specific problems.

We need to select a species that will provide the necessary performance or turf quality under our environment,our location, our expectations (or our clientele's expectations) or even our maintenance budget.

Once we have made a species decision, we then need to make a decision on the proper cultivar or cultivars. For example, if you need a Kentucky bluegrass blend for a home lawn, the decision may already have been made by the distributor. The package you purchase, if you buy a quality product, contains a blend of grasses that will give adequate to excellent performance over a large geographical section of the cool, humid region of the United States.

The cultivar decision becomes more complicated if you are a turf manager with different problems in different areas or locations. At one site stem rust may be your problem and you would select cultivars such as Ruby or Columbia which show tolerance; at another site outstanding turf quality may be the most important need, and you would select improved proprietary cultivars such as Glade, Adelphi, Midnight, or Baron.

Of course, all of this is compounded by the amount of your budget, the availability of various cultivars, and the possibility that you may have more than one problem in an area. This is where blending or mixing may be helpful.

The following table summarizes the cultivar performance data from 1983 and 1984 for the various species and cultivars recommended for Nebraska. This data is meant to be only a guide to show some of the grasses which have performed better than others. The best recommendation for making a good decision is to gather as much information as you can about the various species and cultivars - attend field days, read extension publications, talk to sales people, and then make the right decision.

Table 1 - Turf Cultivars, 1984

Kentucky Bluegrass

Cultivar	1983 Col.	1983 Qual.	1984 Col.	1984 Qual
Adelphi	5.5	5.5	5.8	5.6
America	5.3	4.5	5.7	5.2
Aspen	5.6	5.9	6.3	6.2
Baron	6.0	5.5	6.1	5.1
Bensun	4.7	5.2	5.3	5.3
Birka	4.7	5.2	5.3	5.2
Bristol	5.8	5.2	6.3	5.4
Bonnieblue	5.3	5.4	6.2	5.6
Cheri	5.0	5.4	5.9	5.6
Columbia	5.3	6.0	4.8	5.6
Eclipse	5.2	5.2	6.2	5.6
Enmundi	5.7	5.2	6.2	5.5
Enoble	5.2	5.7	5.6	5.6
Georgetown	-	-	5.5	6.0
Glade	6.0	5.6	6.0	5.6
Haga	5.0	5.0	5.1	5.2
Majestic	5.8	5.6	6.1	5.7
Merit	5.5	5.6	6.1	5.6
Midnight	6.5	5.8	7.1	6.4
Mystic	4.6	4.7	5.4	5.6
Massau	6.2	5.2	5.2	5.2
Parade	5.0	5.2	5.3	5.2
Ram I	5.5	5.4	6.1	5.6
Rugby	5.2	5.6	4.7	5.2
Shasta	4.7	48.	5.3	5.2
Sydsport	5.2	5.3	5.6	5.5
Touchdown	4.8	4.8	5.5	5.5
Vantage	4.3	5.5	5.0	5.1
Victa	5.8	5.6	6.0	5.7
Mean	5.2	5.2	5.8	5.5

Perennial Ryegrass

Cultivar	1983 Test 1 Qual.	Test 2 Col.	Test 2 Qual.
Blazer	6.1	6.3	5.7
Citation	6.5	5.7	6.3
Dasher	-	5.3	6.0
Delray	-	6.0	5.7
Derby	5.9	6.3	6.0
Diplomat	6.1	6.0	5.7
Elka	5.4	6.3	6.3
Feista	6.0	5.7	6.0
Loretta	6.2	-	-
Manhattan	5.8	5.7	6.0
NK-200	-	-	-
Omega	5.4	6.0	6.3
Palmer	-	5.7	6.0
Pennant	6.0	6.0	5.7
Pennfine	5.7	6.0	5.7
Prelude	6.1	6.0	5.7
Premier	6.9	6.0	5.7
Regal	6.5	6.0	6.3
YorktownII	5.4	6.3	6.0
Mean	5.7	6.0	5.9

Tall Fescue

Cultivar	1983 Qual.	1983 Col.
Adventure	6.4	6.0
Brookston	-	-
Clemfine	-	-
Falcon	6.4	6.6
Houndog	5.3	5.8
Jaguar	6.5	6.0
K-31	4.5	4.8
Mustang	-	-
Olympic	6.8	6.0
Rebel	6.5	6.0
Mean	5.8	5.9

Turfgrass Water Conservation Strategies

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Water is critical to the growth, survival, and functional use of turfgrasses. The water status of an individual plant is acutally a dynamic system involving the transfer of water from the soil through the plant into the atmosphere. More specifically, water in the soil is taken up through the root system by the process of absorption and is then translocated upward through the vascular system in the stems and leaves of the plant. Through a diffusion process that occurs along a gradient from zones of higher water content to zones of lower content, water reaches the peripheral portions of the plant, especially the leaves, where it is transpired into the atmosphere. Transpiration, which occurs primarily through stomata in the leaves, involves the conversion of water from a liquid to a vapor state. The rate at which these processes of water absorption, translocation, and transpiration occur are strongly influenced by the environment surrounding the plant.

Only 1 to 3% of the water absorbed by the plant is actually used in metabolic-growth processes. The remainder is lost to the atmosphere by the process of transpiration. However, this is not a complete loss in that the transpirational process cools the leaf surface and thus avoids a build up of heat to lethal temperatures. The evapo-transpiration rate of a turf is greater than the evaporation rate from bare soil.

The Transpiration Process

In order to fully understand the imp ications of various environmental and cultural factors that affect the water use rate, one must first understand the basic process of transpiration. Most of the transpiration occurs through the leaves, although it can occur through stems in limited amounts. Transpiration is of two types: cuticular and stomatal.

Cuticular transpiration occurs directly through the epidermal cells of the leaf, with the rate varying directly in relation to the thickness of the cuticle, which is the wax-like layer on the leaf. This form of transpiration occurs on a continuous basis at relatively low levels.

Stomatal transpiration occurs through small structures distributed across the leaf surface, termed stomata, which are essentally pores with an underlying cavity (Figure 1). The conversion of water from a liquid to a vapor state occurs along the mesophyll cell surface of the inner stomatal cavity. Subsequently, the water vapor diffuses through the cavity and outward into the atmosphere. Although these stomatal pores represent only 2 to 3% of the total leaf surface area, they can be responsible for as much as 90% of the total water transpired from the leaf. Stomatal transpiration is limited to the daylight hours since light is required to stimulate opening of the stomata.

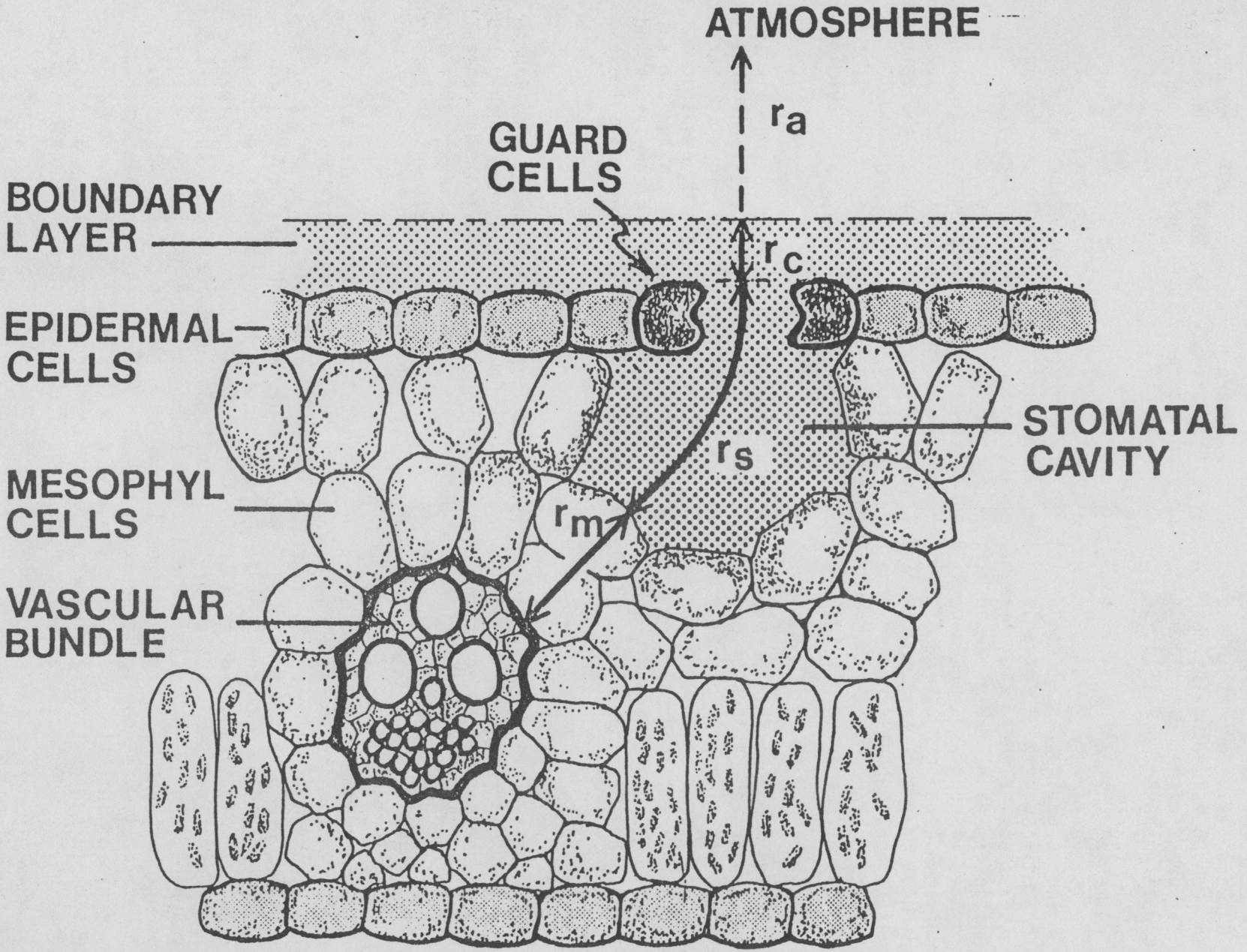

Figure 1. Cross sectional drawing of a leaf through a stomate.

The process of stomatal transpiration is driven by a vapor pressure gradient. The outward diffusion rate of water vapor is dependent on the relative amounts of water vapor outside the leaf versus that within the stomatal cavity. The greater the differential between these two water vapor contents, the more rapid the outward water movement by diffusion.

Environmental Influences

From an environmental standpoint, any factor that increases the water vapor content will suppress the transpiration rate. Environmental factors enhancing transpiration include a low atmospheric water vapor content, moderate wind velocities, medium to high temperatures, and full sunlight, while cool, cloudy humid days without wind movement will suppress water loss by transpiraiton. The former condition increases the liklihood of an internal water deficit and subsequent wilt of a turf that would necessitate irrigation. In contrast, the latter situation would greatly reduce transpiration, which is desirable from a water conservation standpoint. However, if combined with relatively high temperatures it could adversely restrict the transpirational cooling process, thus resulting in heat stress to the grass.

A high atmospheric water vapor level surrounding the leaves is more likely to occur under conditions of poor soil water drainage and/or excessive irrigation. The water vapor level is further accentuated by positioning turfs in sites surrounded by trees, shrubs, and/or hills which restrict normal air movement across the area. From this discussion one can conclude that the specific water use rate of a particular turf may vary significantly depending on the site conditions and cultural practices that affect the enfironment surrounding the turfgrass leaves.

Water Use Rates

The total annual water use rate (WUR) increases in proportion to the length of the growing season. Within a growing season, conditions that favor rapid shoot growth and transpiration cause an increase in the WUR. Thus maximum WUR generally occur in midsummer in most regions and decline to relatively low levels during the winter. On a daily basis, higher WUR typically occur under conditions of full sun, high temperature, low atmospheric humidity, and moderate wind.

These environmental factors not only affect the rate at which the evapotranspiration process occurs, but also affect the basic morphology and physiology of the plant that influence the water use rate. For example, the percent water loss from a creeping bentgrass turf is reduced by almost 50% as the light intensity is reduced from full sunlight to a low intensity found under a very dense tree canopy. This reduction in WUR is highly correlated with a reduced leaf stomatal density caused by the low light conditions under which the turfgrass leaves were formed. A similar response was found when the growing temperature of creeping bentgrass was increased from 50° to 70° F (10° to 21° C). This 20° F (11° C) increase in growing temperature caused a 25% increase in water loss and an associated increase in the leaf stomatal density. It is evident from these data that turfgrasses growing under suboptimal temperatures and/or shaded conditions will have a substantially reduced WUR. Thus irrigation practices need to be adjusted accordingly for optimum water conservation.

Cultural Effects

The effects of specific cultural practices on the water use rate (WUR) are not fully understood for each turfgrass species. However, based on our current level of knowledge some general guidelines can be presented.

The height of cut selected can have a strong influence on the WUR of turfs. The WUR was doubled as the mowing height was increased from 0.25 to 1 to 5 inches (0.6 to 2.5 to 12.7 cm). This response was caused by the increased leaf area from which evapotranspiraiton occurred, combined with a more extensive root system that enhanced the water absorption capability needed to support the higher evapotranspiration rate.

The water use rate also is influenced by the mowing frequency. As the mowing frequency of creeping bentgrass was increased from bi-weekly to weekly to six times per week, the WUR increased 41%. This response was most probably the result of an increased duration when the mower wounds were exposed, thereby increasing the evaporation component of WUR.

Similar effects can be demonstrated from a nitrogen nutritional standpoint. Typically, turfs receiving modest nitrogen fertilization will have a lower leaf extension rate and, thus, a lower water use rate. As the nitrogen nutritional level is increased, the WUR increases proportionally with the increasing leaf extension rate and associated leaf area. However, WUR may decline at excessive nitrogen nutritional levels due to a significant reduction in the depth and number of roots.

A third cultural factor influencing the water use rate is the irrigation frequency. Soils which are irrigated to maintaina moist to wet condition tend to have an increased WUR. Studies have shown that irrigations scheduled three times per week versus only when the turf visually wilts resulted in a 33% increase in the WUR when irrigated three times per week. Thus adjustments in specific irrigation practices can affect the water use requirements of turfs.

The extent of water conservation that can be achieved with any one of these cultural practices on a particular species is not known as adequate data are not yet available. However, the relative responses reported should be comparable.

Turfgrass Species and Cultivar Effects

Specific information concerning the comparative water use rates among various turfgrass species is just now evolving. Generally, turfgrass species that have a lower shoot density, a more erect leaf orientation, a wider leaf, a more rapid vertical leaf extension rate, and/or a higher cutting height requirement also possess a higher water use rate. Among the cool season turfgrass species, the fine leafed fescues have a lower water use rate in comparison to the creeping bentgrasses, bluegrasses, and ryegrasses (Table 1). Among the warm season turfgrass species, buffallograss, centipedegrass, and bermudagrass have much lower water use rates than either St. Augustinegrass of seashore paspalum. These

Table 1. The comparative potential evapotranspiration rates (water use rates) of the major cool and warm season turfgrasses when grown in their respective climatic regions of adaptation and proper culture regime, including irrigation.

Relative Ranking	Turfgrass	
	Cool season	Warm Season*
Very low		Buffalograss Centipedegrass
Low		Bermudagrass Zoysiagrass Grama Bahiagrass
Medium	Hard fescue Chewings fescue Red fescue	Bahiagrass Seashore paspalum St. Augustinegrass
High	Perennial ryegrass Tall fescue	
Very high	Rough bluegrass Annual bluegrass Creeping bentgrass Kentucky bluegrass Italian ryegrass	

* After K. Kim and J. Beard.

rankings are based on the grasses being grown under their respective preferred climatic and cultural regimes. Cutting heights and nitrogen levels that diverge substantially from the optimums can cause shifts in the WUR rankings. Also, keep in mind that the water use rate is not necessarily related to the drought resistance of a turfgrass species.

Differences also exist among cultivars within each species, as reported by Beard et al. for Kentucky bluegrass. However, the specific water use rate differentials are not yet documented for each species. Considerable research is now underway to generate information concerning the specific water use rates of the commonly used turfgrass species and cultivars. The next few years will be characterized by a major research thrust in this vital area. For example, a major water conservation research program is underway within the Texas Agricultural Experiment Station that encompasses a breeding dimension as well as the stress physiology and cultural aspects. This research supported by the United States Golf Association will be especially critical in contributing to enhanced water conservation during the 1990's and beyond.

Suppressing Transpiration

Another approach to water conservation is the use of techniques that reduce transpirational water loss through stomatal openings in leaves. There is considerable interest in a range of materials for this use. For example, there has been success with coatings sprayed upon the leaves of transplanted ornamental plants. These include both plastic and wax-type coating materials. However, such coatings have not proven effective on actively growing turfgrasses since the period of effectiveness is short-lived due to the frequent mowing practiced on most turfs. Another approach involves the application of an antitranspirant chemical which causes closure of the stomata. Phenyl mercury acetate (PMA) and several other experimental materials have shown a degree of effectiveness in stomatal closure under controlled conditions on non-turf species. Scientific documentation that these antitranspirants reduce the water use rates of turfgrasses is lacking.

More recently, Drs. Johns and Beard at Texas A&M University have demonstrated in principle that certain types of growth regulators have potential for use in water conservation on turfs. Specifically, flurprimidol (Cutless®) and mefluidide (Embark®) reduced the water use rates from St. Augustinegrass and bermudagrass turfs in the order of 20 to 35% for a 12-14 week period.

Maximum Water Absorption By Roots

Cultural practices that maximize the rooting depth will enable turfs to absorb moisture from a greater portion of the soil profile, thus delaying the onset of drought stress. There are environmental and cultural factors which the turf manager can manipulate to ensure as deep a root system as possible. They are summarized as follows:

- Soil Environmental Factors:

-- Temperature - Root growth of cool season turfgrasses is greatest at soil temperatures of 50-60° F (10-16° C), while the root growth of warm season turfgrasses is most active in the 75-85° F (24-30° C) range. Soil temperatures above 77° F (25° C) cause the cessation of root initiation from cool season turfgrasses plus the loss of existing roots by increased maturation.

-- Soil pH - Root growth is seriously restricted and root functions limited at soil pH's below 5.6 and above 7.4. Soil tests at 1-3 year intervals should be utilized to monitor the trend in soil pH. Ground agricultural limestone (calcium carbonate) may be used to raise the pH, and a sulphur-containing material to lower the pH.

-- Compaction - Compaction problems are associated with an increased soil density which results in impaired water movement into and through the soil. Existing soil compaction problems can be partially alleviated by coring or slicing in multiple directions. In the case of intensively trafficked areas such as greens and sports fields, a preventive approach involving root zone modification is preferred. Sand is the most common coarse textured material utilized in root zone modification. However, the sand selected must be of the proper particle size distribution and must be mixed off-site in the proper portions with the existing local soil, based on the analyses and recommendations of a reputable physical soil testing laboratory. Alternatives to sand which can be used where costs are competitive include calcined clay of the proper firing intensity and expanded shale. Other materials which may be available locally include waste-ash or blast furnace slag. These are industrial by-products which can be utilized in soil modification, if free of potentially toxic materials, excessive salt levels, and/or improper pH levels.

-- Waterlogging - Waterlogging fills the soil pores with water and thus causes problems due to the elimination of adequate oxygen levels needed for shoot growth and general turfgrass health. One or a combination of conditions can produce a waterlogging problem, including the following: (a) Improper surface drainage. A slope of 1% is minimal with 2% or more preferred; (b) Improper subsurface drainage. In many situations this condition can be corrected through the use of a subsurface drain line system, with french drains, dry wells, and surface catch basins also being installed as needed; (c) Excessive irrigation. This may involve scheduling irrigations too frequently or applying the water at an excessive rate in relation to the infiltration rate of soil; and (d) Excessive rainfall.

-- Lack of Oxygen -- Roots require oxygen for maintenance of their life processes and for continued growth. Soil compaction and waterlogging can seriously limit the soil oxygen level.

-- Toxic Gases - Anaerobic conditions, formed under waterlogged soils, can produce gases and related compounds that are toxic to grass roots.

-- Toxic Herbicides - Some preemergent herbicides have a degree of toxicity to turfgrass roots. These effects may not be evident in terms of above ground shoot growth under normal growing conditions, but can become quite striking during water stress periods when the lack of a root system restricts water absorption. Thus, a herbicide should be applied only as needed to correct a potentially serious weed problem.

-- Salinity and Sodic Soils - Adverse soil salinity levels cause a reduction in turfgrass rooting that is expressed through increased proneness to wilt symptoms. The development of a salinity problem is best prevented by applications of water at a rate greater than the evapotranspiration rate. This approach is required so that the salts are constantly being leached downward through the soil profile to depths below the upper 8-12 inches (20-30 cm), since a major portion of the turfgrass root system is located above this. Subsurface drainage facilitates this approach. Sodic salts are best corrected by an application of sodium or gypsum, preferably by incorporation, followed by downward leaching of the sodium after its displacement from the clay particles.

-- Insect, Nematode, and Disease Injury - There is a whole range of pests which can feed actively on root systems causing serious damage. White grubs and wire worms are particularly damaging to roots. The apppropriate pesticide should be applied to correct the target pest problem when a serious problem starts to develop rather than as a broad spectrum protectant.

-- Hydrophobic Soils -This problem is caused by a surface physical condition on the soil particles which causes them to repel water. It is particularly common on sandy soils and may be associated with soil fungi activity. It is best prevented or corrected by the application of certain effective wetting agents such as AquaGro® and HydroWet®. Effectiveness is maximized by watering in the wetting agent immediately after application.

- Cultural Factors:

-- Cutting Height - As the cutting height is lowered the depth and extent of rooting is restricted proportionally due to a decrease in leaf area available for photosynthesis. Cutting heights of one inch (2.5 cm) or less are especially detrimental to deep rootings.

-- Excessive Nitrogen Fertility - Excessive nitrogen applications that force leaf growth cause the reserve carbohydrates to be drawn from the roots and may result in death of the root system. For this reason, an individual nitrogen application should not exceed 1 pound of nitrogen per 1,000 square feet (0.5 kg are^{-1}) as a water soluble carrier or its equivalent rate as a slow release carrier. The latter is dictated by the percentage of nitrogen that is immediately released for shoot growth. High quality putting green turfs are maintained at a much lower rate, usually not exceeding 0.3 pound of nitrogen per 1,000 square feet (0.15 kg are^{-1}) of a water soluble nitrogen carrier or equivalent as a slow release carrier.

-- Deficiencies of Phosphorus and Potassium - These two nutrients have a striking effect in enhancing root growth and should be maintained at adequate available soil levels. Soil tests conducted at 1-3 year intervals should be used to establish proper base levels of both nutrients. Also, additional potassium should be applied at a rate that is 50-70% of the nitrogen.

-- Excessive Thatch Accumulation - A thatch problem causes an increased percentage of the roots to be concentrated in the thatch layer, thus limiting the zone from which water uptake occurs. For this reason, no more than 0.3 to 0.5 inch (0.7 to 1.3 cm) of mat/thatch should be allowed to accumulate.

Preparing For a Drought

Water availability and water quality are projected to be major limiting factors threatening turfgrass use in the industrialized societies in future years. This developing problem is an even greater threat to the turfgrass industry than that of the world energy shortage or plant nutrient availability. Future projections, particularly for urban areas, indicate that less water will be available for turfgrass and landscape purposes and that the water which is available will be more saline and lower in quality than the present supplies. The increase in salinity and water quality problems will be most apparent in locations which shift to the use of effluent water. In more arid locations and during droughty years, the turfgrass manager may be forced to cease irrigation of certain areas.

Drought develops as a result of an extended period without precipitation, combined with the lack of an irrigation capability and a high evapotranspiration rate. The severity of soil drought is affected by the duration without rain, the evaporative power of the air, and the water retention characteristics of the soil. The frequency with which a soil drought occurs is greater in the more arid western portion of the United States. Localized drought is more severe on the upper portions of slopes where the evapotranspiration rate is increased and the soil water infiltration rate is poor. Droughts are most likely to occur during the midsummer season, although the actual timing of occurrence and frequency are not predictable.

The turfgrass manager has a number of options available to prepare a turf for drought stress. Included are: (a) maximize precipitation effectiveness, (b) select drought resistant species, (c) maximize root absorption of water, and (d) optimize turfgrass hardiness to drought stress.

Maximum Precipitation Effectvieness

Typically, some rainfall occurs during the winter and spring period prior to the onset of a drought. Thus it is important to maximize the amount of available water that enters the soil rather than being lost by surface runoff. Soil cultivation, such as coring, slicing, or spiking, is utilized to ensure surface soil conditons that are receptive for maximum soil water penetration. Such an approach is particularly helpful on sloping areas where water loss by runoff is greatest.

In some cases, a limited supply of irrigation water may be available for use at the discretion of the turf manager. In such situations there are other considerations in addition to maximizing the precipitation effectiveness. A key concern in this regard is that the irrigation water be applied at the proper rate and as uniformly as possible. The turfgrass manager should check to be sure the water application rate is adjusted for each distinctly different turfgrass area being maintained. The water use rate is typically in the range of 0.1 to 0.3 inch per day (2.5 to 35. mm d^{-1}) with rates as high as 0.45 inch (11. cm) occurring in regions where the evaporative demand is extremely high. The manager also should check to be sure that each sprinkler is applying the water uniformly. Finally, each irrigation should be scheduled so that (a) the water is applied under low wind conditions in order to ensure adequate uniformity of application and (b) the water is applied during periods when evaporative losses will be minimal. These conditions are most likely to occur in the predawn nocturnal period.

Selection of Drought Resistant Species

Turfgrass species vary greatly in their relative resistance to drought stress (Table 2). Where one knows prior to establishment that the area will not be irrigated or that the capability to irrigate will be limited, it is usually advisable to consider the use of a more drought resistant turfgrass species. Buffalograss and bermudagrass are warm season C_4 grasses known for superior drought resistance. Unfortunately, the comparative drought resistance of the more recently released turfgrass cultivars is not yet documented. Hopefully, specific cultivar information will be generated from current turfgrass research within the near future.

Optimum Turfgrass Hardiness to Drought Stress

The inherent internal physiological hardiness of turfgrasses to water stress may be affected by the cultural practices employed. Slow growing tissues possessing a small cell size and a high carbohydrate content are more drought hardy. Thus cultural practices that avoid excessive shoot growth stimulation will result in increased drought hardiness. Factors that enhance drought hardiness include: (a) adequate potassium levels, (b) moderate to low nitrogen fertilization rates, (c) moderate to low intensity of irrigation, and (4) full sunlight conditions. The same cultural practices also maximize turfgrass hardiness to heat stress, which is frequently associated with summer drought stress. There are a number of cultural practices that the turf manager can apply to delay the onset of drought stress and, should drought stress occur, produce a turfgrass plant that has the best potential to survive the drought stress. A brown, dormant turf possessing a healthy lateral stem system is not dead. Rather, such a turf possesses the recuperative potential to initiate new growth after the occurrence of the first significant rainfall.

Table 2. The comparative drought resistance of 22 turfgrown in their respective climatic regions of adaptation and proper cultural regime.

Relative Ranking	Turfgrass	
	Cool season	Warm Season*
Excellent		Buffalograss Bahiagrass Bermudagrass (*C. dactylon*)
Very good		Bermudagrass hybrids Centipedegrass
Good	Turf alkaligrass	St. Augustinegrass Seashore paspalum
Medium	Fairway wheatgrass Kentucky bluegrass Tall fescue	Zoysiagrass
Fair	Hard fescue Chewings fescue Red fescue	
Poor	Colonial bentgrass Creeping bentgrass	
Very poor	Italian ryegrass Annual bluegrass Rough bluegrass	

* After K. Kim and J. Beard.

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Nutritional Strategies for Summer Heat and Drought Tolerance

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The degree of tolerance which turfgrasses have to summer heat and drought stresses is influenced by the nutritional strategies employed by the turfgrass manager. A turfgrass possessing optimum heat and drought tolerances typically has been grown under a nutritional strategy that results in (1) the most deep, extensive root system possible, (2) a modest shoot growth rate that avoids an excessive tissue water content or hydration level, and (3) a relatively high level of carbohydrate reserves. The two nutrients of most concern are nitrogen (N) and potassium (K).

Nitrogen. In terms of nitrogen, a base level is required for adequate root growth and turfgrass color. Above this base level, the primary effect of nitrogen is to further increase shoot growth and density. Allied with the rapid shoot growth rate caused by a high nitrogen level is exhaustion of the shoot carbohydrate reserves and an increase in succulence or water content. Such shoot tissues have a reduced hardiness to heat and drought stresses. As a result, the best nutritional strategy for turfs entering a period of anticipated heat and/or drought stresses is to maintain only a sufficient nitrogen level to sustain adequate root growth and a medium green turfgrass color.

The specific rate of nitrogen required will vary with the turfgrass species and their inherent heat and drought tolerances. For example, bermudagrass will tolerate a higher nitrogen level under heat and drought stresses than most turfgrass species. In addition, the summer rainfall and irrigation regime practiced can significantly alter the upper nitrogen limit. Essentially turfs subjected to a higher rainfall and/or intense irrigation have a more rapid growth rate and therefore a higher nutritional requirement; plus there is greater leaching of nitrogen downward through the soil profile. The nitrogen application rate for general turf areas should not exceed 1.0 pound per 1,000 square feet of a water soluble carrier per individual application. On greens and similar high maintence turfs where flushes of shoot growth are to be avoided, the nitrogen rate should not exceed 0.3 pound per 1,000 square feet of water soluble nitrogen per individual application.

Potassium. The turfgrass response to potassium usually is not visually expressed in terms of color, shoot growth rate, or shoot density, which are the typical characteristics commonly utilized to assess turfgrass quality. Rather, the effects of potassium nutrition are more subtle and have a different response to increasing application rates than that just discussed for nitrogen. In the case of potassium, the degree of heat and drought tolerance increases in direct proportion to the level of potassium. The response is associated with an enhanced root system which aids in minimizing or avoiding drought stress, plus sustaining transpirational cooling. In ddition, potassium enhances the inherent internal tissue tolerances to heat and drought by physiological mechanisms that are not yet entirely understood.

Current research indicates that stress tolerance responses to potassium can be sustained at a level in the order of 50 to 75% that of the nitrogen application rate. In most cases, the higher 70-75% range results in the best response, with some data suggesting that a 1-1 ratio of nitrogen to potassium may give an even further response in certain specific soil conditions. The best overall response to potassium is achieved by sustaining the higher level throughout the year, rather than applying it only just prior to anticipated periods of environmental stress.

It should be further understood that a healthy deep rooted turf developed during the spring growing season will greatly aid summer tolerance to heat and drought. A high potassium level in the order of 50-75% of the nitrogen rate should be sustained during the spring period. In addition, forcing shoot growth via higher nitrogen applications during the spring period should be avoided as it may cause reduced summer tolerance to heat and drought stresses.

Other Nutrients. Most of the other essential plant nutrients should be maintained in the adequate range to avoid nutrient deficiencies and thereby ensure proper overall plant health. The key is to avoid excessively low levels that produce severe visual shoot deficiency symptoms. For example, there is no evidence that higher phosphorus levels enhance heat or drought tolerance other than the amount needed to sustain adequate soil levels based on soil test results. In contrast, responses to potassium are achieved well above the soil test level that is generally considered very high. There is one micronutrient, iron, that has been shown to enhance tolerance to water stress under the higher nitrogen levels used on putting greens. Research information is still being generated on this concept.

In concluding this discussion of summer nutritional strategies, it should be pointed out that even when the proper nutritional levels are maintained, especially nitrogen and potassium, there will still be times when the environmental stress is so severe that turf injury occurs.

Winterkill of Cool Season Turfs: Diagnosis, Causes, and Prevention

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Now is the time to start considering a strategy in case turfgrass damage occurs during the winter. Winterkill encompasses all types of damage that occur to turfgrasses during the winter period. It can occur on both cool and warm season turfgrasses, primarily in the northern portions of the cool and warm climatic regions for each group of species, respectively. The major types of winter injury are (1) desiccation, (2) direct low temperature, (3) low temperature diseases, and (4) traffic effects. Note that ice sheet damage caused

by hypothetical oxygen suffocation or toxic gas accumulation underneath an ice sheet is not listed. Winter injury associated with an extended period of ice coverage more commonly occurs during the freezing or the thawing period when standing water increases the crown tissue hydration level. Subsequent injury to the turfgrass plant results if temperatures drop rapidly to below 25°F.

Winter injury of turfs is difficult to interpret because it frequently results from the interaction of several environmental, soil, and cultural factors. If winter injury is suspected, the turfgrass manager should first determine (1) that actual injury has occurred to the turf, (2) the specific cause of the injury, and (3) the turfgrass species, soil conditions, or cultural practices that need to be adjusted to minimize the chance for injury to reoccur in the future. Guidelines in making these diagnoses are presented in Table 1, while the practices available to minimize winterkill in the future are prsented in Table 2.

Assessing the Extent of Winter Injury.

As more favorable temperature and moisture conditions occur signaling the initiation of spring greenup one needs to assess whether winter injury has occurred. This is necessary so that the appropriate renovation and replanting steps can be initiated as soon as possible. In this regard, lead time is required to plan and purchase the appropriate planting materials and to prepare the needed equipment. Two diagnostic approaches can be utilized.

There is a diagnostic technique which can be done well in advance of greenup. It involves collecting five to eight turf plugs from areas where winter injury is suspected and placing them in a greenhouse or under similar conditions of favorable light, temperature, and moisture so that greenup of the surviving turf can be induced artificially. This gives an indication of the potential turf survival of the area, assuming a representative set of turf plugs have been collected. This approach is essentially a biological indicator which the turf manager can utilize to obtain a preliminary assessment of whether turfgrass injury has occurred.

A second approach is to collect individual plants from the turf being assessed for low temperature injury. This diagnostic procedure involves removal of the outer dead leaf sheaths surrounding the plant crown, cutting a longitudinal section or slice through the crown using a razor blade or sharp knife, and then examining the crown area under a 10x magnifying lens. Firm, white crown tissue with turgid cells indicates a healthy crown meristamatic area that has survived the cold stress. Crowns which have turned brownish or dark colored with a mushy appearance (flaccid cells) have experienced extensive low temperature injury. The crown tissue is the critical area to examine for low temeprature injury. A turf can lose all the leaves and roots from winter injury and still recover as long as the meristamatic areas in the basal crown of shoots and in the nodes of lateral stems, either rhizomes or stolons, survive the stress. These meristematic zones are capable of reinitiating both shoot and root growth once favorable spring growing conditions occur.

Table 1. Types, symptoms, and causes of winter injury that commonly occur on turfs.

Type of winter injury	Symptoms	Cause of injury	
		External	Internal
A. Desiccation			
Atmospheric	Leaves turn distinctly white but remain erect; occurs most commonly on elevated sites that are more exposed to drying winds; can range from small irregular patches to extensive kill of large areas.	A drying atmospheric environment, including high winds and low humidity; in addition, soil water absorption is reduced at low temperatures or may be inoperative because the soil is frozen.	Desiccation of the plant causes shrinkage and collapse of the protoplasm that results in mechanical damage and death of the vital cellular components.
Soil	Leaves turn distincly white and are semi-erect; the tissues including the crown are very dry; commonly occurs in a more extensive pattern over the turf than does atmospheric desiccation.	Extended period of soil drought due to a drying atmospheric environment and lack of precipitation or irrigation.	(Same as above)
B. Direct low temperature kill	Leaves initially appear water-soaked, turning whitish-brown and progressing to a dark brown; the leaves are limp and tend to lay as a mat over the soil; a distinct putrid odor may be evident; occurs most commonly in poorly drained areas such as soil depressions; frequently appear as large, irregular patches.	A rapid decrease in temperature, particularly the adjacent soil temperature; kill most commonly occurs during late winter freezing and thawing periods; may be associated with thawing of an ice cover from the underside.	Large ice crystals form within the plant tissues which cause direct or indirect mechanical destruction of the frozen, brittle protoplasm; the higher the water content of the tissue, the larger the ice crystals and more severe the kill.

Table 1. (cont.) Types, symptoms, and causes of winter injury that commonly occur on turfs.

Type of winter injury	Symptoms	Cause of injury	
		External	Internal
C. Low temperature diseases:			
Fusarium patch (pink snow mold)	Pink mycelium on leaves; 1 to 2 inch, tan, circular patches (in fall); or white mycelial mass on leaves, white to pink circular patches up to 2 feet in diameter (in winter/spring).	Gerlacha nivalis; turfgrass temperatures of 32 to 40°F and moist conditions provide a favorable environment.	Parasitic action of fungus.
Typhula blight (gray snow mold)	Light gray mycelium on leaves, especially at the margins of the advancing ring; whitish-gray, slimy, circular patches of up to 2 feet in diameter; brown sclerotia are embedded in the leaves and crowns, ranging up to 1/8 inch in diameter.	Typhula itona, T. idahoenis, or T. ishikariensis; favored by turfgrass temperatures of 32 to 40°F, usually under a snow or ice cover, especially during thaws.	Parasitic action of fungus.
Cottony snow mold (LTB and SLTB)	Light gray, matted mycelial growth may be evident on leaves; irregular shaped patches initially appear yellow and gradually deteriorate to a straw color; individual patches up to 1 foot in diameter may coalesce causing damage over a large area.	Coprinus psychromorbidus, a low temperature Basidiomycete; favored by turfgrass temperatures of 28 to 32°F, especially under a snow cover.	Injury results from hydrogen cyanide gas produced by the saphrophytic fungus; subsequently the fungus invades the host plant.

Table 1. (cont.) Types, symptoms, and causes of winter injury that commonly occur on turfs.

Type of winter injury	Symptoms	Cause of injury	
		External	Internal
D. Traffic			
On frozen turf grass leaves.	Erect, white to light-tan dead leaves; appears in the shape of the footprints or wheels where they have been impressed onto the turf.	Pressure of traffic (shoes) or wheels) on the rigid, frozen tissues; problem most commonly occurs during the early morning hours.	Disruption of the frozen, brittle protoplasm by ice crystals surrounding and extending into the plant cells.
On wet, slush	Leaves initially appear water-soaked turning whitish-brown and progressing to a dark brown; the leaves are limp and tend to lay as a mat over the soil; appears in irregular shapes associated with previous patterns on concentrated traffic; soil rutting may also be evident.	Snow cover thaws to a slushy condition causing increased hydration of the turfgrass crowns; traffic, including skis and snowmobiles, force the wet slush into intimate contact with the turfgrass crowns; kill most commonly occurs if this event is followed by a decrease in temperature to below 20°F.	Not completely understood, but related to the direct low temperature kill mechanism.

Table 2. Practices available to minimize winter injury on turfs.

Type of winter injury	Cultural practices that minimize injury: Turfgrass	Cultural practices that minimize injury: Soil	Specific protectants	Turfgrass species most commonly affected
A. Desiccation:				
Atmospheric	-Moderate nitrogen nutritional levels. -Elimination of any thatch problem	-Do not core in late fall and leave the holes open.	-Synthetic winter protection covers. -Polyethylene sheets (4-6 mil). -Saran Shade Cloth (94%) -Topdressing (0.4 cu.yd/ 1000 sq.ft.) -Windbreaks such as snow fench, brush, or ornamental trees & shrubs. -Natural organic mulches.	All species
Soil	-Provide moderate nitrogen nutritional levels. -Irrigate or haul water to critical sites.	(Same as above)	(Same as above)	All species
B. Direct low temperature kill	-Provide moderate nitrogen nutritional levels. -Provide high potassium nutritional levels. -Provide higher cutting heights. -Eliminate any thatch problem. -Avoid excessive irrigation.	-Provide rapid surface drainage by proper contours, ditches, and open catch basins. -Provide adequate subsurface drainage by drain lines, soil modification with coarse textured materials, slit trenches, and dry wells.	-Synthetic winter protection covers. -Soil Retention Mat -Enhancing snow cover with snow fence or brush. -Organic mulches such as straw. -Soil warming by electricity.	Annual bluegrass Fescues Ryegrasses

Table 2 (cont.) Practices available to minimize winter injury on turfs

Type of winter injury	Cultural practices that minimize injury: Turfgrass	Cultural practices that minimize injury: Soil	Specific protectants	Turfgrass species most commonly affected
C. Low temperature diseases:				
Fusarium patch	-Provide moderate nitrogen nutritional levels. -Provide high potassium and iron nutritional levels. -Provide moderate to low cutting heights. -Eliminate any thatch problem.	-Avoid neutral to alkaline soil pH's.	Mancozeb, iprodione, benomyl, thiophanate-ethyl + thiram, PMA, PCNB, thiram, thiophanate-methyl + mancozeb, triadimefon. or thiram + PMA; mercury chlordies are for putting green use only.	Annual bluegrass Bentgrasses Fescues Kentucky bluegrass Ryegrasses
Typhula blight	-Provide moderate nitrogen nutritional levels. -Provide moderate to low cutting heights. -Eliminate any thatch problem.	-Provide good surface & subsurface drainage. -Cultivate when compaction is a problem.	Cadmium compounds. anilazine, thiram, chloroneb, iprodione, thiophante-ethyl, + thiram, thiram + PMA. pr triadimefon. For golf greens only: merchur chlorides, PCNB, or PMA.	Annual bluegrass Bentgrasses
Cottonly snow mold	-Eliminate any thatch problem. -Provide moderate nitrogen nutritional levels (late summer-fall).	-Provide good surface and subsurface drainage.	Mercury chlorides or thiram+cadmium compounds; PCNB labeled for use in Canada.	Annual bluegrass Bentgrasses Fine fescues Kentucky bluegrass

Table 2 (cont.) Practices available to minimize winter injury on turfs.

Type of winter injury	Cultural practices that minimize injury: Turfgrass	Cultural practices that minimize injury: Soil	Specific protectants	Turfgrass species most commonly affected
D. Traffic	Apply a light application of water in early morning; this is most effective when the soil is not frozen and the air temperature is above freezing.		Withhold or divert traffic from turfgrass areas during period when the leaf and stem tissues are frozen.	All species
On wet, slush-covered turf		Dig drainage ways through pseudo-ice or snow dams to provide surface drainage.	Withhold traffic on turfgrass areas during wet, slushy conditions, especially if a drastic freeze is anticipated.	All species

Pesticides

Some individuals have been guilty of misuse of pesticides in the past. There was a need for use restrictions and educational programs to avoid potential problems in the future. This resulted in formation of the Environmental Protection Agency whose primary emphasis to date has been on environmental impacts. We have seen the elimination of many pesticides which are not rapidly biodegradable. The lack of persistent soil active insecticides, such as the chlorinated hydrocarbons, has led to a substantial increase in white grub problems across the United States. Now , most costly programs and diagnostic procedures must be developed through integrated pest management programs to alleviate this and similar pest problems in the future.

Governmental controls have also greatly increased the cost of developing and registering a new pesticide. Knowledgeable specialsts in this field indicate that there may be no new pesticides developed specifically for turf use in the future. Most pesticides that do become available for turf use will be spinoffs from the agricultural industries. Thus, during the 1980's, we may have only two to four prominent new turf pesticides developed. At the same time, the EPA may remove registration approval for more turf pesticides than that. There is also the problem of escalating costs for pesticides which is projected to continue at a rate of 25 to 30% annually. What are the trends?

1. Few pesticides available to the turf industry.
2. Costs increasing substantially.
3. Tighter controls on pesticide use.
4. Emphasis on selective control rather than broad spectrum applications.
5. Increasing employee awareness regarding safe handling of pesticides through training programs.

In summary, we will need increased efficiency when applying pesticides, yet retaining adequate safety standards. Pesticide usage will be practiced only as needed to control a serious, threatening problem pest.

Nutrients

For the most part, fertilizers will be subjected to the same trends as pesticides. That includes increased cost, more restrictions on use, and reduced application rates. Lower nitrogen levels will be used along with increasing rates of iron and potassium application relative to the nitrogen application rate. This translates to a more controlled shoot growth rate. Through research, there will be further improvements in the development of slow release nutrient carriers to extend the longevity of release and thus reduce nutrient leaching losses. Emphasis on maximizing the efficiency of nutrient utilization will also be achieved through other techniques such as the use of mulching mowers for recycling of nutrients. Research will also emphasize the development of cultivars with lower nutrient requirements, yet at the same time retaining their important functional characteristics.

Equipment

Information from leaders in the equipment field indicate no major innovative breakthroughs in mowing equipment can be anticipated in the 1980's. Such statements may be dictated by the need to maintain secrecy even if there were some innovate concepts in the formative stages. Trends that are indicated include increased use of mulching mowers, better equipment for improved efficiency in pesticide and nutrient application, and increased use of diesel engines. All turfgrass equipment will experience a substantial increase in cost throughout the 1980's. Thus there will be even greater emphasis on extending the operating life of this equipment through good preventive maintenance. Such programs translate to the hiring of a well trained mechanic and the development of training programs for employees to insure proper equipment operating and maintenance procedures that will maximize the operating life of each unit.

Manpower

The previous five areas of concern have all focused on the need for better trained professional turf managers. They must possess the needed formal knowledge followed by adequate experience to implement the previously mentioned operating efficiencies and conservation of resources. The job opportunities and salaries for such individuals will be better in the 1980's than ever before. Prospective turf managers will also be better educated than before in terms of formal degree programs. Adult educational activities such as state and regional turfgrass conferences will also play an ever-increasing role. Finally, individual turf managers must increase their efforts in developing on-the-job training programs for their employees.

Summary

The key theme throughout the paper is efficiency. This focuses on management, and most specifically, the turf manager. There must be a constant vigil to seek efficiencies in the use of energy, water, pesticides, and labor. Through these efforts, the turf manager will be able to exercise cost controls that will provide a functional, adequate quality turf for the user at the most economical cost and investment in non-renewable terms.

There is also a second key - research. Research will develop new cultivars that will possess a slow vertical shoot growth rate, low water use rate, minimum nutrient requirement, drought hardiness, wear tolerance, disease and insect resistance, and green color retention at low fertility levels. This research will be critically needed by the turfgrass industry during the 1980's and 1990's. All professional turf managers should do their part by articulating and working for the support of research programs around the country.

Some might interpret this paper as being a doom and gloom position. It is not intended to be that at all. It is intended as a realistic assessment of the situation which will stimulate thought on what adjustments need to be made to meet the needs for our changing times. We cannot continue to do things the same way we have for the past 20 or 30 years. We can continue to provide functional, quality turfs for the user which contribute so much to our quality of life in the United States. Achieving this will require more well trained, motivated turfgrass managers than ever before. Thus, from an employment perspective, the demand for good turf managers rather than just "grass cutters" will be greater than ever before. The challenge will be great, but achievable. The future offers excellent opportunities for a well trained, conscientious turf manager.

What's New In Turf Weed Control

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Certain turf weeds have some resistance or tolerance to the herbicides that are available today. This makes it increasingly difficult to meet the continual demand for weed-free turf on golf courses as well as on home lawns.

There are several factors to be considered when a herbicide seems ineffective. Often the herbicide cannot penetrate the plant cell structure where control is obtained. A closer microscopic inspection of a broad leaf weed shows that the surface is not flat, but consists of numerous small cells that have a curved, convex surface. Electron microscopic views of the leaf show the herbicide to be concentrated along the edge of each cell in the small "valleys" created between adjoining cells. As we inspect a cross section of a leaf we shall see that the cell walls are thicker at this point and thus present a stronger barrier to herbicide entry into the plant.

Another contributor to reduced herbicide efficacy is a layer of wax or cuticle on the leaf surface. This layer is almost impenetrable to the herbicide. Sometimes a surfactant is necessary to alter the surface layer and permit the herbicide to penetrate the leaf.

An additional problem is the potential of herbicides to dry or crystallize on a leaf surface before they have had a chance to penetrate. In these dry or crystalline forms they are no longer effective.

A low volume controlled droplet applicator (CDA) has been developed in an effort to increase herbicide efficacy. The low volume, resulting from the use of less water, provides a higher concentration of herbicide. This technique, by producing smaller droplets, all of nearly identical size, also enchances surface cover.

For many years there has been little change in the herbicides available for selective broad leaf weed control. Only recently have we begun to see formulations other than the phenoxy (2,4-D's) and benzoic acids (dicamba) herbicides appear. One of these, Garlon (triclopyr), has been effective when mixed with the phenoxy herbicides in the control of yellow wood sorrel (Oxalis spp). and wild violet (Viola spp.). Another recent introduction to turf in the U.S. from Europe is 'Lontrel', a Dow herbicide containing 3,6-dichloropicolinic acid. It has shown good postemergent activity against many of the weeds tolerant to 2,4-D, 2,4-DB and 2,4-DP.

To date, most of the annual broad leaf weed control in turf is obtained with postemergent applications. In the future this will change to the use of preemergent control. This will be as common as the present preemergent control of annual grass weeds.

There is already evidence of successful preemergent broadleaf weed control. For example, Dacthal serves as a preemergent control of Veronica spp. (speedwell) and Euphorbia spp. (spurge). Newer herbicides, used agriculturally on other crops, such as 'Goal' and 'Cinch', offer a broad range of preemergent broad leaf weed control.

Another new herbicide that is currently being developed for agricultural crops and which offers potential in turf is Telar (Glean or chlorsulfuron). Maloy and Christians, Iowa State University, have obtained selective control of tall fescue in bluegrass at a single rate of 2 oz/A and split rates of 2 + 2 oz/A at a two week interval. There is also some evidence to indicate selective control of Poa annua in bentgrass.

New selective perennial grass weed control herbicides including Hoelon, Poast and Fusilade may also have potential in turf. These herbicides can control perennial grass weeds including quackgrass (Agropyron spp.) amd bermudagrass (Cynodon spp.). There is some evidence that they may selectively control these grass weeds in an established perennial grass turf.

One of the more recent and interesting developments in selective weed control in turf is that of selective suppression of growth without killing the weed. The growth rate is reduced. As a result, the weed is no longer an aggressive, competitive plant. The existing desirable perennial species, which have demonstrated tolerance to the herbicide, are then the more competitive plant and, with proper management, will eventually take over.

A recent example of such selective suppression is demonstrated by the growth regulator 'Cutless' from Elanco. Early tests have shown that Poa annua is much more susceptible than either perennial bluegrass or bentgrass. When 'Cutless' is applied in a mixed stand the Poa annua growth is suppressed. The bluegrass or bentgrass then becomes the more aggressive grass. Our tests at Purdue have shown bentgrass mowed at putting green height to be tolerant of rates as high as 1.5 lbs. ai/A. The concept of selective suppression will apply to other weeds as we identify new products along with tolerant and susceptible plant species.

All the recent herbicide developments mentioned give us reason to be optimistic about future success in broad leaf, annual and perennial grass weed control in turf as well as in other areas.

Budgeting Trends In The 80's

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Objective: To observe budgeting trends for golf

Although it is difficult to compare budgets of different golf courses, it is possible to observe trends that may be taking place within the industry. The purpose of this study was to see if any trends are taking place, and if so, what they are.

Materials and methods used:

- Budgets from nine golf courses in the Midwest
- Reference from Chapter 5, Turf Managers' Handbook
- Study of past material in the industry on budgeting practices

This study would not have been possible without the help of nine superintendents who willingly participated by providing five years of budgets.

Procedure: The following categories of budgets were studied to observe trends:

1. Salaries and wages
2. Chemicals
3. Fertilizer
4. Sand and topdressing
5. Landscaping, tree maintenance and seeds
6. Equipment repair
7. Gas, oil and lubricants
8. Supplies

These eight categories were selected because of the breakdown in the budgets provided. These categories also make up the major portion of any budget and include all the cultural practices that make golf courses beautiful.

Table I

Cost of Salaries and Wages

Club	80	81	82	83	84
A	44.55%	60.20%	51.23%	55.26%	60.61%
B	68.22	75.23	62.65	65.35	67.57
C	68.65	67.64	68.00	70.00	68.00
D	--	47.10	50.50	51.00	52.00
E	56.00	51.27	54.60	56.64	52.56
F	61.40	60.65	57.10	54.00	57.80
G	59.10	60.50	61.50	62.44	63.14
H	53.27	57.96	58.60	51.57	58.70
I	63.40	65.70	63.24	62.00	61.64

Note: All of the categories were computed as above. The figures above are expressed as a percentage of the total budget (i.e., Club A used 44.55% of their total budget for salaries and wages in 1980). After all the figures are computed, an average of the nine clubs is got for each year. All of the following tables are presented with the averages compiled from the nine clubs.

Table I-A

Average Costs of Salaries and Wages

80	81	82	83	84
59.32%	60.79%	58.59%	58.69%	60.22%

Table II

Fertilizer Use

80	81	82	83	84
2.27	2.74	2.86	2.73	2.88

Table III

Chemical Use

80	81	82	83	84
6.10	6.87	7.27	8.18	7.20

Table IV

Sand and Topdressing Use

80	81	82	83	84
1.1	0.9	1.3	1.6	1.8

Table V

Landscaping, Tree Care and Seeds

80	81	82	83	84
1.9	3.3	3.5	3.0	6.4

Table VI

Equipment Repair and Maintenance

80	81	82	83	84
6.6	7.4	7.2	6.6	6.6

Table VII

Gas, Oil and Lubricants

80	81	82	83	84
4.5	4.9	4.5	3.8	3.8

Table VIII

Supplies

80	81	82	83	84
2.5	2.1	2.3	2.0	2.2

Results:

Trends observed in this study:

1. Salaries and wages have remained constant
2, Chemical use has increased considerably
3. Fertilizer use has remained steady
4. A gradual increase in the use of sand and topdressing
5. A big increase with landscaping, tree care and seeds
6. Equipment repair and maintenance is constant
7. Gas, oil and lubricants have decreased slightly
8. The category of supplies has remained constant

Discussion:

Questions that should be asked:

1. What area of chemical use is increasing:
2. How much revenue is used for sand in topdressing
3. With landscaping, how much is devoted to:
    a. Entrance to and clubhouse area
    b. Teeing areas
    c. Beautification of the overall golf course
    d. Tree care, removal and maintenance
    e. Seeds - wild flower seeds, grass seeds, i.e. overseeding

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Sod In The Midwest

Dale Habenicht
H & E Sod Nursery, Markham, Illinois

My association with the sod business dates back 37 years. During the 40's the majority of the sod sold in the Midwest was pasture sod. Several of the larger metropolitan markets such as Chicago and Detroit had nursery grown sod available for sophisticated customers. In 1947, my father and uncle started H & E Sod Nursery near the south Chicago suburb of Tinley Park. Every summer I worked at the sod farm until 1959 when I graduated from Purdue.

Over the past 37 years many changes and innovations have occurred in the growing and harvesting of sod. Initially common Kentucky bluegrass and Toronto C-15 bentgrass were the two types of sod we offered for sale. At that time many homeowners thought a creeping bent lawn was a status symbol. During this era Ryan developed the self-propelled sod cutter. But the sod still had to be cut in lengths and rolled by hand. Each piece then had to be packed on a truck.

During the early 50's Merion bluegrass came onto the market. This grass revolutionized the sod business in the Midwest. It would become the primary sod for the next twenty years. Being resistant to leaf spot and having a dark lush green color, Merion sod had a very strong appeal.

The demand for nursery grown sod grew dramatically during the late 50's. With the need to cut sod faster, new ways of harvesting sod were being tested. Palletizing of sod became a standard in the industry during this time period. Many sod growers began making their own home-made harvesting equipment. First sod rollers came onto the market followed by sod harvesters.

New bluegrass varieties began arriving on the scene during the late 60's. By the early 70's blending of several of the newer elite bluegrass varieties became popular.

Today, most of the sod sold in the Midwest is a blend designed to incorporate disease resistance, esthetic value, and durability. Currently we are marketing approximately 800 acres of irrigated bluegrass sod and 20 acres of bent sod annually. I estimate between 4,000-5,000 acres of sod marketed annually in the Chicago metro market. Strong sod markets also exist in the metropolitan areas of Michigan, Ohio, Minnesota, Wisconsin and Indiana.

Sod For Athletic Turf

William J. Huber
Huber Sod Ranch, Schneider, IN

In our present society, and more so in the future, recreation such as sporting events will play an important role. This importance leads to competition which results in excellence.

Since artificial turf is simply a lower maintenance fascimile and with the poor accident record that has evolved, there is a decided trend away from its use. As a result, there appears to be no substiute on the horizon for natural turf.

In order to achieve this natural beauty, either seeded or sodded fields are needed. In the case of seeding an athletic field, you really have to figure the better part of a year for establishment to the point that it will hold up to the traffic. This would be especially true if rains became a problem. The cost of maintaining the field for a year and the added cost of pushing the grass for its maximum growth appears to be quite expensive. A larger problem seems to be the loss of use and revenue during this period of time.

Since sod is the answer, what is your question? Using sod as your turf surface, you need only figure on one month out of play. After four days from installation you should have good rooting being started. With a PAT System we have achieved 5 inch roots in twenty days.

In the case of baseball fields, the fall is the best time to re-work your field for early spring play, using sod to improve any areas that require complete renewal such as an infield.

In the case of football or soccer fields, the spring is the best time to renovate, using sod as the final step. Any time you renovate a field it is a good opportunity to improve your drainage. In addition to drainage tile, this is the time to aerify and add sand to your subsoil.

Common sense seems to dictate the use of sod to guarantee the results. Now in the case of sod, the soil type on which the sod is grown is of great importance. The idea is to use a soil type that will blend with the subsoil. This will eliminate the stratification that can occur between the sod layer and the subsoil. Huber Ranch Sod Nursery has a sandy loam type soil and from our experience has proved to be the best for athletic applications.

In a very related field we are the exclusive distributor for DuPont's 'Remay' fabrics that show tremendous promise in renovating fields or for use in normal maintenance. The covers are white and porous and are made of spun nylon. The 12 x 100 covers are staked in place with six inch staples which are most necessary over the winter. It would even be economical to seed after a game and then use the covers for a two-week period between games. The concept is that the water and sunshine can move through, and the wind, birds and changing temepratures are kept out. These features allow the sod or seed to grow at peak performance. Since this topic is being covered by Dr. Roberts, I won't spend any more time on it.

Principles In Sports Field Management

Dr. Kent W. Kurtz
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Professional sports field managers have one of the toughest jobs in all of turfgrass management. Parameters are established by the weather and enivornment, unusual demands are made upon the turf each day, people beat on the lowly grass plant, use and abuse set the tone for the beginnign and ending of each working day, and politics interefere with daily routines and dictate the use of the playing surface. Somehow, the playing field is ready for the big game and most often the credit is given to those people with the big titles and much larger salaries.

When the playing surface is viewed from a distant press box or prime view seats by the press, sports announcer, administrator or casual observer, it is often criticized for its color or appearance. Coaches look beyond the superficial surface features and are concrned more with safety, firmness, sound footing, and resiliency, but they do not know how or what is involved to make the field playable.

Many sports turf managers understand and use good sound agronomic principles in their daily operations. But the sad truth is that there are even more individuals who do not have the necessary credentials or backgrounds to successfully carry out their duties. A thorough knowledge and understanding of the basics are not only necessary but essential. Merely being able to grasp certain principles is not enough; one must be able to apply principles and put them into practice.

The successful sports turf manager should know as much as possible about soils, fertilizers, plant nutrition, diseases, insects, and the physiological complexes which interact to either benefit or detract from the aesthetics and playability of the field environment. To achieve success and remain current in the field of sports turf management, grounds workers, supervisors and management personnel need to combine the science of growing turfgrass with the art of maintaining sports turf. The preparation of sports turf for the big event or game requires long, dedicated hours, confidence, patience, perserverance, a sense of humor, the ability to deal with and get along with people, flexibility, more give than take, making quick decisions, swallowing pride, and above all, deriving satisfaction from a job well done as compensation for that extra effort.

Events Leading to the 1985 Rose Bowl Game

The Rose Bowl is located in Pasadena, California. It is a municipal stadium. The city administers all events, maintenance, and activities in and around the Bowl including the operation of a 36-hole public golf course. A maintenance crew of five city employees care for the entire stadium complex and sports field. Since the Rose Bowl accommodates over 100,000 spectators it is in constant demand for numerous events such as football, soccer, mud bogs, motocross, concerts, dances, religious events, movies, television shows, commercials and much more.

Prior to U.C.L.A.'s opening game in the fall of 1983, a new turfgrass was introduced and installed as sod in the Rose Bowl, Seashore paspalum cv. 'Excalibre' (paspalum vaginatum). After a season of use the Excalibre was heavily overseeded with a perennial ryegrass blend just prior to the 1984 Rose Bowl game. Due in part to mismanagement and the competition resulting from the dense canopy and shade from the ryegrass, the Excalibre did not recover well after the Rose Bowl game. The decision was made to overseed the field with 'Olympic' tall fescue to fill in weak areas and provide a tougher surface for the Olympic soccer competition. Several events were held on the field during the spring of 1984, but the event that caused the final demise of the turf was motocross. The heavy equipment used to build the silt and clay roadways caused extensive compaction and damage killing a good poriton of the field.

Less than one month before the Olympic soccer matches, the decision was made to completely replace the field sod. Once the old sod was removed, the surface soil was loosened and four inches of sand was spread evenly over the entire field surface. The field was graded, laser-leveled, and a crown established for surface drainage. Santa Ana hybrid bermudagrass was sodded and follow-up maintenance included fertilization, aerification, sand topdressing and frequent irrigation. The field was in excellent condition for the Olympics. In fact, it received a rating of 98 (100 being best) by the World Soccer Federation.

Once the Olympics ended, the field was maintained with scheduled irrigation, bi-weekly mowing, and monthly applications of a synthetic organic fertilizer for the U.C.L.A. football season. The author was appointed the Rose Bowl Agronomist in October 1984. The first several weeks were difficult because people resist change and the Rose Bowl staff had to accept new ideas, viewpoints, procedures, and learn to use new products that the author initiated or requested. Considerable resistance, distrust and apprehension prevailed. Once the field supervisor decided to apply 1800 lbs. of annual ryegrass seed to the field and after it had been sown, called to ask permission. This obviously created tension but the error was corrected by expending several thousand dollars to correct the playing surface appearance. Once the annual ryegrass germinated, it masked over the richer, darker green Santa Ana bermduagrass with a light, yellow-green color. The week prior to the nationally televised game between U.C.L.A. and U.S.C. the field had eight sections from end zone to end zone completely worn down to the bermudagrass where the U.C.L.A. band had marched and stomped for three straigh hours. The field had to be sprayed with special turf colorant that had a yellow pigment added to its normally light green color. It worked, but the cost was not justified.

Field Preparation for the 1985 Rose Bowl Game

The Rose Bowl field has no internal drainage system and the clay-grown sod further inhibited good moisture penetration. Renovation was initiated following the conclusion of the U.C.L.A. football season in November. To open up the surface of the field, a triplex greens mower outfitted with vertical blades was used to vertical mow the entire field in several directions. All trash and debris were removed with a turf vacuum. The field was aerified with two Greensaires using 1/2 inch tines. All plugs (cores) contained clay and these were removed.

Pregermination of Seed

A perennial ryegrass seed blend was selected for the overseeding; therefore it was necessary to pregerminate over 4,000 pounds of seed. The seed was transferred to burlap sacks and the sacks were suspended into 40 gallon trash cans which were filled with warm water. Seed in the sacks was soaked for eight hours and then removed for eight hours to drip dry. This procedure was repeated for five days with fresh water added after each eight hour increment. A wetting agent, AquaGro, was added to the water on both the fourth and fifth days to swell the seed.

Once the swollen seed exhibited a radicle and small shoot, the seed was combined with a medium grade nursery sand in a concrete mixer and then applied to the field using a topdresser (sand to seed ratio 4:1). Approximately 60 tons of the sand-seed mixture were applied to the field and brushed into the verticut grooves and aerification holes. An additional 60 tons of sand were topdressed over the first application and worked into the field surface with brushes. The field was fertilized and a granular fungicide for control of Phythium was applied.

Following seeding, the weather turned cold and early December saw several days of rain and cloudy weather. Soil temperatures remained at 50°F or lower, restricting germination severely. It was decided to cover the entire field with covers of Remay. The Remay raised the soil temperatures an average of 10°F (to approximately 60°F) which accelerated both seed germination and growth of the grass seedlings. Two weeks later severe Santa Ana winds exceeding 75 mph completely removed the field covers. Even though the ryegrass looked adequate, the decision was made to pregerminate another 2,000 pounds of perennial ryegrass seed and a crash program was instituted on a 24-hour around the clock basis. Temperatures at the stadium dropped to below freezing at night, so propane heaters were rented to heat the press room (70°F) for the seed containers. Procedures described earlier for pregermiantion were repeated,and after six days the swollen seed was hand broadcast over the entire field. The field was re-covered with a new set of field covers that had to be air-expressed from the East coast.

Rainy weather continued and the south end zone and tunnel entrance areas were extremely wet and soggy. Approximately 8,000 square feet of Santa Ana bermudagrass sod was ordered and laid in these areas. The sod was fastened down by shatter core aerification and then rolled. Field covers were finally removed on December 27, 1984.

To enhance the color of the perennial ryegrass, an application of calcium nitrate was applied six days prior to the Rose Bowl game at a rate of 1.0 lbs. of actual N per 1,000 square feet. The field was mowed at 1.0 inch with a triplex reel mower prior to the fertilizer application. Iron sulphate was also sprayed over the entire field on December 30th to increase the greenness of the turfgrass. Intermittent rainfall dampened the field surface the last few days before the game. The rainfall interferred with the painting of logos and yardage markers and lines. To dry up the field surface, the Pasadena Police Department dispatched a helicopter to assist in drying up field moisture.

At one point, three different paint crews were working on the field simultaneously. City painters were spraying yardage lines, numbers and hash marks, the Pasadena Junior Chamber of Commerce were painting the end zones and roses, and the Rose Bowl staff were spr ing green turf colorant along the sidelines and on the newly sodded areas. Weak areas on the field were lightly topdressed with sand dyed green with turf colorants. The green sand served three purposes: 1) to dry up wet areas, 2) to create a dark surface to encourage warmth for new seed germination, and 3) to serve as a cosmetic in concealing problem areas from TV cameras. Calcined aggregates (Turface) were also distributed in wet areas to soak up moisture.

The weather warmed up the weekend prior to the game and continued nice right up to game time (75°F). The grass grew, the morning of the game the field was mowed carefully with a 21 inch rotary mower, the field dried and by game time the paint was set and the field surface was firm. A new geotextile material was placed along the sidelines under both bench areas to take up the wear and tear of the players feet. Geotextile was also placed beneath the plywood roadway built for the field TV cameras. These areas were in perfect condition following the Rose Bowl game and it should be noted that without the use of the Remay and sand topdressings, the field probably would not have been ready on time.

Looking back on the experience it is evident that when a crisis situation exists, people pull together and all work for a common goal. This is exactly what happened and although there were many twelve-hour days and frustrating moments, the end result was a field that held together and provided a safe, aesthetically pleasing surface for the big game. The 1986 Rose Bowl field preparation will be much easier to cope with because we all learned from an adverse experience that cooperation, communication, and team work are the only way to accomplish our common goal of providing a top-notch sports turf.

The Malta Story
Or, What Made The Maltese Cross?

John Souter
Stirling, Scotland

In 1967 Souter (all two of them) were awarded their first contract at Hampden Park, Glasgow, for Queens Park Football Club.

What's more, they have been there ever since and the Park, according to Mr. Jock Stein after the Yugoslav game in September (they won 6-1), was the best it has ever been.

How about that for continuity? Souter have been responsible yearly for the maintenance programme and have installed the drainage slits and underground heating.

In 1984 Souter was appointed on a recommendation from the Rangers Football Club as the "team" to put right the biggest headache in the F.I.F.A. Circuit - the notorious National Stadium at Ta'Qali, Malta.

The original playing surface was opened in December 1980, and it was soon obvious that all was not well. During excessive rain the pitch flooded as they can experience at times up to the equivalent of 7 inches in 24 hours from October to March. The summer, from April to September, is one long drought with temperatures around 100°F.

Levels on the surface 'altered'. Instead of the crown effect they were left with two "bowls" one at each end. With the top zone being clay these held water in the winter and cracked in the summer. The surface was considered dangerous.

After taking levels and preparing the appropriate drawings, the work commenced during April by ploughing and regrading the base to a proper crown. Some 1,600 tonnes of medium/fine sand (125-500 microns) was added to the top zone and ameliorated into the top 4 inches of the existing materials.

Periphery and lateral drainage was then installed, capable of coping with any rainstorm. New outlet manholes were created where the flow rate of water from the pitch could be monitored after rain.

Surface preparation then commenced to create a seed bed. After sowing, the biggest headache was watering and here we required three bore holes with sufficient capacity to cope with the need throughout the summer months.

A SISIS Hydromain was suggested with all the appropriate attachments and this has proved most successful as the surface is spiked three times per week, sand dressed when required. The Ground Staff visited us in Scotland (two of them) during November to be trained in all aspects of maintenance. I would stress that this is the key to the continued satisfaction of a client after a job properly installed.

During the Close Season of 1985 sand slits 10 inches deep and 2-1/2 inches wide and further sand dressings will be the basis of the programme.

Further advisory visits are to be made during the early months of 1985 to ascertain this year's programme.

Reports from Malta are so far good and it looks as if the first surface may be the start of many more on the Island.

As a point of interest, Souter have been involved in the reconstruction and renovation of the following football clubs and stadiums:

Aberdeen
Dundee
Dumbarton
Leicester City
Stirling Albion
Aidrie
Celtic
Arbroath
Partick Thistle
Clyde
Rangers
Dundee United
Motherwell
Liverpool
Ayr
Clydebank
Morton
Hibernian
Kilmarnock

In the Rugby world, Scotland's Grand Slam was achieved on Murrayfield Pitch where renovation works were carried out under the superivision of Jim Thain, the Head Groundsman. Other clubs includ North Section's Chairman, John Adamson's Gordonians pitch, West of Scotland R.F.C., Hutchinsons R.F.C., St. Aloysius R.F.C (the two biggest swamps - now cured) Cartha R.F.C and Division II top of the table, Stirling County.

Intense Sports Field Management

Joe Motz, President
Motz Landscaping Company, Cincinnati, Ohio

Motz Landscaping Company has a continuing contract to maintain the practice fields of the Cincinnati Bengals. Mike Brown, general manager, wants the new facility to be the best possible. Since he jogs on the turf it gets plenty of inspection.

Briefly, in 1983 the old facility called Spinney Field was renewed. The old artificial turf was replaced as a complete new field. It took nine men nine days to lay and line the new Astroturf.

The Prescription Athletic Turf System (PAT) was installed along one side for 280' x 200' and across one end 105' x 200' for 102,000 sq.ft. The PAT is 2.4 acres. Its irrigation was three sections of two rows each and drainage was three sections. The patented system was used beginning 1 AU 83. George Wyatt, of Dixie Irrigation, Louisville, KY, licensee, built the PAT System. New shrubs and trees were planted to line all fences. My company contracted to do all maintenance.

Mowing was done every three-four days spring and fall, during rapid growth, with an average of 40 cuttings per season or one per week for extended season.

Fertilization was 7 applications of 4-1-2 ratio for 8-10 lbs. N/1,000 sq.ft./ season.

During the wear period (September-November) applications were heavier.

Tupersan was preemergent to allow overseeding as needed. Fungicides were once in spring for leafspot and once in fall for pythium as preventatives.

Spot seeding was done weekly during heavy wear period. Palmer, Yorktown II and Manhattan were mixed with peat and sand, pregerminated and spread. In total 400 lbs. of seed were used. Dormant seeding at the end of the season was with a bluegrass blend.

Coring was 3/4 cores 3 inches deep by a Dido on hydraulic drive of Steiner four-wheel drive tractor. This procedure reduces sealing of the surface, dilutes the thatch and improves reseeding. Taking cores two inches apart was our target so three to four passes were made in one day. Don't worry about doing too much tearing. A flail mower with hammer knives break up and distribute cores.

Sanding was done with second coring to keep holes open, protect crowns of grass, and reduce sealing of surface. A total of 45 tons was spread.

Rolling is done to smooth surface after excessive use and at end of season.

Three moisture controllers regulate surface and subsurface irrigation. Generally because of .8 acre of perimeter turf and many shrubs the surface watering is used. When on the site the controllers are monitored and records made of the readings. Because of conservation of water, whether rain or irrigation, the watering is important. We like to see a little wilt between major irrigations in summer.

The drain outflows are closed in summer for maximum conservation but open in late fall, winter and spring. The vacuum pump assures fast drainage when desired during use periods.

Soil heating cables are 2' apart. Use in late fall until the end of the season has assured thawed soil and playable conditions at all times.

Marking is a big chore! The exact initial layout is quite tedious. A lot of time is required for biweekly lining throughout all practice periods.

A budget of $25,000 for all PAT areas (102,000 sq.ft.) is surprisingly modest. The perimeter turf and shrub maintenance is $3,000. The hours of labor average ten hours per week over a 40 week period.

The Bengals' management insists on the safest turf possible and have been very supportive of good maintenance.

Economical Management For Twelve Years

Richard Kercher, Advisor
Foreman Field, Goshen High School, Goshen, IN

Foreman Field, Goshen High School football field, was the pilot model for the PAT System. I was fortunate to have been the contractor at the time it was constructed and have been the turf manager of the field since that time. The center third of the field was installed as Prescription Athletic Turf, the remainder as a conventional turf field. The installation has the capability of being irrigated either overhead or the PAT area by subirrigation controlled by moisture sensing. This field was installed in spring of 1972, sodding completed July 1972, and the first game played on it in early September. The field is treated not as a monument, but as a facility to be used by as many students of the Goshen system as possible. It has been used each year since it was constructed by the varsity, junior varsity, and junior high school students. For example, this past season there were five varsity games, six JV games, three ninth grade, three eighth grade and three seventh grade games as well as ten pregame practices, a football preseason open house and a minimum of twenty two-hour and practices during the season.

Like any turf area, and particularly one used as this one is, we have our problems. Some of our problems in the past twelve years have been excessive wear directly in front of the goal post, patches of bentgrass in some areas of the field, and excessive wear along the player area of the side lines. Like all public school systems, we have not been overblessed with operating funds but have been able to operate on sufficient funds to maintain a first class facility.

With the exception of the player area on the side lines and a few isolated spots, no resodding has been done since the field was constructed. The patches of bentgrass which unfortunately are spread from aeration of the field, are treated in November by spraying with Roundup and reseeding in early spring with Wabash bluegrass. This has proven to be a very satisfactory means of keeping the bentgrass under control but it does leave the field in the spring looking like

it has been visited by a pack of dogs. Since the player area along the sidelines is also in the vicinity of the finish line of the running track, it has not been possible to repair it until the track season is over in late May. Therefore, we find resodding that small area is the preferred treatment.

Our maintenance program has been as follows. Each spring during freezing and thawing we overseed the center one-third of the field where most of the wear takes place with approximately 1 lb./1,000 of Wabash bluegrass seed. At about the same time we apply 10 lbs. of 16-8-8/1,000 or 1-1/2 pounds of N to the entire area. This is then followed about May 15th with an application of 1/2 lb. of N per 1,000 applied as a foliar spray using a regular ag supplied 28% liquid nitrogen. This application is repeated again in late June. This year in the first liquid application we applied Dacthal to the center area to help control a crabgrass problem that we first experienced in 1983. We have had a few isolated soil insect problems but have controlled those with a spot spray application of diazinon followed by thorough irrigation.

The middle of August following aerification, an application is made of 31% Par-Ex IBDU at the rate of 10 lbs. per 1,000 sq.ft. In late November an application of 1/2 lb. per 1,000 sq.ft. of 45% urea is applied.

In addition to this maintenance the field is aerified at least three times during the year with a Ryan pull type aerifier making at least three passes each time. Aerifying is done in early spring, early July, and two weeks prior to the first varsity game. Immediately following the July aerification, a topdressing of fine mason sand is applied. A total of 30-35 tons of sand have been applied each July since the field was installed. So far, with our maintenance program thatch has not been a problem.

The practice football field and baseball field maintenance has been about identical to the PAT System field except, due to heavy use, we have been reseeding in the wear area with one of the new fine leaf tall fescues and perennial ryegrass. We have not each year applied a sand topdressing to the practice field largely because of our failure to get it done early enough prior to the start of fall practice. The coach seems to object to practicing on a field that was topdressed with sand just ten or fifteen days before the beginning of practice.

Now a few figures, or just what the school system spent for materials during 1984 to maintain the varsity playing field, practice field and baseball diamond:

Fertilizer and chemicals	$1,125.00
Seed & sod	215.00
Sand and application	275.00
	$1,615.00

In summary, the $1,600 is spent basically for materials,excluding irrigation water, to maintain what I feel is a first class facility with a low operating budget. I am sure there are lots of things we could do that would probably put the icing on the cake, but as a taxpayer in the community, I feel that we have gotten the maximum for our dollars.

Thank you for this opportunity to tell again, twelve years later, about the Goshen High School football field.

Building PAT Fields

George Wyatt
Dixie Irrigation Co., Louisville, Kentucky

Dixie Irrigation was approached by Dr. Daniel back in 1982 about our possible interest in becoming a licensed contractor for the construction of the PAT athletic fields. After some correspondence back and forth we signed an agreement with him in January 1983. Shortly after that he had a partner enter the business with him whose home was in Cincinnati, Ohio. I am sure he played a large part in our becoming the first contractor under Turfgrass Services to construct a PAT field, a practice area for the Cincinnati Bengals. Prior to this contract our largest jobs had been installing irrigation on golf courses, most of which were nine hole and therefore not very large ventures, so we were naturally a bit apprehensive. The Bengals and the City of Cincinnati had been in litigation for some time over the quality of a practice area and shortly before the case was to come to trial the City settled out of court. The Bengals decided to build a PAT field and the City of Cincinnati would be responsible for relocating utilities, moving and adding to the board fence that separates the field from a city tow-in lot, and providing an outlet in the storm sewer for our system to dump in. The City also was to provide excavation necessary to give us the proper grade for working on and they also provided trucks and space for removing and storing excess soil. The field was turned over to us in June 1983, and we were to have it completed within a specified number of days.

Slide presentation: This is the west field and a portion of the artificial turf field showing the concrete footer, rock, asphalt, etc. along with the condition of the grass area that we will be working on. We are checking the grade before our acceptance from the City. Notice the quality, or should I say lack of same, of the first on subgrade. Here is a comparison of the two subgrades, dirt and artificial turf. Which would you rather play on? This shows final grade of subbase and we had to bring back in some soil to cover all the brickbats, etc. The city had done a fine job, however we did have to dress up the edges a bit and reshape them somehwat and smooth the subbase before applying any barrier. Trenches had to be cut for the laterals to be nested into and the lateral to the pump through the barrier had to be installed in place. Since the base was not too stable with some rocks, etc. protruding, we felt rolling would be in order and this operation really worked well. You saw the lateral earlier and this is the method for going through it from the PAT to the pump. This shows a typical layout of the lateral and collectors plus the white pipe which is our surface irrigation supply line and now with abrrier, collectors, alterals and sprinkler lines in place sand is beginning to be spread over the field. All drains, conduits and pressure pipe comes to the pump pit for hook-up and proper distribution with the approriate fittings applied and all drainage is carried to the storm sewer by this line being installed now.

We had to be particularly careful of the artificial turf and keep it as clean of sand as possible so a little extra care was given to the match up area as shown in these slides. Here you see more of the sand operation which probably is one of the larger tasks in the construction. To hold all drainage pipes in place a man preceeded the equipment and shoveled some sand onto them as shown in this

slide. Then we start the final grading and transition at the edges with a little more precision being added as progress was attained. A snag was reached and the transit man gave up to temptation. The topmix was stored on their parking lot and mixed on site with a bulldozer and was applied by pulling this truck with dozer. The correct relation between ground speed and distribution was realized this way and the mix was worked in with this homemade rake system and final grade was attained also. The sprinklers were set and some hand work was performed, heating cables were trenched in, the pit for the vacuum breaker was built (at a cost of $4,000 I might add), and the job of sod laying was started with all of the Ed Motz family helping out. The pump pit is completed and sodding almost done.

A few days later aerifying was completed and more diversion added along with some polyester threads Dr. Daniel had brought with him. Somehow they got scattered over the field and he was hoping the aerifier would push tehm into the soil and help the grass roots to stabilize the surface. The area between the parking lot and artificial turf was also regraded and sodded and a surface irrigation system added. This is approximately six weeks after sodding with the Bengals at practice in the background. This is one corner of our new field and we were so proud of it. The rainfall was very heavy and all the sod here slipped into the storm sewer and stopped it up. However, this shows that our drainage system was working and working well since we didn't have the pump hooked up yet. Within two hours or less the enormous lake was now just a large puddle and since this drain was installed directly into a six-inch drain that runs directly into the storm sewer, no problem has been encountered other than the diversion that keeps creeping into this presentation.

This was in March 1984, and we were most proud to have Turfgrass Services meet in Cincinnati with all their licensees to visit the Bengals field and see the "proof of the pudding". A control system is installed that will either apply water from the surface or subsurface as necessary or water can be pumped from the field should that be necessary. You can see the root growth which has to indicate near perfect conditions for the growth of grass.

Construction and Maintenance of Athletic Fields In Europe VS U. S.

Dr. James B. Beard
Texas A&M University, College Station, TX

Introduction

In many aspects, the application of existing technology to the maintenance of sports turf is more advanced in Northern Europe than in North America. This is true in spite of the fact that a great amount of the basic principles and information on which these practices are based has been generated from research conducted in the United States. Much of this can be attributed to poor decisions made by those responsible for establishing budgets and specifications concerning sports field construction and maintenance. The two major areas where drastic errors occur are: (1) failure to provide a proper rootzone for turfgrass culture in terms of optimum drainage and minimum compaction proneness and (2) a tendency to employ inexperienced, untrained personnel to supervise the maintenance of these sports fields. This is done with the false hope that money can be saved by hiring the cheapest man available. In most cases a knowledgeable, properly trained individual can more than pay for a higher salary through proper decision making processes which will provide the best functioning, highest performing sports turf at the lowest possible cost. One of the major distinctions between North America and Northern Europe is that there is a grand tradition of professional grounds maintenance personnel who have devoted their lives to the field and have "come up" through the ranks as apprentices and have sought out the available educational opportunities. A similar system exists in golf course operations in the United States, but the U. S. is decidedly deficient in the area of qualified sports grounds maintenance personnel.

Characteristics Desired for Sports Fields

As a basis for the following discussion it is important to recognize those characteristics of most concern in developing a turf sports facility which will provide the best possible playing conditions for the particular game involved. The major characteristics generally include the following:

1. Moderately close mowing of 0.5 to 1.2 inches
2. Firm footing
3. High shoot density
4. Good wear tolerance
5. Tolerance to the action of cleats and spikes
6. Good recuperative rate from divot damage
7. A moderate resiliency or cushion
8. Uniform, level surface
9. Rapid removal of excess water

The cutting height employed on soccer fields in Europe is generally considerably shorter than that practiced in the United States. No doubt as the game continues to increase in popularity and we become more sophisticated in the techniques of soccer play, the shorter cutting height will be recognized as being of increased importance to the game in North America. A number of the subsequent criteria listed

relate to traffic effects and recovery from traffic stress. The effect of resiliency or cushion is important in terms of minimizing injury to participants caused by falling on the turf surface as well as to cushion the tiring shock effect to players' legs when running on the surface. Rapid removal of excess water, both by surface runoff and subsurface drainage, is extremely important in terms of maintaining a quality, playable surface since many sporting events are continued regardless of the weather conditions. The excess water removal also minimizes the chance of mud problems developing.

Characteristics Desired in Turfgrasses for Sports Fields

Relatively few turfgrass species are well adapted for sports turf use. Characteristics desired include the following:

1. A low, prostrate growth habit and tolerance to mowing
2. Excellent wear tolerance
3. Good recuperative rate
4. Uniformity
5. No surface runners (stems) which can entangle cleats

Fortunately, those in the southern U. S. have bermudagrass (*Cynodon* spp.) which is one of the better adapted turfgrasses for use on sports fields for such recreational activities as soccer, football, softball, and baseball. Bermudagrass possesses outstanding wear tolerance, a rapid recuperative potential, and tolerance to close mowing, which are particularly desirable traits. A potential limitation is the restricted late fall shoot growth and recuperative potential caused by the bermudagrass entering dormancy due to mid to late fall low temperature stress.

In the northern cool climates, Kentucky bluegrass (*Poa pratensis*)is widely used on sports fields. The more recent development of turf-type perennial ryegrass (*Lolium perenne*) cultivars has stimulated an increasing interest in their use on sports field turfs in polystands with Kentucky bluegrass. Also, tall fescue (*Festuca arundinacea*) is used in the transitional climatic zone.

Sports Field Construction

The foundation of successful, efficient turfgrass culture on intensively trafficked sports fields is a rootzone soil mix of sufficiently coarse texture so that rapid downward internal drainage of excess water will not be impaired and thus minimize proneness to soil compaction. The typical scenario in sports field construction in the United States is to spend generous sums of money on the construction of a stadium, but at the same time, try to find the cheapest "dirt" available for the sports field itself. Within the last eight to ten years the northern Europeans have awakened to the need for coarse textured rootzones in order to achieve a favorable environment for turfgrass culture. Investigations have been conducted by the Europeans utilizing a wide range of synthetic soil amendments with little success. A sand of the proper particle size distribution range still remains the most widely available material for use in rootzone modification of sports fields. Unfortunately, the Europeans do not have easy access

to a physical soil analysis lab as in the United States since the main laboratory for this type of work is located at Texas A&M University under the direction of Dr. Kirk Brown.

Fortunately, we in the United States are also seeing an encouraging awakening of the "directors" of sports grounds to the need for rootzone modification. Much of this seems to be related to the backlash from the high cost of artificial turfs. Suddenly, the amount of expenditure required to construct a sports field with the proper rootzone for optimum turfgrass culture does not look prohibitive when compared to that required for an artificial surface. Still, all too many fields in the United States are being constructed with impermeable rootzones of high compaction proneness. Continual educational efforts will be needed to correct this problem. Fortunately, more progress is now being made than at any time in the past.

There are two other key aspects in sports field construction that are required to insure adequate drainage. They include (1) a properly designed subsurface drain line system and (2) a sufficient surface contour or grade to allow rapid removal of excess surface water.

Sports Turf Culture

Assuming the proper turfgrass species has been selected and the appropriate rootzone, surface contours, and subsurface drainage system provided, then the subsequent cultural practices utilized will be simplified and of lower cost.

Mowing. The specific cutting height selected will range form 0.5 to 1.2 inches, depending on the particular turfgrass species involved and the type of sports activities for which the turf is to be utilized. Bermudagrasses respond quite well to cutting heights in the 0.5 to 1.0 inch range, whereas the Kentucky bluegrasses and perennial ryegrasses should be mowed somewht higher. Raising the cutting height of the latter species during the off-season will enhance the recuperative rate of badly thinned areas. However, the cutting height must be lowered back to the desired height for the playing season and should be achieved in gradual increments initiated sufficiently early so that the adjustment can be achieved with minimum negative effects on the turf. Soccer fields should be mowed lower than football fields for optimum playability. The European sports fields are maintained at a closer mowing height than those in North America. As a result, a relatively high population of annual bluegrass is present in many of the fields, particularly where soil drainage is poor.

Clippings do not need to be removed if the turf is mowed at a sufficiently frequent interval so that the individual clippings readily fall down through the turf into the zone of decomposition. A mowing interval of one to two times per week may be required on the more intensively maintained sports fields having a close cutting height, frequent irrigation, and high nitrogen nutritional level. The careful planning and execution of mowing patterns to give an attractive visual appearance is widely practiced, almost as an art form, on a number of European sports fields. Many types of checkerboard and linear patterns can be obtained which give the spectator a very favorable impression of the sports facility.

Fertilization. In comparing fertilization practices between North America and Europe there is not a great deal of difference in the basic principles involved. Adequate phosphorus and potassium levels are maintained based on soil tests. In terms of nitrogen nutrition, there is a tendency for Europeans to fertilize their sports fields with lighter amounts applied at more frequent intervals than is practiced in the United States. An important principle to keep in mind is that there is a minimum level of nitrogen needed to maintain good overall health and vigor. At the same time, there is always the potential problem of a restricted root system and sod strength due to the application of excessive amounts of nitrogen fertilizer. This can be due to the nitrogen applications being made at too high an annual rate or too much in any one single application. Slow release forms of nitrogen are receiving considerable interest in Europe as is the case in the United STates. Iron deficiencies are generally not as great a problem in Europe as in those parts of the U.S. where alkaline soil conditions exist.

Irrigation. The irrigation of sports fields is not as critical a need in northern Europe as in much of the U.S. If anything, too much water is a greater problem than too little. As a result, the sophistication of the irrigation systems that are being utilized is not at the level found in the United States. It is important to plan irrigation timings such that the field is relatively dry just prior to scheduled dates for individual sporting events. High soil moisture contents during periods of anticipated intense traffic only increase the potential for soil compaction. This dimension of sports turf culture is of most concern on soils having a relatively high clay content, unless rootzone modification has been accomplished.

Pest Control. Those responsible for sports turf maintenance in Europe are faced with weed, disease, and insect problems just as we experience in North America. The specific causal species need not be discussed as they vary considerably from those occurring in Texas. However, it should be mentioned that a national law exists in the Netherlands which prohibits the use of most herbicides on public recreational and sports turfs. This situation emphasizes the value of the turf manager in selecting and executing turfgrass cultural systems that will provide maximum competition by the desired turfgrass species in order to minimize the invarion of potential weed problems.

Minimizing Traffic Effects

The effects of traffic include (a) turfgrass wear or the aboveground bruising and thinning of the turf, (b) soil compaction which is a "hidden", below ground increase in soil density, and (c) divoting of the turf caused by the twisting and turning action of cleated shoes. Preventive and corrective approaches that can be used in minimizing these traffic effects include:

1. Use a coarse textured (sandy) rootzone
2. Provisions for rapid removal of surface water
3. Providing as dry a turf and rootzone as is practical during periods of intense play
4. High shoot density
5. High potassium level
6. Moderate to minimal nitrogen level
7. Soil cultivation by coring or slicing as needed
8. Capability of alternating play between several sports fields, as dictacted by the degree of turfgrass wear
9. Constant, open communications with coaches and recreation personnel concerning your approaches and objectives in relation to their needs.

Compaction is best prevented by means of a coarse textured rootzone combined with an adequate subsurface drain line system and proper surface contours to insure rapid removal of surface water. Unfortunately, budgets are not available to provide the desired degree of rootzone modification on all sports fields. In this situation where a compaction problem has developed on a fine textured soil, it may be necessary to utilize turfgrass cultivation techniques. This typically involves either coring or slicing. Both are generally preferred to spiking due to the deeper penetration and greater degree of lateral shattering that can be achieved. Keep in mind that soil cultivation will vary depending on the intensity of traffic and degree of compaction that is developing. It may range from once a year immediately following the playing season to monthly intervals throughout the off-season. Soil compaction can be assessed by means of two primary indicators. One is a lack of surface resiliency indicated by a hard feel when walking over the area and difficulty in pushing a soil probe into the soil surface. A second very good indicator is a declining rate of water infiltration into the soil, providing the same rate of irrigation water application is provided. Soil cultivation is best accomplished when the soil is moist, but not water saturated; the intensity of use is low; and the weed invasion potential is minimal.

Insuring a relatively dry turf and rootzone during periods of intense play through the proper timing of irrigations is very beneficial in minimizing soil compaction problems. In large stadiums the effective use of tarps can also be very important in insuring a dry root zone during scheduled sporting events. Both approaches will minimize compaction proneness and the chance that mud problems will develop.

Maximum turfgrass wear is achieved by providing a high shoot density or as large a surface biomass as is practical. In addition, providing high levels of potassium and modest to minimal levels of nitrogen during the actual playing season can be important contributing factors in enhancing wear tolerance.

A very significant difference between Europe and the United States in their approaches to minimizing traffic effects is the use of alternate fields. It allows a periodic resting period as needed so that the turf can recover before the wear becomes so great that the turf is thinned beyond a point of recovery without extensive renovation. This approach of alternating sports fields may be one of the key reasons that Europeans tend to be more successful in maintaining adequately turfed sports fields in comparison to the typical situation found throughout the United States with bare soil existing from the mid-point of the season onward. Obviously we in the United States have a long way to go in this regard.

Who Are The Decision Makers?

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This is a subject that has intrigued, mystified, frustrated, angered, and surprised salesmen since man started selling. No single question plagues a salesman more than the question of who should he be spending his time and effort with.

In two years of promoting and selling the PAT System to professional teams, colleges, universities, high schools and municipal recreation departments we have concluded there is no one common answer. In one instance, it may be the turf maintenance supervisor or groundskeeper. In another, it may be an obscure politician who for some reason or other simply wields unexplained power, It may be a new coach, it may be an old successful coach, it may be the board of trustees, the city council, the mayor, or even the governor. One thing is sure, very seldom do the players who perform on the surface have any serious input into the decision.

Actually, in most instances, the decision is made by the person or persons holding the purse strings. But are they the ones who best understand the advantages and disadvantages of the various options available?

Of course, I'm talking about the decision of whether the football field, the soccer field, the baseball field, the intramural sports field is going to be natural turf or a plastic carpet laid over asphalt.

Who should make the decision? In considering this question, I am reminded of an article written recently by Pat McInally, punter and wide receiver for the Cincinnati Bengals. Pat is a Harvard graduate and writes for the Cincinnati Enquirer in the off-season. Allow me to quote from Pat's article entitled, "Nothing Artificial About Recent Super Champs":

"Palo Alto, California,January 15, 1985 - What was the last Super Bowl team whose home field was covered by artificial turf? Believe it or not, the Cincinnati Bengals in 1981. In fact, every team who has played in the Super Bowl since then, including this year's teams, Miami and San Francisco, have had natural grass home fields. The last five world champions in football have had home grass fields.

What an irony. With all the money and energy that's been spent on developing newer and better artificial surfaces during the past 25 years, it's about time to recognize the fact that the game was invented and meant to be performed on the good old green stuff most of us grew up playing on.

Football was intended to be played with real, old fashioned cleats, in mud, snow and rain, in uniforms covered with green and brown stains at the end of the game. Domes? Forget it. Not one of the six teams playing indoors has ever made it to the Super Bowl. The perfect conditions might help kickers and keep the fans warm and dry, but they sure haven't led to any championships.

There are 17 teams playing their home games on artificial turf of some type. Though most of them also have grass practice fields, the largest percentage of their workouts, particularly late in the year, are on the Astroturf. While there are only 11 teams still playing on grass, these are the franchises that are producing the winningest records and dominating playoff games, particularly when they're hosts. They keep capturing all the big trophies. Doesn't it make you wonder why there's such a discrepancy here?

Most people will hurriedly state that Miami, Washington, San Francisco, and Los Angeles (Raiders), who have played in all the recent Super Bowls, simply had superior talent and coaching and that the surface of their playing fields has nothing to do with their success. Others will point out that the Pittsburgh and Dallas dynasties of the 70's were built on artificial turf. But I'm talking about now. In the past five years, parity has evened up the talent. The edge of a grass home field is making a major difference now.

As a player who has performed in the NFL for ten years, I know that practicing and playing on natural grass has tremendous advantages. First, there are fewer injuries. Impact injuries to the arms, legs and shoulders have been proven to occur more often and with greater severity on artificial turf. This would make sense to anyone who has ever walked on a field with an artificial surface. The stuff is hard and definitely not an inviting substance to fall on, especially with a half ton of bodies on top of you.

Practicing on artificial turf is much tougher too. It's much harder on an athlete's legs, knees and ankles than the softer, more giving surface found on grass fields. As a receiver, I know how much the hard surface of Astroturf takes out of my legs. Believe me, after 20 weeks of it, players who have been working out on it are more tired and literally run down than opponents whose legs are fresh and stronger from working out on grass. Pete Johnson, the Dolphins' bruising fullback who played seven seasons on artificial turf with the Cincinnati Bengals before enjoying this year on the grass confines of Miami, says: 'Practicing and playing on Astroturf is tough week after week. My legs feel better right now than they have ever felt in any January of my career. Grass is so much softer. The pounding my legs take on that hard Astroturf, particularly at my size (between 250-275 pounds, depending on the scales), really wears you down after a season of it. Grass definitely lengthens a player's career and leaves him fresher for the playoffs'.

There are also tremendous physical and psychological advantages for teams with grass fields when they host their artificially homed enemies. It is much tougher to adjust to grass because the uneven surface of natural fields, along with the dirt and mud, combined with slickness due to rain or snow and the soft ground itself, make precise moves and timing much more difficult. Sharp cuts, changing speeds, stopping and just plain running are different on grass."

Chuck Studley, the Dolphins' defensive coordinator has coached on Astroturf at Cincinnati and Houston and on grass at Miami and San Fransisco. He says, "There's definitely a greater difficulty in adjusting to a grass field after performing regularly on Astroturf. And some players are simply more effective on the artificial surface. For instance, Tony Dorsett is almost unstoppable at Dallas, but get him on grass and at least you have a chance. Players simply aren't as fast and can't make the cuts on grass as they do on turf."

In Pat's article he has said so well what we hear regularly from athletes representing both the college and professional ranks. George Brett, third baseman for the Kansas City Royals says, "The guys who invented artificial turf sure didn't have to play on it."

The NCAA has recently published a preliminary report covering two years of a survey on athletic injuries. In the first two years of the survey the NCAA finds that total football injuries on artificial turf are running 1.5 times the injury rate on natural turf. Knee injuries requiring surgery are running at an even higher rate on artificial turf.

Whoever the real decision-makers are, we are convinced of the following:

1. They presently tend to overlook injury rates.
2. They presently refuse to listen to players' desires.
3. They presently are influenced by the clean, bright green appearance of plastic which looks neat on television.
4. They presently refuse to believe that natural turf can be just as neat and at the same time be safer for the valuable players who, in the professional ranks, are being paid as much as $1,000,000 per year and who cannot perform when injured.

As natural turf proponents, we all have a job to do. Otherwise, the day could come when we would all be plastic carpet janitors removing chewing gum and tobacco stains and sewing torn seams.

I frankly do not think that will happen. I have positive faith that in time the decision makers, whoever they are, will come to their senses and opt for soft, cool, aromatic, natural grass to put the athletes of this country on. I'm convinced that "God is on our side".
