1982 TURF CONFERENCE PROCEEDINGS

sponsored by the
MIDWEST REGIONAL
TURF FOUNDATION

and

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PROCEEDINGS OF THE

1982

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(continued)

The 42 talks included in these Proceedings are condensations from speakers before sections of the 1982 M.R.T.F, Conference. We appreciated the willingness of the speakers to participate and prepare materials for your reading. A copy of these Proceedings has been mailed to all those attending the 1982 Conference; one person of each member organization within the Midwest Regional Turf Foundation not in attendance at the Conference, and to a list of those in educational activities.

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One must consider many things when recognizing 'Old' Bill Lyons. He is noted as a post card writer, a sharer of concerns, a generator of ideas.

Bill is an idealist! He dreams and considers what can be done. He was in solution feeding of turf through irrigation early. He used magnesium sulfate "Epsom Salts" on gravelly soil areas for color improvement when magnesium was in short supply.

Bill sought and maintains contact with many in turf research. Of all things, he's noted for cheese, balogna, a drink and discussion at turf conferences across the Midwest and East. We have been enriched by his sharing... Editor's Note.

FOOTPRINTS IN THE DEW

William H. Lyons, Sr., 'Old Bill'
Lyons Den Golf, Canal Fulton, Ohio

The story of a man who, without a high school diploma, achieved golf course ownership and made a few friends...

It all started in the depression of the 1930's. Penniless, my parents gave me shelter. I was about twenty-five years old and out of a job. I felt like the whole depression was on me. I felt guilty, not being able to help my parents who had other younger mouths to feed besides themselves.

How could I help? If I could get the use of two vacant lots near the home maybe I could raise a food garden? But I did not know anything about soils. All I knew was that vegetables grew out of it. Where could I turn for information?

I remembered a newspaper story that my mother sent me about a girl who attended the same school as I who was now secretary to the county agricultural agent. So, off I went to get, through her, FREE bulletins on soils and vegetable growing. Little did either of us realize that that girl, Lucile Carr, would someday be Lucile C. Lyons.

Through these agriculture bulletins I learned that Ohio State University offered a correspondence course in Agronomy. I signed up for it because it was FREE. My only expense was the postage to return the weekly reports. Sometimes they were delayed for lack of postage funds.

Lucile Carr gave me a book on soils; that was the start of a very good library. Many of these books I have read and re-read so often I feel a kinship with the authors even though many have passed on.

Our vegetable growing was a success, supplying a surplus of fresh food. Mother had the instinct of a squirrel for storing the surplus, canned or dried. (Freezing was not popular then). Ten gallon crocks held carrots, beets, turnips and kraut. The outdoor storage pit held a supply of root crops and cabbage until spring. Thrift was, "Waste not, want not". It taught the lesson of all wealth coming from the soil. Then too, any job done right is an uplift to the doer. During the depression we all needed an uplift!

I have been accused (and cussed) for being a perfectionist. How did a pauper such as I acquire that trait? While in the sixth grade my dad farmed me out to the owner of the Mercer County, Celina, Ohio, Democrat, a weekly newspaper. I spent my free hours from school setting type. Lesson learned: only perfection is acceptable.

The year following our vacant lot experience, my brother and I began raising acres of vegetables. We studied the market to learn why California grown produce sold at higher prices than those of the same kind grown locally. The answer: perfection in quality and packaging. The local growers flooded the weak market with ungraded, mixed quality in old dirty baskets. Their tomatoes moved slowly at twenty-five cents a bushel. (Baskets cost fifteen cents.) Sweet corn was eight cents per dozen. Could we challenge and market and win?

We sold our first tomatoes, sized and packed in new peck baskets, under our farm label - Lyons' Sub Acid Tomatoes - thirty-five cents a peck. At the close of the season we were getting sixty-five cents a peck and could not fill the demand. The ungraded tomatoes were still at wenty-five cents a bushel.

This know-how with vegetables was to lead to the challenging job of Victory Garden supervisor for the world's largest employee garden program. (Received a Presidential citation...) Millions of Victory Garden bulletins I wrote helped people grow their own fresh vegetables. Our Experimental Garden idea helped that company to become the second largest supplier of gardening equipment in the nation.

Than the crash came! The boss called me in and told me the Victory Garden program was to be closed out. It was a sad day; twenty-five hundred families I had worked with to plan, grow, show and preserve their vegetables were to be denied their garden plots.

So, I expected the pink slip. Instead, the boss told me their golf course superintendent resigned and top management wanted me to take over two 18-hole golf courses. I said, "I don't know crabgrass from bluegrass and have hardly heard of bent grass." But, by then, Lucile had given us two little boys. I had mortgage payments to meet. I was trapped and accepted. They knew I had some knowledge of soils and fertilizers, and they also knew that I knew their system of operations (chain of command).

The first step was to take an inventory of soils and equipment. The State of Ohio limited water supply from their canal to 200 gallons per minute for 36 holes. Today 1,000-2,000 gpm is common on many courses with automatic systems. (Misuse of these has destroyed much good turf.)

There were nineteen sprinklers with hundreds of feet of heavy 3/4ths inch rubber hose, just one outlet per green. The system was to water the A Course one night, then move the equipment to the B Course the next night. The night watering man walked, carrying a lantern in one hand and a hose repair kit in the other, as he made his rounds to make four sets per green. There were a few fairway outlets. The two-inch rubber hose was so heavy it had to be moved with a tractor.

Greens were mowed with Toro and Pennsylvania PUSH mowers. We had only four so we mowed A Course one day and B Course the next. One nice elderly workman had a daily expression as we loaded the mowers on to a high truck, "Take it easy, Bill; we like to ride and we will all last longer."

The courses had no record of a complete analysis of the soils in the greens. I was going to make sure that ALL the ills of the greens could be cured based on soil testing. Samples went to several university soils labs. Wow! No two had the same answers, yet all read high in phosphorus. One traveling salesman agronomist called them 'phosphate mines'.

Here is where luck came to my rescue. During the Victory Garden days I was vegetable garden advisor to the world's largest greenhouse grower of mums. The government ruled they had to grow X number of acres of vegetables to qualify for X number of tons of coal to heat their greenhouses. (They had only to grow, not to market.) I saw their hydroponic (soil-less) growing of flowers and vegetables.

I asked their chemist, Mr. Stewart, to visit the courses with me to see if he could tell what was wrong with the greens. He did, and this is what he said, "That is the first golf green I have ever seen, but I will tell you from here (50 yards away) that green is out of phosphorus." "But", I said, "Look at the soil tests. They read toxic high in phosphorus." Quickly he came back to ask me if lead arsenate had ever been used on the greens. (Used for crabgrass, Poa annua, and chickweed control in early days.) The old barn was littered with broken bags of the stuff. He explained that lead arsenate and phosphorus would have the same color in soil tests. He took some clippings back to the laboratory for tests. Sure enough, the greens were sick for the lack of phosphorus. This debunked the 'phosphate mine' theory.

Mr. Stewart and the late Dr. George N. Hoffer taught me how to adapt hydroponic fertilization (slop culture) to golf greens. And why not? Ninety-five percent of all the nutrients that go into a grass plant has to come from the soil's solution. And now, thirty-five years later, we have never applied dry fertilizer to a golf green. In those days the chemicals at our disposal were "HOT" and had to be handled carefully. Wet the turf first, apply, then wash down using a shower head, four times over, IMMEDIATELY! The spray lawn industry learned the idea from us. We are happy to have had a part in this development. Thousands of home owners are enjoying better turf because of their services.

May we pause to reflect that in the early 40's there was no turf research at Ohio State University or at the Wooster Experimental Station. We were invited to Purdue University to a turf conference. The program was mostly generalities. The smoke filled rooms at night were used for cards, bottles (illegal at that time) and off-color jokes. Not a good way to invest time and one's own money to acquire knowledge. THERE HAS TO BE A BETTER WAY. That motto should be in every golf course equipment center.

The next year we took along a supply of Ohio's best Swiss cheese to buffer the alcohol. It worked. The "Cheese-Bar" became a tradition at the (now) Midwest Regional Turf Conference and later at Penn State. It was at our second Purdue turf conference, with the help of Dr. Volk, head of the Agronomy Department, that we came up with the idea of a seven state Midwest Regional Turf Foundation to sponsor turfgrass research. It was incorporated in 1945. I was honored to serve on the first board of directors.

The best advice ever given to me came from my garden office secretary. "Bill, get yourself ready. This company will fire you when they think they have gotten the best years out of you." (There was no union to protect.)

Taking her advice, we worked the off-hours from our job for ten years to build Lyons Den #1 golf course. Sure enough. My secretary's advice was correct; they fired me. But I was ready. The hard work had paid off. We try to share with others our limited funds and knowledge that we have gained.

Every man owes his support to the organizations that are kindred to his business. During the last decade I've spent much effort in working with other golf course owners towards solving mutual problems.

"JUST OUR BILL"

Composed and sung to his own accompaniment by

Stan Fredericksen

to

Old Bill Lyons

Midwest Regional Turf Conference, March 2, 1982

Verse

Back in those early days at Purdue
We sought a friend - tried and true!
We knew we'd recognize him the moment he
came into view.
We always used to fancy then he'd be one
of those god-like kinds of men
With a giant brain and a noble head
Like the heroes bold in the books we'd read.

Chorus

But along came Bill, who's not the type at all.
To see him on the street you'd scarcely notice him.
His form and face, his manly grace,
Are not the kind that you would find in a statue.
And we can't explain, it's surely not his brain
That makes us thrill.
We love him, because he's wonderful
Because he's just Ole' Bill.

Verse

He can't play golf or tennis or polo
Or sing a solo, or row.
He isn't half as handsome as dozens
of fellows we know.
He isn't tall, or straight, or slim,
and he dresses no better than Ted or Jim,
And we can't explain why we make such fuss
o'er this guy how means all the world to us.

Chorus

For he's just plain Bill, an ordinary guy.
He hasn't got a thing that we can brag about.
And yet to us, he rates A-plus, his
hospitality is something truly 'extra-special'.
But we can't explain, it's surely not his brain
that makes us thrill.
We love him! Because he's, I don't know,
Because he's just our Bill.

LOOKING INTO THE EIGHTIES

Gene Johanningsmeier
Turfgrass, Inc., South Lyon, Michigan

I feel a little like the professor who said, "I shall now illustrate what I have on my mind," as he erased the blackboard. To look ahead and forecast with any degree of accuracy or to prophesy what is in store for us implies that one is a prophet. A prophet I'm not! Your guess is as good as mine. Chrysler Corporation had a long-range forecast when they presented their case before the Federal Loan Guarantee Board that predicted 1981 to be a break-even year but because they could not accurately forecast how hard hit the industry would be with slowing sales, the forecast was revised during 1981 to predict a loss of $500 million. This forecast was concurred with by the wizards of Wall Street right up to the announcement a couple of weeks ago that the actual loss was something like $435 million. That's only a little over a ten percent error.

Fortunately, the golf industry has not had to deal with such serious problems. As fiscal 1980 drew to a close, it was apparent that growth of the game of golf was minimal. Research figures showed a growth of only two percent in rounds of golf played throughout the country when the rate of growth should be five to ten percent for a healthy industry. National Golf Foundation's treasurer, Robert MacNally, prepared a paper titled, "Growth of Golf", for review by the Foundation's board of directors which set forth the trends that retard the growth of golf and proposals for combatting them. I will read this paper to you.

Growth of Golf

The rate of growth of golf, by almost any measure, has been very slow for the past several years. The number of players, rounds and facilities has increased at a pace slower than most other industries.

Several forces currently threaten to retard the growth pattern still further in the coming years, such as:

A. Rising land values, encouraging conversion of golf courses to realty developments.

B. Rising property taxes, making cost of operating courses more expensive.

C. Rapid increase in course maintenance costs, particularly in materials and labor, making play and membership more expensive.

D. Water shortages in many parts of the country.

E. Strong competition from a variety of other leisure time activities, most of which are considerably less expensive and require less time to play.

E. Golf has strong competition from counterprogramming on television, which has caused falling ratings and decreased coverage.

G. Threats of adverse legislative action on issues of private club discriminatory admissions practices and the tax treatment of business expenses incurred at private clubs.

H. A reduced population of younger players brought about in part by replacement of caddy programs with golf carts.

All these, and more, will tend to reduce further golf's already stagnant growth rate. Presently, many of the associations and businesses which make up the golf industry are undertaking individual programs to combat these trends. Some of these efforts have been successful and others have not; many of the plans are underfunded, and the total thrust is somewhat fragmented in character.

What seems desirable is a means of gaining a strong, coordinated effort to create dynamic growth in golf by bringing to bear the full resources and ideas of all elements of the golf industry.

Other industries have enhanced their growth rate with such unified programs. Golf should undertake a goal of increasing the present growth rate to 5-10 percent annually. It is toward this end that the following proposals are presented.

Proposals

1. To expand the membership of the National Golf Foundation to include major golf associations, media and companies supplying golf related products and services.

2. To hold annual fall membership meetings of the foundation, beginning in 1981, for the sole purpose of planning an overall strategy and programs to create dynamic growth.

3. To support these various programs through a funding plan based on assessment of equitable contributions from the membership.

The National Golf Foundation has taken the bull by the horns and is doing something to help golf grow. They have expanded their board of directors to include representatives from G.C.S.A.A., Club Managers Association of America, the PGA, LPGA, USGA and the American Society of Golf Course Architects. This group met for the first time at the "Forum of Golf" in October, in Dallas, Texas, and held a second meeting in Miami, Florida, January 9, 1982. N.G.F treasurer, Robert MacNally, indicated a need for as much as three million dollars per year to support the growth of golf. They are requesting participation and support from print and TV media as well as companies outside of golf that benefit from the game such as food and beverage, airline and insurance companies. Maybe one day when driving down the highway we will see something on a billboard to compete with one I see frequently. It is sponsored by the Bowling Proprietors Association and has large letters, "Bowling's a Gas Saver - There Is An Alley Near You". Bowling is serious competition for the recreation dollar and time. Bowling proprietors would like to extend their season to ten or eleven months to maximize their return on investment.

We have a very successful golf operation in Michigan that offers two beautiful eighteen hole golf courses to play and has constructed several villas and cottages for customers to rent for various time periods during the season. These are already booked solid for this summer with only a few openings on Mother's Day weekend and some after October 20th. On a few of the longer days in the season, they have enjoyed over one thousand rounds of golf played at their course. When golf begins to grow again, I'm sure they will accommodate by building another eighteen holes and some more villas.

Some of the management trends reported at the Ohio conference, at Michigan State University, and here at Purdue, are dealing with more intense management of fairways. This, at least on the surface, seems to be the direct opposite of reduced costs and less grooming to conserve energy and water. It appears to be a move to regain some turf quality differential between courses that can afford the extra dollars versus those that have to stand by and say, "Gee, that would be great if we could afford it." I remember a superintendent once telling me he had a question from a member, "Why can't our tees and fairways be as good as our greens?" His response was, "Oh, they can be if you are willing to pay for it." Next question: "How much would it cost?" Answer: "I'll have to figure it out." Using time and cost of maintaining greens and mathematics, he arrived at a figure to answer this member's question, and that was that. Nothing more was said about having fairways and tees equal to greens.

Because of the good results obtained on the courses that have been removing clippings from fairways, there will be at least four courses in our area trying the same technique on a limited basis this year. This trend will be limited by its cost and probably will not become a standard practice for very many courses.

Small gains in housing are forecast. Estimate 1.25 million starts versus 1.1 million in 1981, with more activity in the "growing" parts of the country. Mid-1983 is the estimated date for more normal rate of 1.5 million. Creative financing already making its appearance in promotion on house real estate sales. Greater emphasis on lawn and landscaping for recreation plus beauty. This is from the American Sod Producers Association management letter February 15, 1982, as is the following: energy prices rose 35% 1979, 19% 1980, and 13% 1981. Now there's a trend we'd like to see continue. A mayor, who naturally is very proud of his city, was asked recently how the recession had affected it. "We don't have a recession here", he answered, "but I will admit we are having the worst boom in many years."

How could we look ahead without consideration of the weather? It affects what we do and often how we do it. Maybe, if it's very wet, mowing with light weight mowers and grass catchers would let us mow when heavier equipment couldn't go out on the course. We are very concerned with what the weather has already done for us in Michigan this year. We may not have much live grass to work with when Spring finally arrives. About January 5th, we had a freezing rain that left a blanket of ice 1-6 inches thick and in some low areas that do not have surface drainage, twenty-four inches of solid ice. Poa annua can survive under ice cover for a relatively short period of time. Research by Dr. Beard in the early 1960's at Michigan State University, established that while Toronto creeping bentgrass could survive at least 150 days while forzen in solid ice, annual bluegrass could survive only 60 to 90 days. Death increased, until at 90 days no Poa survived. Since most of our greens are Poa annua and the ice has been with us 65 days today, we have a cause for concern. On Saturday, February 20, the soil at Hancock Turfgrass Research Center at East Lansing was frozen to a depth of 22-24 inches. This means the surface ice is frozen into the turfgrass layer, which makes removal very difficult without damage to the turf. Several golf courses have removed the 8-20 inches of snow that was on top of the ice and have applied Milorganite at four bags per green. The dark color absorbs heat from the sun and speeds the melting process. Others have broken the ice layer without removing it and still others have broken up the ice and removed it. Then there are those that haven't looked at it and say the Lord put it there and He'll take it away. Some are buying seed just in case, and others are looking for job openings in the Sunbelt.

I'd like to predict that people will still be playing golf well past the 1980's (maybeon on sand greens again if we run out of water), and that some of Old Bill Lyons' practices will be used by more people instead of less just as soon as they find out how well they work.

AGRONOMIC NEEDS ARE CHANGING

A. J. Powell, Jr., Department of Agronomy
University of Kentucky, Lexington, Kentucky

You need to reflect back only a few years to realize how drastically golf course management is changing. The superintendent's job is much different today than it was thirty years ago. The old term "greenskeeper" was descriptive in many ways, although it may not have been inclusive enough and may not have been understood. The word greenskeeper implied an art of greens care. This art was a special touch in management that was very much cost-related and innovative. Webster defines "art" as "human ingenuity in adapting natural things to man's use." That certainly describes the superintendent's past history. During the 60's and 70's we lost some of that touch, or art. We may have become so scientific in our management and lavish with our spending that our profession was changed and the game of golf was changed.

When you are required to prepare the green so perfectly uniform that you have to scientifically measure the speed to maintain playability, then obviously the game of golf has changed. What happened to the skill (art) of "reading the greens"; reading the height and variability of grass growth, the density, the direction of grain, etc.? With our increasingly frequent topdressing, the golfer is putting mainly on sand with a green appearance. You can't have "grain" on a green at algae height. It can be brown (dead) and still putt well for a spell. So now the player doesn't

read the green; he uses physics to determine the "lateral displacement of the ball depending upon slope, distance and PSI at impact." That's not reading the green, that's measuring the green; the art is greatly diminished. To the average golfer who doesn't measure each hole he plays, this may be a disservice. It is obvious we want character on our fairways - trees, traps, water, doglegs, etc. - but total uniformity on our greens. We are rapidly approaching a synthetic putting surface. Is it unrealistic to assume that in the future we may be asked to revive this art of "reading the green" by maintaining greens at different heights on the same course?

The golfer has depended upon the superintendent to make the grass adapt. He is mainly concerned about appeal and how well the green putts. If the sometimes lonely superintendent doesn't do it, no one defends the defenseless grass. It is sad to say that this is one of the biggest liabilities in our profession because it pits the superintendent against the agriculturally inexperienced employer. How we have come this far is a surprise! In many aspects, though, we are only reacting to the problems and not solving them. If the grass is not growing, you fertilize it; if it's wilting, you water it; if it's diseased, you dope it; if it's dead, you look for another job. Taking revenge on the problem will not keep it from occurring a-gain. What is going to happen to our current management programs next year and the following year?

Because greens management is so important, we have adjusted to a program of excesses. Whatever we "think" may be needed on the greens, we buy and apply. We may not be able to build new greens, but usually can spend all the money we think necessary on the greens we have. We hear many college graduates saying they soon become bored being a superintendent. The superintendent is most often trained as an agronomist. An agronomist is one who manages the crops and soil. As is suggested below, today's superintendent is not generally performing as an agronomist.

Instead of reading a soil test report to determine fertilizer needs, we are applying a magical mix of organic fertilizer with minor elements that is sure to take care of any potential nutrition problem. Many people would like to believe that we cannot use the "agricultural" fertilizers on our golf courses. To me this is a gross fallacy. The specialty formulated turf fertilizers have reduced the needed expertise of the superintendent. You don't have to be so concerned about foliar burn, about getting the right ratio of nutrients, and the right rate. All you have to do is read the bag and look for the spreader settings needed. You don't even need to calibrate the spreader. In the future, can we afford these materials that may be three to four times as expensive as agricultural fertilizers?

Instead of observing growth rate, weather, etc., and determining when to mow, we mow daily. In the past five to ten years we have both decreased the mowing height and increased the frequency. This extra mowing certainly increases the need for more disease control, pesticides and overall management. We used to be satisfied with 1/4 to 5/16 inch summer heights, but now are happy only if we can maintain that height at 1/8 inch or less. We used to be satisfied with three or four mowings per week on greens, but now must mow every day, and even cross-cut on weekends or special holidays. This has taken away from our "greenskeeping". We make the grass adapt to our schedule. Even if it dies, we will cut it every day while looking for another job. It certainly doesn't take an agronomist to send the mower operator out every morning.

Instead of modifying the topdressing with our own designed blend, we often topdress with pure sand. It certainly doesn't take much art or agronomic expertise to buy sand and put it on the green.

Instead of detecting the weather factors and turf "health" for disease control applications, we schedule a preventative fungicide program. This has helped to almost eliminate visible damage to greens, but it has required more labor and pesticides. This has increased the cost and lessened the need for a superintendent's expertise. You don't have to know or project when the disease will occur, you just apply the pesticide anyway. If the pesticide you are using won't control the disease, then it probably can't be controlled anyway. You are already using the best pesticides on the market, regardless of the cost of the products.

We now have the equipment to make the irrigation easy; in fact, too easy. We often over-irrigate turf just because it is not a major job. In case of doubt concerning whether or not to irrigate, it is easier to irrigate. Prior to our automatic systems and pop-up sprinklers, in case of doubt, we usually did not irrigate. It was a very laborious operation. With today's increasing cost and shortage of water, can we continue to over-irrigate our turf? Will we not need to reinstigate sound agronomic principles of watering?

In many subtle ways, I believe this has greatly affected our profession. Instead of our small courses needing a greenskeeper, they often feel they need only a personnel manager or business manager who will see that the adopted mowing, fertilizer, and pesticide schedules are being followed. Many of the agronomic principles of management are being obtained from commericial or university literature. Employee training often becomes the stepchild of a local superintendent, equipment or pesticide peddler, or some other employee such as the pro. This has often caused our agronomy trained superintendents to become dissatisfied with their training and if they cannot perceive themselves as the future club manager, then the profession seems rather terminal.

We should not be pessimistic about the future of the superintendent. The profession will see better days. We have major problems facing this country which have already affected our golf courses.

As long as our basic resources are diminishing, the cost for golf course management will greatly increase. The average golfer is not a part of the affluent society. There is a greater and greater need to find other financial resources for the club. In any case, we will have to make the best purchases possible.

Management is becoming more and more difficult because the "buffers" are being taken out of our God-given environment. We have replaced soil with sand, mow every day, verticut weekly, apply water every day it doesn't rain (and some days that it does), apply pesticides on a preventative schedule, etc. The turf lives on the edge of disaster. There are still no miracle products that are going to save us from these self-imposed problems.

Our regulatory agencies may take a back seat for a short period of time, but the enforcement of pesticide usage is here to stay. "Pest management" is the vogue term at the present time. Certainly in the areas of ornamentals and turf, pest management programs are already beinginstigated and may be forced upon us. The intent of these programs is to identify, with trained scouts, major pest problems and apply controls only when necessary. This concept will certainly eliminate some preventative applications of pesticides and further emphasize the art of "greenskeeping".

Future research may be less helpful than in the recent past. The Turfgrass Research Division of the American Society of Agronomy developed a list of research priorities that would be (and should be) goals for this decade. The efficient use of water, development of stress tolerant varieties, and the development of energy efficient management programs top the list. These are all areas in which little research has been conducted, and they are all areas of utmost importance. This new emphasis is coming at a time in which industry money and support of turfgrass research is drying up. Recreation is not a high priority for either industry or government. Therefore, our scientific emphasis may diminish.

Professional responsibility, common sense management, is basic to turfgrass survival and growth. No longer can we do without education. The creation of EPA, HEW, OSHA, and the exploitation of scientific research has almost eliminated the turf manager that has only on-the-job training. Local conferences, short courses, and training schools are of utmost importance in continuing education for the manager. However, we must never underestimate the importance of experience. Formal education and experience develop the professional responsibility that can separate fact from fiction.

In the not too distant past, you may have heard someone say that you can't grow creeping bentgrass south of the transitional climatic zone, that perennial ryegrass is a short-lived perennial that has no place on the golf course, that you can't grow good turf on sand greens, that tall fescue is not a turfgrass, that you can never depend on Poa annua for quality turf, that you can't place riding mowers on greens, that automatic irrigation will never work, etc. Obviously, we are broadening the adaptation (imposed adaptation) of our grasses. The basics haven't changed, but the utilization of the basics has become more critical. As we impose additional stresses upon the turf, we must counter-balance that with improved management techniques.

We work within an amazingly complex biological system that allows us to make mistakes. Sometimes these mistakes do not manifest themselves for many years. Little do we know what will happen in the future. For sure, however, the art of "greenskeeping" should not be lost. You can't "buy" quality turf. You must "grow" quality turf.

MANAGEMENT TRENDS IN THE MIDWEST

Stanley J. Zontek, North Central Director
USGA Green Section, Crystal Lake, Illinois

As midwest regional agronomist for the United States Golf Association Green Section, I have the opportunity of seeing and visiting with almost 200 golf courses and their superintendents in a nine-state region. These half-day visits give us an excellent overview of what is happening today. In this presentation, I will endeavor to highlight some of the major trends we see. Please note that we see quite a cross section of golf courses, high to low budgets, and all else in between. Let us now discuss the trends we are seeing.

Common Sense Management - We are seeing and indeed encouraging superintendents to manage the grass for the deepest and most fibrous rooting system possible. When golfers look at turf, they basically are looking at the tops of the grass plants. As agronomists and turf managers, you should really look at the roots first as they support the growth of the top. This is a far better indicator of the overall health and potential survivability of that grass plant during the summer stress period. There is a tremendous amount of evidence which states that a naturally healthier grass plant will be much more resistant to diseases, insects, and stresses of mowing, wear and weather. Therefore, the very first criterion for a turf manager should be to develop a healthy turf and then apply chemicals as necessary to protect this grass. This is a very important point because without a deep and fibrous rooting system it will be difficult to maintain a good stand of grass.

There really is no secret to developing a good rooting system. Aeration, along with other methods of soil cultivation, helps to physically open the soil for the freer movement of air, water, nutrients and especially roots into the soil.

Balanced fertility and fertility applied in moderate to light amounts is also important. That is, over-fertilized turf will have a very lush top at the expense of the root system. Soil tests are important in maintaining these proper levels in the soil.

Water control. Irrigation too early in the spring or too much irrigation during the year can cause a root system to die back and be shallow. Careful water control, applying only enough water where and when it is needed is essential for good root growth.

Finally, it is important to know the life cycle of that grass plant so that you can better time such things as aeration and topdressing for better roots.

Topdressing - Only a few years ago topdressing wasn't being practiced anywhere near what is being done today. Almost every golf course we see is topdressing more. Is it better for the grass plant? Yes, especially as it relates to the playability of the putting green. A good putting green is smooth, true, firm, with tight turf, and at least above average in terms of speed as measured by the Stimpmeter. To achieve these ends, a good topdressing program is essential.

There will probably always be a debate on what is the best topdressing material to use, but there will never be a debate on what topdressing is accomplishing. We are seeing more topdressing and feel this trend will continue. Greens topdressed on a light and frequent program look and play better.

Pesticides - We are seeing pesticides used on more areas of the golf course than ever before. This is particularly true in the case of fairway fungicide spray programs. There seems to be a real trend in having better and more playable fairway turf and controlling diseases is certainly an important part of keeping the grass plant in the fairway healthy. In our travels, we are seeing more courses starting or expanding their fairway fungicide efforts.

Recently, some new and very effective fungicides have been made available to the turfgrass industry. This is excellent! New fungicides for a wide range of diseases, including the difficult to control ones, such as pythium and Fusarium blight, are making effective control of diseases a reality. This is not to say that the old materials did not do the job; rather that the older tried and true products can now be supplemented with some of these new materials for even better disease control. The materials are expensive, but nonetheless should be a good investment.

Poa annua - We are seeing more and more golf courses and superintendents living with Poa annua. It is true that right now there is no foolproof method of Poa annua control. Also, our understanding of the Poa annua grass plant itself, along with some new and effective fungicides and better irrigation tehcniques, are giving many managers a real chance of keeping Poa annua through the summer stress period. Careful manipulation of the cutting height, irrigation, soil cultivation, fertility, and fungicide spray programs can result in improved chances of Poa annua survival year in and year out. We simply are seeing more superintendents doing a much better job of Poa annua maintenance.

Fairway Renovation - On those golf courses where, for whatever reason, the type of grass wants to be changed, we are seeing some fairly extensive renovation efforts. Some are using nonselective herbicides, such as Roundup™, to literally kill all the vegetation and replant to new grasses such as creeping bentgrasses or Kentucky bluegrasses with some perennial reygrasses added.

The other form of fairway renovation we are seeing is simply overseeding established fairways with either bentgrasses or a mixture of Kentucky bluegrasses and perennial ryegrasses. Ryegrasses are being established in fairways and although they are not a panacea, we are seeing them used quite a bit, especially in high traffic areas where they will stand up much better than other species.

In the more southern areas of this region, we are seeing some conversions of fairways to zoysia and bermudagrass. It has been our experience that bentgrass is moving farther south and warm season grasses are moving farther north. Why? The answer is that the warm season grasses are at their best during June, July and August when the cool season grasses are generally at their weakest. For many golf courses which experience peak play in the summer, there is a strong case to be made for zoysiagrass or bermudagrass establishment. There are certainly pros and cons to this, but again, in our travels we are seeing golf courses considering the use of these warm season grasses on their fairways. Some new techniques are being developed, such as row planting, to establish these grasses, and these techniques certainly have not yet stood the test of time. However, there is ongoing work to determine the best way to establish warm season grasses in at least the southern portions of the Midwest.

The Natural Golf Course - Much has been said in the last few years about golf courses "going back to nature". Deep rough areas are being left uncut, banks and fringes around bunkers not mowed, and maintaining parts of the golf course with less grooming. It is interesting to us that what began as a way of saving some dollars of a budget has now developed into a way of presenting an attractive and more playable golf course. Many of these natural golf courses play better than some of their softer and wetter neighbors. To many golfers today, this improved playability is their most important consideration, so the more natural golf courses are benefitting both by somewhat lower levels of maintenance and improved playability. We think that this natural trend will continue.

Mowing Fairways With Triplex Mowers - It may seem inconsistent to talk about a more natural golf course on one hand and talk about mowing fairways with triplex mowers and even picking up the clippings on the other hand. However, when you really look at what these programs accomplish, you begin to see that they really aren't inconsistent, but rather are quite compatible in achieving one goal - improved playability.

Triplex mowing has a dramatic impact on the playability of the fairway turf. It simply must be seen to be appreciated. What started out on a few golf courses is now beginning to spread through the Midwest with golf courses stretching from New York to Chicago that are mowing their fairways this way now and more will conceivably be doing this in the relatively near future. It is an expensive way to mow the fairways. However, some courses, which have the mixtures of bentgrasses and Poa annua in their fairways, can afford and want the optimum in fairway playability. Mowing the fairways with triplex mowers and picking up the clipping is one way to achieve this. Again, this is a trend and is certainly quite a departure from the past when we spoke about efficiencies in maintenance using seven to nine gang tractors, mowing huge swaths of the fairways. It is quite a change, but there is no doubt that the improved fairway playability and overall health of the grass plant is certainly improved by this mowing technique. This topic will be discussed in more detail by others.

Summary - In summary, it is our firm position that the future of golf and golf turfgrass management is bright. There are many challenges facing the superintendent today. However, there are more effective pesticides, modern equipment, and better irrigation systems to give the golfers what they want. More and more, the golfers seem to be asking for improved playability. Therefore, in discussing trends the most important part is ever-improving playability of the golf course. There seems to be a trend away from the green, soft, wet, lush golf courses that, although they look pretty, don't play as well as the somewhat firmer, tighter, drier, and ultimately more playable, natural golf course.

COPING WITH STRESS

Carl Landgrebe, Superintendent
Hinsdale Golf Club, Clarendon Hills, Illinois

I am going to talk to you today about a major problem which affects everyone in this room. Stress. It affects almost every person today in our sophisticated socity. I am going to talk in some abstract terms, not lbs/1000 sq.ft. or in "Royal" Stimpmeter measurements. I'm not going to show you a lot of slides of beautiful green grass and tell you how I made it green. Rather, I am going to show you some adversities and how you and I might deal with them. So, after I sit down you'll have no better handle on growing grass, but you might just live longer.

Stress. What is stress? Why should we concern ourselves with it? We concern ourselves with it because we have to control it. Medical research is daily uncovering more and more links between major physical disorders such as heart attack, high blood pressure, ulcers, colitis, respiratory and digestive disorders and, recently, even arthritis. The underlying biological weakness determines the type of illness we express. Under stress, the parasympathetic nervous system, present under calm conditions gives way to the sympathetic nervous system. This change has been conclusively shown to cause an undesirable metabolic change leading to various physical and mental disorders.

What are some common causes of stress?

Anxiety	Future uncertainties
Time deadlines	Boss pressure
Uncontrollables	Worries
Adversities	

We don't have to look far to find potential uncontrollable adversities. Poa annua, Anthracnose, Dollarspot, Ataenius spretulus - disasters just waiting for a place to happen. It is these sometimes uncontrollable situations which set our jobs apart from other jobs.

What's the different element? Nature, and its infinite matrix of variable situations thrust upon us in such an unpredictable manner. So much is at stake emotionally. We put so much time, effort and investment into something that can be swept away by a three-inch thunderstorm the day before the invitational, or Pythium seemingly feeding on the Dollarspot preventative just applied.

Truly, our work environment is unique; a far cry from that of the airline pilot mostly on autopilot or the conductor of a train whose destination is established and route clearly defined by two steel rails. It is a different ballgame indeed when your success of failure depends greatly on the perpetuation of the living.

Ours is a challenge unparalleled. Think about it a minute. At 6:00 a.m. we must motivate the minimum wage earner, and at 8:00 a.m. explain to a chief executive officer of a billion dollar conglomorate on the first tee why frozen turf succumbs under the wheel of a golf cart. One might consider that a crisis, another might consider it opportunity. Depends on how you look at it!

Our environment is a stage set, with stress playing the leading role. Supporting actors? We have plenty, and you can name them just as well as I can; their names are in the club directory. They come with scripts well written, intentions not harmful, but somehow the result is all too often dramatic, with our emotions the victim. Triumverate system or three ring circus? You're at the controls indeed with all those self-acclaimed authorities, posing as consultant, who are trying to decide when the golf carts can roll, why the greens are slow, or whether the tees should be cut every day. So, ours is a tough task of developing a system to deal with stress so we are left emotionally uninhibited to control and organize the daily unpredictable elements of nature into a consistent product - a playable golf course.

There are many approaches to dealing with stress. I would like to draw your attention to two methods which I will call the direct method and the aversion method. The two methods differ in the way they approach the problem of stress.

In the direct method you attack your stress factors; thus the name, direct approach. The first step is to identify your stress factors or things which trigger tension in you. Write them down. A typical list for us might approach fifty items, and include such things as intolerable boss, fungal attack, three-inch Friday thunderstorms, undisciplined employees. The next step is to single out those which you can effectively control, and eliminate them one by one.

To realize how important elimination is we must understand the effect each additional stress factor has on the individual. As we add stress factors we are not adding simply the weight of an additional straw to the camel's back bringing us closer to the breaking point. We are not only adding the tension associated with the new factor, but adding a composite stress factor. In other words, we compound the amount of stress caused by each of our previous stress factors.

I personally don't put much confidence in the direct method because, quite frankly, I feel there isn't much we can do about the intolerable boss or the Friday thunderstorm or the furious club member who lost $200.00 because he missed a twenty-foot putt that he stroked perfectly across your "terrible" greens. So, I rely on the aversion method which I find very successful. It goes like this:

Stress factor-adversity. I can hear them now. What happened to the greens? Will the grass come back? Can we play? This provides the setting which starts the process, which provides the tension, which triggers the sympathetic nervous system which results in what we recognize as head throbbing, dry throat, queasy stomach, or body jitters.

Now it's time for you to step in and do something positive; take control of the situation. How do you do that? Apply the flashback. Flash back to some memorable experiences, places, events, or people. Relive those precious moments in your mind. Take yourself back momentarily. Break away mentally. This will help you maintain your composure when faced with the various pressures surrounding adversity. Regroup your thoughts, maintain that overall perspective to allow you to keep the impact of that adversity in context. Don't allow it to balloon out of proportion. Don't let it dictate your mood.

The system works for me. I am sure it would work for you. It's simply a way to actively take charge of your mood. The doctors call it hypnotherapy. They are much better instructors, I admit, but frankly, I can't afford their $100.00 plus per hour fees. So it's imperative that we develop our own system to cope with our individual stress factors.

Don't think this is a one-shot process. It is a perpetual process requiring periodic implementation. Because, as sure as you think you have it licked and are flying high, here comes that three-inch Friday afternoon 100-year storm that seems to come every other year. This can send you reeling down once again to the emotional cellar. While you're there don't reach for the wine though; it's not that kind of cellar. That will only lead to other more direct physical problems. As you well know, it's not at all hard to slip away, bury yourself in your sorrows, heap great mental anguish upon yourself, and get yourself into a downright irritable mood and thus put yourself into a much less tolerant position to listen to petty comments.

Practice the aversion method. Think of something pleasurable, memorable. It will once again serve to release tension, block the inevitable multipler build-up effect of tension. This is a way to wisk away those headaches and give you a soothing feeling like first stepping into that hot bath.

Here's an opportunity I have right now on my course to practice the aversion method. This ice coating of adversity came January 2. After overcoming the initial emotional depression brought about by the thought of the possible ramifications of this ice coating, we acted quickly. We researched the situation and devised two tools - the inverted lever implement and the multiple piercing implement.

(shovel) (pick)

The removal of the ice barrier from an acre of fairways assisted us in removing emotional stress factor Number 106. Until that time though I had my mind focused on some pleasurable thoughts.

Let me share with you now another adversity, one I might class as a super-adversity, one which goes beyond the need for momentary aversion and positive flashback control. This adversity allowed me a nine month extended period for daily aversion practice! You guess it - the old and familiar storm-sewer-across-the-golf-course adversity. For you out there who have not directly experienced this adversity, your time is coming.

Let me explain further why I consider this a major adversity. Case in point: golf course founded in 1898, automatic irrigation installation completed July 1979, commencement of installation of 24" storm sewer and retention berm across golf course September 1979. The eighty year old golf course and the village approved installation of this project to begin just two months after the completion of the automatic irrigation installation. Believe me, that's adversity in its purest form!

I'm sure you've heard the saying, "when it rains, it pours", and have probably used it many times yourself. Then you realize it's usually used in relation to adversity. Well, I got to concentrating so heavily on this super-adversity that I guess it affected even my subconscious because one night I dreamed it rained and poured and the wind blew. Yes, the wind did blow and blow and blow. When I arrived at the course Wednesday morning I realized that my dream had come true! You couldn't see the golf course for the debris. You're right; more aversion practice. With three fourteen hour days we successfully removed this adversity, and by Saturday there was no sign of a storm.

Let me go back to a previous list of adversities I gave you and dwell a moment on one which I think needs special attention - time deadlines. This is, I think, a very common self-inflicted adversity. I'm talking about where we schedule more work than we can physically complete in a given period of time and is commonly known as bitingoff more than you can chew. The fault in this is obvious. We distort the impact of time, making a glance at our watch seem like a vision of the tower of Big Ben. Be careful, this can lead you into a head-on collision with your deadline.

Let's face it. There are those times when you feel totally downtrodden, emotionally out of it, depressed. Nothing can go right. Let me, with the use of visual aids,quickly run you through the aversion process. Here you are, feeling as though you have a mass of burdens perched directly overhead. Don't relent, exercise your aversion technique. Look up. You will be surprised at what you may envision. In fact, you may get a glimpse of Heaven. Believe me, it can be a soothing, refreshing experience, and certainly a positive approach to affecting your mood.

As we search our memories for possible subjects for use in our aversion system, I might suggest looking within the confines of one's own golf course. You know, ours is a work environment second to none. If one likes the out-of-doors, you can't beat our surroundings, so search your mind for those pleasureable moments, experiences or accomplishments on your course that might serve as reserve subjects for pleasant recall process. They might be special reconstruction projects you completed, such as tees. I have 26 of these I can pick and choose from for memory recall. But don't let those authoratative consultants rob you of your memorable visions by casting out those petty criticisms, like, shouldn't you have done it this way or that way?

Keep your mental registry process open so that when you have an opportunity to turn something like this into something like that, you can use it in the future as a mental recall reinforcement of your mood. True, these accomplishments may not compare to Michaelangelo's Pieta, but who's to be the wiser if, in your own mind, you retain them as your own personal Pietas, for your own future reference.

KENTUCKY BLUEGRASSES AND THEIR CULTURE FOR TURF

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Kentucky bluegrass, Poa pratensis L., is the most important lawn grass in the northern half of the United States. It is hardy, aggressive, persistent, attractive and widely adapted. New lower-growing Kentucky bluegrass varieties have been developed which produce a more attractive, durable, persistent turf under a wide range of environmental conditions. These are making this species more useful to the turfgrass industry.

Origin and Adaptation

Kentucky bluegrass is native to the Old World and occurs naturally throughout the temperate regions of Europe and Asia. Early colonists brought the grass to North America in seed mixtures, hay and bedding. It was disseminated rapidly by birds and other animals. Much of the bluegrass found on millions of acres of fertile pastures, roadsides, and other open areas developed without seeding by man. Its ability to colonize is one of the reasons for its widespread occurrence.

Like other cool season grasses, Kentucky bluegrass grows best during the cool months of spring and fall. Studies at Beltsville, Maryland and Kingston, Rhode Island have shown that some root growth will occur throughout much of the winter in unfrozen soil if fertility and soil pH are adequate. With prolonged summer drought, Kentucky bluegrass may become dormant and turn brown. However, cooler temperatures and favorable soil moisture usually reverse the process and it usually recovers and resumes growth quickly. Instances of poor recovery from summer drought are usually associated with insects, thatch, excessive density, disease or management practices which include excessive applications of nitrogen fertilizer and/or close mowing. The development of varieties with greater tolerance to the long hot summers is a real challenge to the turfgrass breeder.

Soil Adaptation

Kentucky bluegrass is best adapted to well-limed, fertile loam soils. In humid regions the soil pH should be corrected to 6.0 to 6.8 for optimum performance. Under arid soil conditions in dry land areas Kentucky bluegrass thrives on soils having a pH as high as 8.0 if irrigation is provided.

Growth is best on well-drained soils. However, it is considerably more tolerant of poor soil drainage than the fine fescues. Helminthosporium leaf spot and crown rot can be especially damaging to susceptible varieties on poorly drained soils.

It is not as well adapted to the extremely sandy coastal plain soils as the fescues, or zoysiagrass unless such soils are properly modified with appropriate additions of organic matter, lime, fertilizer and irrigation. It is also moderately intolerant of excess salt accumulations.

Excessive traffic and poor management weaken the turf and may favor the invasion of species more tolerant of compacted soil conditions such as Poa annua and knotweed. Friable soils of good physical condition enhance the ease of establishment.

Fertility Response

Bluegrass responds well to generous fall fertilization but minimal spring and summer fertilization is usually best under conditions when summer stress is severe. Turf should be fertilized primarily to improve color and density or to heal injury. This can be done most effectively from September through late fall. Short days and cool fall temperatures stimulate tiller production and root growth. They also reduce the rate of leaf blade elongation and cause the plant to grow in a more decumbent manner. In contrast, during the long days in May and June rapid leaf elongation occurs and plants are upright.

Excessive nitrogen that stimulates bluegrass in late spring and summer prevents it from developing a physiologically hardened condition that helps it survive heat and drought stress. Lush growth resulting from high fertility also intensifies damage from the Helminthosporium leafspot and crown rot diseases. In short, fall fertilization of turf causes less turf injury during stress, requires less mowing, gives adequate color and better turf density than spring fertilization.

Adaptation to Shade

Bluegrass normally performs best in full sun. It will tolerate light to moderate afternoon shading. In fact, the cooling effect may reduce injury from chinch bugs, Fusarium blight, heat and drought. In warmer regions, bluegrass is normally found only in partial shade. Shaded areas with resticted air movement result in slow drying of turf and a hot humid microenvironment which weakens the grass and provides conditions favorable for disease development.

Moderate to heavy shading reduces carbohydrate food reserves, restricts development of roots, rhizomes and tillers and causes long thin succulent leaves. Such turf is predisposed to diseases, intolerant of wear and less able to recover from injury. Kentucky bluegrass sod laid in dense shade roots slowly and usually fails in one to three years.

There is some variation in the shade tolerance of bluegrass varieties. Powdery mildew, (Eysiphe graminis), is a disease which is very damaging to susceptible varieties growing in shade, but of little consequence in full sunlight. Selection for mildew resistance has been of primary importance in breeding shade tolerant bluegrass varieties. Warren's A-34, Eclipse, Bristol, Benverde, Touchdown, Nugget, Birka and Glade are varieties with moderate-to-good mildew resistance. However, it must be pointed out that different pathogenic races of powdery mildew develop naturally which cause some of these selections to become infected.

Shade tolerant bluegrasses should have good resistance to leafspot and other diseases. Also, they must have the ability to photosynthesize enough food to give tillering, generous rooting, rhizome development and carbohydrate storage.

Breeding Behavior

Bluegrass produces seed both sexually and asexually. The latter occurs through a process called apomixis. In this process an unreduced egg develops into the embryo of the seed without fertilization by the male nucleus of the pollen. Seed formed by apomictic reproduction is therefore genetically identical to the mother plant. Many bluegrasses produce nearly all of their seed by apomixis so breed true to type through many generations of seed increase. Some are highly sexual and must be propagated vegetatively to maintain genetic uniformity and the original characteristics.

Disease Resistance

Use of disease resistant varieties along with good management practices is the safest and most economical means of controlling many important turfgrass disease problems. Resistance to disease is a prime consideration in selecting bluegrass varieties.

Melting Out Disease

The most damaging disease of Kentucky bluegrass in humid areas is a leafspot and crownrot caused by the fungus, Helminthosporium vagans, which is commonly called melting out. This disease appears as circular to elongate, purplish to brown spots with straw-colored centers occurring on leaf blades and sheaths. Some lesions extend the entire width of the leaf, especially on the finer-bladed varieties, causing the portion of the leaf blade distal to the affected area to wither and die. During the severe attacks, especially in late spring and early summer, the fungus causes severe leaf die-back and extensive crown rotting which leads to a "melting-out" condition.

Leafspot produces abundant spores during the cool, cloudy, wet season from October through April. Moderate disease buildup may occur in the fall, persist through the winter, and subsequently intensify into severe damage in April, May and early June. If the turf has not been damaged too severely it will recover significantly provided growing conditions are favorable.

Table 1. Resistance of Kentucky bluegrass varieties to leafspot under turf maintenance.

Good Resistance	Moderate Resistance	Poor Resistance	Very Poor Resistance
Nugget	Victa	Newport	Primo
Touchdown	Baron	Cougar	Delta
Enmundi	Cheri	Prato	S-21
Merion	Plush	Delft	Park
Bonnieblue	Glade	Windsor	Arboretum
Eclipse	Mystic		Palouse
Bristol	Merit		Geary
Majestic	Vantage		Kenblue
Birka	Aquila		Nu Dwarf
Adelphi	RAM I		Common (So. Dakota)
Columbua	Scenic		Troy
Georgetown	Wabash		Argyle
Parade			
Trenton			
Rugby			
Warren's A-34			
Sydsport			
America			

The severity of the Helminthosporium leafspot and crown rot is greatly influenced by various management practices. Disease injury is more severe with close mowing than high mowing. The shorter cut removes more photosynthetic surface thus limiting carbohydrate development. This weakens the turf, making it more susceptible to damage and less capable of recovery. Plants receiving low to moderate levels of nitrogen fertilizer often show greater numbers of leafspot lesions when examined in March and April. However, during late May and early June when the melting-out or crown rot phase of the disease is most severe, turf receiving high rates of nitrogen fertilizer suffers the greatest damage. Low light intensity due to either shade or cloudy weather also lowers carbohydrate reserves and increases disease damage.

The best methods of controlling this disease are the use of resistant varieties (Table 1) such as Eclipse, Bristol and Touchdown, higher cutting heights, and avoiding excessive nitrogen fertilization during the spring season. Varieties such as Park, Delta, Arboretum, S-21 and Kenblue perform little, if any, better than Common Kentucky bluegrass due to their high susceptibility to Helminthosporium vagans.

Stripe Smut

Stripe smut caused by Ustilago striiformis can cause serious damage through the United States. Apparently, it is not a serious problem in Europe. Stripe smut has been observed for many years and can be found in virtually all mature bluegrass stands. Spores present in the soil or carried on the seed germinate and systemically infect tillers and young seedlings. Long, narrow, gray to black stripes develop on the leaves. The gray stripes are unruptured sori. The black streaks result when the smut sori rupture and liberate mature spores. Following the rupture of the sori, infected leaves curl from the tip downward and become shredded. Such tillers then die and disappear during periods of winter and summer stress. The result is a progressive weakening and deterioration. Temporary periods of partial recovery may occur. Most new stands of the susceptible varieties, if infected, do not deteriorate seriously until they are three to four years old. Some turfs escape damage for longer periods. Turf infected with strip smut becomes much more susceptible to leafspot and other diseases. Resistant varieties (Table 2) offer the most practical means of control. Some of the systemic fungicides are useful for control of stripe smut in turf.

Table 2. Resistance of Kentucky bluegrass varieties to stripe smut under turf maintenance, N. J.

Good Resistance	Moderate Resistance	Poor Resistance	Very Poor Resistance
Glade	Adelphi	Cougar	Newport
Warren's A-20	Bonnieblue	Baron	Merion
Touchdown	Majestic	Cheri	Windsor
Plush	Fylking	Victa	
Birka	Pennstar	Scenic	
Eclipse	Parade		
RAM I	Columbia		
Enmundi	Trenton		
	Rugby		
	Vantage		
	Sydsport		
	Park		
	Bristol		

Dollar Spot

Dollar spot is caused by Sclerotinia homeocarpa. This disease is increasing in importance because of the widespread use of irrigation and susceptible varieties. (Table 5.) On bluegrass it forms small circular spots two to five inches in diameter which may merge to form large, irregular areas. The spots become straw colored and dead grass occupies the center. Fine, white, "cobwebby" mold growth may be seen in these spots on mornings when a heavy dew is present and the fungus is active. Lesions on individual leaves appear as bleached areas extending the width of the leaf with constricted margins and a chocolate-brown border. Moderate temperatures (68-86°F.) and thick thatch are favorable for dollar spot buildup. Turf deficient in nitrogen tends to show more damage from dollar spot than turf which is adequately fertilized. Different races of dollar spot respond differently to fungicide control and may attack varieties in a different manner.

Table 5. Reaction of Kentucky bluegrass varietites to dollar spot.

Moderate Resistance	Moderately Susceptible	Highly Susceptible
Eclipse	Merion	Nugget
Majestic	Fylking	Kimona
Adelphi	Pennstar	Mystic
Trenton	Glade	
Banff	Touchdown	
Columbia	Sydsport	
Parade	Baron	
Vantage	Victa	
Kenblue	Cheri	
Bristol	Plush	
	RAM I	

Growth Habit and Turf-Forming Properties

The growth habit of Kentucky bluegrass is influenced greatly by day length, light intensity and temperature. During short days, Kentucky bluegrass assumes a more decumbent growth habit, has a lower rate of leaf elongation, and tillering is more abundant. During long days, growth is more erect and leaf elongation is more rapid. Reproductive development also occurs during the long days of late spring. High light intensity increases photosynthesis and promotes the development of thick sturdy leaves and a deep green color. Low light intensity produces weak, thin, etiolated plants with a rapid rate of leaf elongation.

Common varieties such as Park, Delta and Kenblue have a rather erect growth habit wich a rapid rate of leaf elongation. Such varieties do not tolerate high nitrogen fertility and close mowing, especially during the spring and summer seasons. During the long days of spring and summer these varieties make noticeably taller growth. This results in the removal of a higher percentage of the leaf area and makes attainment of good turf difficult. Carbohydrate food reserves are depleted and such varieties become highly susceptible to damage from leafspot and crown rot disease.

Varieties such as Nugget, Eclipse, Midnight, and Glade appear to exhibit the short day length response of decumbent growth and slow leaf elongation through much more of the year than the common type bluegrass varieties.

Fusarium blight

The Fusarium blight disease is causing serious damage to the more lush bluegrass turf in the warmer regions. This disease is believed to be caused by either Fusarium roseum F. sp. cerealis or F. trincinctum F. sp. poae. Both species are capable of surviving as saprophytes in soil and on thatch. Fusarium blight is generally most severe during periods of high atmospheric humidity with daytime air temperatures of 80° to 95° F and night air temperatures above 70° F. Temporary drought stress, high nitrogen levels and heavy thatch appear to contribute to the severity of this disease. Control with fungicides such as benomyl require proper timing and is expensive. More information is needed on varietal resistance to this disease and on the stability of such resistance. Observations at New Brunswick during the summers of 1972 through 1976 showed that varieties differed substantially in susceptibility to Fusarium blight. Under conditions of high nitrogen fertility and 3/4-inch mowing, the common types of Kentucky bluegrass including Park, Kenblue, Arboretum and South Dakota Certified showed extensive damage from Fusarium blight disease. Fylking, Nugget, Geronimo, Delft, Modena and Enita had more damage than Merion. Windsor, Columbia, Enmundi, Parade, Adelphi, Rugby, Sydsport, Majestic, Vantage and Glade showed rather good resistance in these tests. Considerably more work is needed to develop better Fusarium blight resistance.

Rusts

A number of genera, species and races of rust infect Kentucky bluegrass. A variety resistant to one species or race of rust may be highly susceptible to another. Stem rust (Puccinia graminis) (Table 3) causes considerable discoloration of susceptible varieties in many parts of the United States. The disease is normally most serious under conditions restricting vigorous vegetative growth such as low fertility and moisture stress. An improvement in growing conditions usually brings effective control as new leaf blades are removed by mowing before infection develops. Merion and Touchdown are susceptible to stem rust, whereas Plush, Eclipse, Majestic, Adelphi, Bristol and Bonnieblue show moderate resistance to present races. Leaf rust (Puccinia poae-nemoralis) is common on Kentucky bluegrass but is normally of concern on only the most susceptible varieties such as Vantage (Table 4).

Table 3. Reaction of varieties to stem rust incited by Puccinia graminis at Adelphia, N.J.

Variety	stem rust rating
least = 0	
Eclipse	0.5
Plush	0.5
Majestic	0.5
Adelphi	1.0
America	1.0
Bristol	1.0
Bonnieblue	1.0
Enmundi	1.0
RAM I	1.0
Warren's A-34	1.5
Kenblue	1.7
Victa	1.8
Fylking	1.8
Nugget	2.3
Baron	3.0
Birka	3.0
Touchdown	6.8
Merion	7.5
most = 9	
$LSC_{.05}$	0.9

Table 4. Reaction of varieties to leaf rust incited by Puccinia poae-nemoralis at Adelphia, N.J.

Variety	leaf rust rating
least = 0	
Touchdown	0.6
Glade	0.6
Columbia	0.7
Trenton	0.7
Nugget	0.7
Warren's A-20	0.7
Park	0.7
Adelphi	1.0
Fylking	1.4
Sydsport	1.5
Delta	1.5
Bonnieblue	1.5
Majestic	1.6
Prato	1.7
Warren's A-34	2.7
Campus	2.8
Brunswick	2.9
Newport	3.0
Victa	3.0
Merion	3.0
Vantage	3.5
most = 9	

Fusarium blight

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Rusts

A number of genera, species and races of rust infect Kentucky bluegrasses. A variety resistant to one species or race of rust may be highly susceptible to another. Stem rust (Puccinia graminis) (Table 3) causes considerable discoloration of susceptible varieties in many parts of the United States. The disease is normally most serious under conditions restricting vigorous vegatative growth such as low fertility and moisture stress. An improvement in growing conditions usually brings effective control as new leaf blades are removed by mowing before infection develops. Merion and Touchdown are susceptible to stem rust, whereas Plush, Eclipse, Majestic, Adelphi, Bristol and Bonnieblue show moderate resistance to present races. Leaf rust (Puccinia poae-nemoralis) is common on Kentucky bluegrass but is normally of concern on only the most susceptible varieties such as Merion. (Table 4).

Table 3. Reaction of varieties to stem rust incited by Puccinia graminis at Adelphia, N.J.

Variety	Stem Rust
	least = 0 rating
Touchdown	0.6
Glade	
Columbia	
Trenton	
Nugget	
Warren's A-20	
Park	
Flyking	
Pennstar	
Sydsport	
Delta	
Bonnieblue	
Majestic	
Prato	1.8
Warren's A-34	2.8
Campus	
Brunswick	
Newport	
Victa	
Baron	
Merion	
Vantage	most = 9 7.3

Table 4. Reaction of varieties to leaf rust incited by Puccinia poae-nemoralis at Adelphia, N.J.

Variety	leaf rust
	least = 0 rating
Eclipse	0.5
Plush	
Majestic	
Adelphi	
America	
Bristol	
Bonnieblue	
Enmundi	
RAM I	
Warren's A-34	1.5
Kenblue	
Victa	
Flyking	
Nugget	
Baron	
Birka	
Touchdown	7.5
Merion	most = 9
LSD .05	0.9

Tolerance of Close Mowing

For golf course fairways, the turf should make an attractive, uniform carpet which is dense enough to give a good lie to the ball. It must also be able to heal divots rapidly, tolerate considerable traffic and resist the invasion of annual bluegrass.

Frequent, close mowing, adequate fertility and water are needed to produce the dense, stiff leaves required to support the ball above the soil surface. This dense turf is the result of a much higher population of tillers per unit area. Because of this increased competition between tillers plus more severe defoliation the grass may be weakened. It develops a less extensive root system and is more subject to drought damage and disease attack. Close cutting and frequent watering encourages rooting above the soil surface and thatch buildup. This favors many disease organisms. Also, damage from disease is more apparent on an otherwise attractive, uniform,closely cut turf.

In less favorable climates improved varieties and better management are needed for successful results. Many of the current Kentucky bluegrass varieties including Nugget, Warren's A-20, Touchdown, Bonnieblue, Eclipse, Birka, Fylking, Majestic, Merion, Adelphi, Glade, Sydsport, Victa, Cheri, RAM I, and Baron have characteristics which make them more suitable for close-cut fairways than erect-growing leafspot susceptible varieties. New selections collected from close-cut turf areas and those generated in hybridization programs give promise of additional improvement.

Table 6. Growth habits of Kentucky bluegrass varieties.

Lower-growing with a moderately slow rate of vertical growth	
Midnight	Glade
Nugget	America
Eclipse	

Moderately low-growing		
Brunswick	Baron	Parade
Warren's A-20	Victa	Columbia
Merion	Bristol	Trenton
RAM I	Sydsport	Rugby
Bonnieblue	Majestic	Banff
Birka	Fylking	Newport
Touchdown	Aquila	Windsor
Cheri	Adelphi	Wabash

Erect with Rapid Vertical Growth	
Park	Kenblue
Arboretum	Common
Palouse	Delta
S-21	Troy
Geary	Argyle

Heat Tolerance

Most of our attractive, dense, lower-growing turf type varieties were selected in the cool summer climate of Northern Europe and from other breeding and evaluation tests located in cool environments. Many of these varieties are often disappointing in southern trials. An extensive program to collect and evaluate adapted germplasm from summer stress areas of the Mid-Atlantic area and lower Midwest should provide varieties with improved summer performance and dependability. Under conditions of moderately low nitrogen fertility and high cut, varieties that typify common types, such as Kenblue, have survived well in the transition zone. Under conditions of somewhat closer mowing and higher fertility the lower-growing, wider leafed, open types having extensive deep rhizomes, such as Vantage, have performed better. Merion has shown above average summer performance when managed properly and when not affected by disease or insect problems.

Color

Visitors at experimental plantings of selections and hybrids are impressed by the great diversity of shades of green observed. Mystic has a very attractive bright light green color. Adelphi and Glade have bright, dark colors. Some selections like Bonnieblue, Parade, Columbia and Majestic retain excellent color into the winter and green up early in the spring. Others like Midnight go dormant in late fall and green up later in the spring. Still others like Nugget green up very slowly in the spring. Many types show a pronounced purplish cast in late fall, winter and early spring, whereas some, such as Parade, Columbia and Bonnieblue appear to lack this purplish pigment./[1]

KENTUCKY BLUEGRASS VARIETIES

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Adelphi is a moderately low growing, turf type bluegrass with a very attractive, dark green color which is maintained throughout the entire growing season. It has shown good resistance to leaf spot, Fusarium blight, stripe smut and rust and has moderate resistance to dollar spot. Adelphi is a hybrid between a fairway selection from the Bellevue Country Club near Syracuse, NY, and Belturf.

America originated as a single, highly apomictic plant. It was selected from the open pollinated progeny of a highly sexual hybrid from the F_1 progeny of the cross 'Bellevue' x 'Belturf'. America is a leafy, low-growing, turf type bluegrass capable of producing an attractive, compact, fine-textured turf of high density and a dark green color. America has shown good resistance to leaf spot and leaf rust. It has shown less damage from stripe rust than most varieties.

Baron was developed in Holland. It has rather broad leaves, a moderately low-growing, turf type growth habit and a medium dark green color. Baron has shown moderately good resistance to leaf spot and has been widely accepted as a good variety. It has shown moderate susceptibility to leaf rust, stem rust, dollar spot and powdery mildew. Baron is moderately slow to become green in the spring. It has a large seed and rather fair to good seedling vigor.

/[1] Some of this work was performed as part of New Jersey Agricultural Experiment Station Publication No. J-15166-3-82, supported by State funds, other grants, and gifts. Additional support was received from the U.S. Golf Association Green Section Research and Education Fund, Inc.

Birka was developed in Sweden. This variety has a medium fine texture, a moderately low growing turf type growth habit and a moderately dark green color. Birka has shown good resistance to leaf spot, stripe smut and powdery mildew in New Jersey tests. It is moderately slow to green up in the spring. The variety is susceptible to stem rust.

Bonnieblue is a hybrid between the selection from Bellevue C. C. and Pennstar. This moderately low growing, turf type variety has good resistance to leaf spot, stripe smut and rust. It has a bright, rather dark green color and becomes green early in the spring.

Bristol is a hybrid between a fairway selection from the Bellevue C.C. and Anheuser Dwarf. This variety has a rich, dark green color, wide leaves and a rather decumbent growth habit, with a moderately slow rate of vertical growth. Bristol has good resistance to leaf spot and moderately good resistance to stripe smut , dollar spot and most races of powdery mildew.

Cheri was developed in Sweden. This variety has medium broad leaves, a moderately low growing, turf type growth habit and a medium dark green color. Cheri has shown moderately good resistance to the leaf spot and crown rot disease. It has been moderately susceptible to leaf rust, stem rust, dollar spot and powdery mildew. Cheri is moderately slow to green up in the spring. Cheri has large seed and rather good seedling vigor.

Columbia was selected from an old, non-irrigated, moderately low maintenance turf near Frederick, Maryland. This moderately low growing, turf type variety has medium texture, good density, and a bright, medium dark green color. Columbia has an exceptionally attractive early spring color, the ability to stay green into late fall, and the capability of maintaining good winter color in protected locations. Columbia has shown good or moderately good resistance to leaf spot, leaf rust, stem rust, dollar spot, stripe smut and Fusarium blight. Turf produced may have a high proportion of stemmy reproductive tillers in late spring and early summer.

Common, South Dakota Certified, is another source of natural bluegrass harvested from native stands. Kenblue and Park have visually outperformed South Dakota Certified in New Jersey tests. Studies by Dr. Glen Wood in Vermont showed that bluegrass from the Kentucky area produced turf more resistant to weed invasion than bluegrass obtained from South Dakota.

Delta was selected in Canada. It is similar to common in growth habit and appearance and is also highly susceptible to the H. leaf spot and crown rot disease. In earlier years Delta generally performed as well as common Kentucky bluegrass in turf tests at Rutgers. However, during the past few seasons the performance of Delta has been poor.

Eclipse is a highly apomictic hybrid selected from the progeny of the cross 64-765-4 x Anheuser Dwarf. The female parent, 64-765-4, was selected from the progeny of the cross SP-1 x Belturf. Eclipse is a low growing, leafy, turf type variety capable of producing an attractive, dark green turf of good density, good vigor and medium texture. Eclipse has demonstrated good to moderately good resistance to leaf spot, leaf rust, stem rust, powdery mildew, stripe smut and dollar spot. It has performed well in shade trials.

Enmundi is a leafy, attractive,moderately low growing variety developed in Holland. The variety has shown good resistance to leaf spot, stripe smut and Fusarium blight. Low seed yields are limiting the use of Enmundi.

Fylking was developed in Sweden. This turf type variety has good resistance to the H. leaf spot and melting out disease. It is damaged by dollar spot and Fusarium blight. Fylking produces an attractive, dense, moderately low growing turf of a rather fine texture. An attractive, rich, dark green color is developed in early spring which is maintained into late fall and under moderately adverse growing conditions such as low fertility and incipient drought. The variety has rather fine leaves which tend to lean at higher cutting heights, thus a neater appearance is attained with moderately close mowing.

Glade is a moderately fine textured, dark green selection obtained from an old lawn in Albany, New York. It has shown excellent resistance to stripe smut, powdery mildew, and rust, and it has moderate resistance to leaf spot. Glade is an aggressive, turf type bluegrass with a relatively slow rate of vertical growth. This variety has shown good seedling vigor. It has performed well in blends and mixtures. It has shown some tolerance of moderate shade. Glade is moderately slow in spring green up.

Kenblue represents a blend of seed harvested from selected seed fields of 8 to 15 years standing, situated on 12 farms located in seven central Kentucky counties. After blending, part of the seed was used to establish a breeders seed block. The remainder was distributed to producers of certified seed. The first certified seed was harvested in 1967.

Majestic is a moderately low growing, turf type with a rich dark green color and rather prostrate leaf blades. It has shown good resistance to leaf spot and leaf rust and moderate resistance to dollar spot and stripe smut. It has excellent color especially during the cool seasons of spring and fall, and greens up early in the spring.

Merion originated from a single plant selection made by Joseph Valentine of the Merion Golf Club, Ardmore, Pennsylvania in 1936. Until recently, Merion was the only commercially available variety with good resistance to the H. leaf spot and crown rot disease. Compared with common Kentucky bluegrass, Merion has wider leaves, lower growth, darker green color when properly fertilized, higher resistance to H. vagans and greater tolerance of close mowing. When properly managed, Merion is attractive, dense, vigorous turf, highly resistant to weed invasion and capable of withstanding moderate wear.

Weaknesses of Merion are susceptibility to strip smut, powdery mildew, stem rust, dollar spot and Fusarium blight. The latter disease is associated with turf weakened by high temperatures, excessive nitrogen, thatch accumulation, close mowing and with prolonged drought or improper watering.

Merit is a moderately low growing, turf type variety with a medium dark green color, a medium coarse texture, and medium density. Merit has moderate resistance to the H. leaf spot and crown rot disease. It has moderate color retention during low temperatures and medium spring green up. Merit has large seed and above average seedling vigor.

Newport originated as a single apomictic plant selected from coastal bluffs near Newport, Oregon. Newport has demonstrated good resistance to most current races of stem rust and powdery mildew, but is susceptible to leaf spot and stripe smut. Turf stands of Newport become very stemmy at seedhead setting time in June. Newport is often a short-lived type, performing better than common during the first two or three years of a test, but it does poorly or it dies out as it ages. Its only use appears to be in blends with other more persistent bluegrass varieties. Newport is a heavy seed producer.

Nugget was found growing in Hope, Alaska. This variety produces a very dense, compact, rather low growing turf which can be extremely attractive, especially in mid-to-late spring. Nugget has good to excellent resistance to leaf spot, most races of powdery mildew and New Jersey races of leaf rust. Unfortunately, it appears to be susceptible to stem rust, dollar spot, Fusarium blight and aphids. This variety has good tolerance of close mowing and moderate shade when free of disease and insect damage. Nugget is very slow to start growing in the spring and has very poor early spring color. Nugget has frequently looked promising in preliminary turf trials. Its performance has been very erratic.

Parade was developed in Holland. This moderately low growing, turf type variety has a medium texture and a pleasing moderately dark green color. Parade has good resistance to leaf spot and rust and above average resistance to dollar spot and stripe smut. Parade has excellent early spring color. Early summer turf quality is often adversely affected by an abundance of reproductive tillers.

Park resulted from an extensive selection and testing program initiated in Minnesota in 1937. A large number of plants were collected from old pastures and wasteland areas. The 15 best apomictic strains were blended to produce Park, which was released in 1957. The variety has excellent seedling vigor and has shown moderate resistance to stripe smut, leaf rust and stem rust. Some of the component strains have good resistance to powdery mildew. Park is similar in appearance and growth habit to common, and is susceptible to H. leaf spot. Park has often shown some advantage in performance over common.

Ram I was discovered growing on a putting green of the Webhannet Golf Club in Kennebunk Beach, Maine. Ram I is a moderately low growing, leafy, turf type cultivar with a medium texture and a rich, dark green color. Ram I has shown good tolerance of moderately close mowing and good early spring color. It has moderate resistance to leaf spot and stem rust, good resistance to stripe smut and most races of powdery mildew. It has moderate susceptibility to leaf rust and dollar spot.

Rugby is a mdoerately low growing, turf type variety with medium texture, good density, and a bright, medium dark green color. Rugby has a very attractive early spring color, the ability to stay green into late fall, and can maintain good winter color in protected locations. Rugby has shown good, or moderately good resistance to leaf spot, leaf rust, stem rust, dollar spot, stripe smut and Fusarium blight. Turf produced by Rugby is generally very stemmy during its reproductive period.

Sydsport was developed in Sweden where it is reported to have good tolerance of the wear and abuse received on athletic fields. It has medium wide leaves and can produce a rather tight, dense sod of a medium light green color. Sydsport appears to have moderately good resistance to leaf spot and stripe smut but susceptibility to dollar spot has been observed in some tests.

Touchdown is a fairway selection from the National Golf Links of America located on Long Island. It has excellent resistance to leaf spot, stripe smut, leaf rust and most races of powdery mildew but is moderately susceptible to stem rust and dollar spot. Touchdown is a very aggressive turf type variety with medium texture and a moderately dark green color. Like Warren's A-34 and Brunswick, Touchdown has an excellent record of bring able to compete well against annual bluegrass in closely mowed tests at Rutgers. These very aggressive varieties will normally dominate in blends and usually produce more thatch. Touchdown also shows promise of good performance in moderate shade.

Victa was developed by O. M. Scott's. It has medium broad leaves, a moderately low growing, turf type growth habit and a medium dark green color. The variety has shown moderately good resistance to leaf spot. It has been moderately susceptible to leaf rust, stem rust, dollar spot and powdery mildew. Victa is moderately slow in spring green up. It has large seed and rather good seedling vigor.

Wabash is a Purdue release of 1979. It was selected for use in parks, playgrounds, sports areas and roadsides. It is recommended for mixing with the improved turf type ryegrasses and new turf type tall fescues. Wabash has fast germination, good seedling vigor, and thus should get a better start than many bluegrasses in these competitive grasses. Wabash has good tolerance to Fusarium and rhizoctonia but can show moderate leaf spot infection. Seed is small, similar to Merion.

Warren's A-34 is a vigorous, disease resistant variety with somewhat better shade tolerance than other Kentucky bluegrass varieties currently available. When maintained at a two-inch mowing height, it will tolerate 65% shading in the daylight hours during the tree leaf period. A-34 also does rather well in full sun, producing a dense, medium green turf with moderately good resistance to stripe smut, powdery mildew and leaf spot. It has also performed well in wear tolerance trials in Michigan.

Varietal Blends. The admitted weakness of all currently available bluegrass varieties has caused many turf workers to recommend the use of varietal blends for better lawns, fairways and most other types of turf. It is hoped that the weakness of one variety will be covered up by a complimentary strength of another variety. This may or may not be true depending upon a number of complex ecological factors. We need much more research data on ecology, long-term performance and regional adaptation of bluegrass blends.

Research at Rutgers strongly suggests that a variety with good resistance to both strip smut and Helminthosporium leaf spot should be included in all bluegrass blends recommended for use on intensely maintained turf areas. Also, one or more should have high tolerance of close cut unless the turf will be mowed high.

PERENNIAL RYEGRASS VARIETIES AND THEIR CULTURE FOR TURF

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New Brunswick, New Jersey

Many exciting developments have occurred during the past 14 years in the breeding, development and use of improved turf type ryegrasses. Compared to perennial ryegrass, they have finer leaves, are much more attractive, more persistent, more resistant to many diseases, more shade tolerant, lower growing, easier to mow,leafier, and have much

better turf forming qualities. They are also quick to germinate, easy to establish, highly wear tolerant, and will grow on a wide range of soil types.

Turf type ryegrasses presently on the market (20) include: (Manhattan), Pennfine, Birdie, Citation, Omega, Derby, Diplomat, Yorktown II, Regal, Fiesta, Dasher, Blazer, Loretta, Belle, Pennant, Delray, Premier, Barry, Prelude, Palmer and Elka. Experimental varieties presently under development show promise of continued improvements in mowability, disease resistance, stress tolerance, insect resistance, attractiveness, ease of maintenance and turf performance.

The new ryegrasses have performed well on many soil types where Kentucky bluegrass is not well adapted. However, in areas where bluegrass is well adapted, a blend of the best varieties generally gives a superior lawn type turf. In situations where the slower establishment of bluegrass is not of serious concern blends of bluegrasses or mixtures with fine fescue should be used. When situations call for rapid establishment the turf type ryegrasses can provide a quick turf in heavily shaded areas. Their excellent seedling vigor and wear tolerance make them very useful on school grounds, play areas, and parks that receive heavy use, especially during cool weather.

The newer ryegrasses are especially valuable and widely used for the winter overseeding of dormant warm season grasses in southern areas to provide an attractive, useful winter turf. Their persistence and ability to tolerate close mowing and weed competition make them useful on fairways and tees. Successful ryegrass-bermudagrass combinations are providing good year-round turf on some golf course fairways in the Washington, D.C. area. On home lawns, the ryegrasses can be used in mixtures with bluegrasses and fine fescues to provide quick establishment where soil erosion, excessive weed competition, off-season establishment, or other factors make this desirable.

Mixtures of turf type ryegrasses and Kentucky bluegrass are often useful for overseeding or renovating turfs devastated by disease, insects, injury or wear. Often the ryegrass will remain a component of the permanant turf. A blend of the best bluegrasses mixed with the best ryegrasses often helps to insure improved long-term performance under varied management and stress conditions. Ryegrass persistence in mixtures also appears to be favored by close, frequent mowing and high soil fertility.

The professional turf grower should know the strengths and weaknesses of the turf-type ryegrasses, their areas of usefulness, where they should or should not be used, and their cultural requirements.

Establishment

The rapid, easy establishment of the turf type ryegrasses has been a prime factor in their popularity with both homeowners and turf professionals. Germination can be expected within five days and a cover ready to mow can be produced within three weeks if fertility, moisture, and temperature conditions are near optimum. Pythium damping-off and Rhizoctonia brown patch are two seedling diseases favored by hot, humid conditions and are more severe when nitrogen fertility and seeding rates are excessively high.

Growth Characteristics, Texture and Density

All of the better turf type ryegrasses have the ability to produce an attractive, leafy, medium dense turf in their area of adaptation. (Table 1). Present varieties are substantially lower growing than common perennial reygrass and varieties such as

Cropper, Game and Linn. However, they are still not equal to the best turf type bluegrasses in this respect. Continued improvements in reduction of vertical growth rate should be made in the next few years.

Experience has demonstrated that ryegrass forms much less thatch than bentgrass, Kentucky bluegrass, or Chewings fescue.

Table 1. Tiller densities and leaf width measurements of perennial ryegrass varieties grown at Adelphia, New Jersey during 1981.

Variety	Tillers per 100 sq. cm.	Leaf width mm.	Variety	Tillers per 100 sq. cm.	Leaf width mm.
1. Manhattan II	513	1.7	16. Regal	398	1.9
2. Prelude	457	1.9	17. Fiesta	394	1.8
3. Palmer	457	1.7	18. Dasher	371	1.9
4. All-Star	436	1.8	19. Diplomat	362	1.9
5. Premier	436	1.8	20. Derby	357	1.9
6. Yorktown II	434	1.7	21. Accliam	355	1.9
7. Barry	427	1.6	22. Pennfine	355	1.9
8. Blazer	426	1.7	23. Pennant	353	1.9
9. Elka	424	1.6	24. Manhattan	302	2.0
10. Goalie	420	1.9	25. Rex	296	2.1
11. Jackpot	407	1.8	26. Barcelona	288	2.0
12. Barclay	406	1.9	27. Caravelle	269	2.1
13. Belle	404	1.9	28. Cropper	196	2.4
14. Delray	403	1.9	29. NV1-Code	170	2.3
15. Loretta	402	1.6	30. Merion bluegrass	275	1.9
			$LSD_{.05}$ =	53	0.2

Color

Most turf type ryegrasses developed in this country have a bright, attractive, medium dark color. Of the adapted varieties, Citation has the darkest green color. Caravelle and some of the experimental selections are even darker. Loretta and Elka have a bright, medium green color preferred by many Europeans.

Wear Tolerance

Manhattan is very widely used on soccer fields in Northern Europe because of its excellent wear tolerance, rapid recovery from injury, ability to compete with Poa annua, and good winter performance. The ryegrasses are most vigorous during the cool moist periods of spring and fall. The better ryegrasses can be very useful for sports turf and other excessive wear situations if properly managed. They have a low crown, a tough leaf and an excellent capacity to recover from wear. Their tolerance of soil compaction is superior to most cool season turfgrasses. Areas that acquire excessive wear should receive regular overseeding. A turfgrass variety exhibits its best wear tolerance under conditions where it is best adapted. Wear tolerance is reduced by disease, shade, insect injury, poor management, or unfavorable environmental conditions.

Mowing Characteristics

Poor mowing during certain stress periods is an area of concern with all ryegrasses presently available. The improved turf types generally mow rather well during the cool moist seasons of early spring and fall, but with greater difficulty during the reproductive period in late spring and during periods of heat and drought. Frequent cutting with a sharp, well-adjusted mower is very important in the maintenance of an attractive ryegrass turf. Infrequent mowing reduces turf quality and lowers turf density. Improvements in ryegrass mowing quality is a prime objective of turfgrass breeders.

Elka and Loretta normally show the best mowability during cool weather. The more heat tolerant varieties such as Manhattan II, Palmer, Prelude, Premier and Citation show less loss of mowing qualities during hot weather and rank highest during the summer months. Earlier maturing varieties including Regal, Citation, Derby, Pennfine, Birdie and Pennant produce an abundance of stemmy reproductive tillers during May and may become difficult to mow at that stage. The later maturing varieties such as Elka, Loretta, Manhattan, Manhattan II, Diplomat, Yorktown II, Blazer and Palmer are less likely to have an excessively stemmy turf during their reproductive stage.

Shade Tolerance

Although the turf type ryegrasses will not persist well in heavy shade, they can frequently be very useful as a temporary turf. Their rapid establishment enables them to produce several months of turf cover during seasons when tree leaves are absent, and they will persist several weeks into the summer after the leaves return. Improved shade tolerance is advantageous in many situations and breeding programs for this trait should be encouraged.

Summer Performance

Many turf type ryegrasses including Palmer, Prelude, Premier, All-Star, Manhattan II, Pennant, Citation, Pennfine, Birdie, Diplomat, Yorktown II, Omega, Fiesta, Dasher, Blazer, Delray, Derby and Regal demonstrate substantial improvements in heat tolerance and summer performance. Improved resistance to the Rhizoctonia brown patch disease is a very important factor in their improved summer performance in warm humid climates. This disease can frequently cause serious damage to ryegrass turf. The earlier group of ryegrasses developed in cool summer climates of Northwestern Europe are highly susceptible to Rhizoctonia brown patch. The newer turf type varieties originating from germplasm collected from old turfs of the mid-Atlantic region of the United States have shown significantly improved resistance to Rhizoctonia brown patch. (Tables 2 and 3)

Reaction to Rhizoctonia Brown Patch

Adelphia, New Jersey, July 1974

Table 2

Variety	Percent disease
Yorktown II	7
Citation	10
Pennfine	10
Derby	11
Omega	13
Diplomat	17
Yorktown	22
Manhattan	32
Eton	61
NK200	68
Linn	73
Servo	81
NK100	83
Pelo	86
S-23	88
Sportiva	89
Parcour	91
Endura	91
Splendor	92
Caprice	92
Compas	93
Combi	94
LSD at 5%	11

Adelphia, New Jersey, August 1978

Table 3

Cultivar or selection	Disease rating 9 = least damage
1. Pennant	7.5
2. Blazer	7.4
3. Yorktown II	7.0
4. Fiesta	7.0
5. Citation	7.0
6. Dasher	6.9
7. Belle	6.8
8. Diplomat	6.6
9. Regal	6.3
10. Derby	6.2
11. Omega	6.0
12. Birdie	5.9
13. Pennfine	5.8
14. Manhattan	5.0
15. Loretta	4.9
16. Score	3.1
17. NK100	3.1
18. Hunter	3.0
19. Caravelle	2.9
20. Sprinter	2.5
21. NK200	2.1
22. Linn	2.0
23. Venlona	1.9
24. S-321	1.9
25. Ensporta	1.8
26. S-101	1.7
LSD at 5%	0.6

Winter Performance

Manhattan, Omega and Yorktown II have shown the best winter hardiness in Vermont tests. Delray has performed well in Minnesota. Nevertheless, additional improvements in winter hardiness are needed. Winter kill has been observed in wet depressed areas where ice sheets have formed during two of New Jersey's most severe winters. Improved resistance to winter disease, including snow molds and the winter brown blight disease, incited by Drechslera spp., is also an objective of improvement programs. Palmer, Manhattan, Manhattan II, Yorktown II, Blazer, Diplomat, Omega, Belle, and Pennant show improved resistance to winter brown blight. (Table 5)

Table 4. Winter injury.
Seeded 30 Au 77, Rated 30 Mr 78
Adelphia, NJ

Variety	Winter injury
	%
Blazer	0
Yorktown II	0
Belle	0
Pennant	0
Fiesta	0
Diplomat	0
Dasher	0
Omega	0
Regal	0
Manhattan	0
Score	4
NK200	4
Loretta	5
Hunter	8
Sprinter	8
Citation	11
Birdie	12
Derby	14
Pennfine	18
Ensporta	24
Venlona	28
NK100	31
Linn	38
Caravelle	45
S-101	48
S-321	63
LSD at 5%	7.3

Table 5. Winter brown blight damage.
Seeded Aug 1974, Rated Dec. 1974
New Brunswick, NJ

Variety	Brown blight rating
	9 = least disease
Manhattan	7.6
Yorktown II	7.4
Blazer	7.3
Yorktown	7.2
Pelo	7.0
Diplomat	6.8
Omega	6.7
Fiesta	6.0
Dasher	5.8
NK200	5.0
S-321	5.0
Game	5.0
NK100	5.0
Eton	4.7
Derby	4.6
Linn	4.3
Birdie	4.2
Pennfine	4.0
Citation	3.6
Ensporta	3.0
LSD .05	0.9

Sod Webworm Resistance

Severe damage from sod webworm feeding was observed on variety trials at Adelphia, New Jersey during the abnormally dry months of August, September and October of 1980. Pennant showed substantially lower larvae counts and less damage than any other named variety. Additional research is needed to determine whether Pennant and some experimentals also resist other species of this insect pest.

Billbug Resistance

The bluegrass billbug (Sphenophorus parvulus Gyllenhal) often causes damage to Kentucky bluegrass and other grasses. Billbug larvae feed on the bases of grass stems during early and mid-summer. Small patches may coalesce to form large areas of damage. Tillers are easily pulled from the soil revealing signs of insects feeding at their bases. Severe damage from billbugs was observed during the summer of 1981. Pennant and Regal showed the best resistance when some others were heavily damaged. (Table 6)

Table 6. Relative billbug damage in turf trials at Adelphia, NJ, summer 1981

Variety	% Turf damage	Variety	% Turf damage
Pennant	3	Belle	34
Regal	4	Diplomat	36
Clipper	13	Rex	37
Barry	16	Birdie	37
Lp20	17	Ensporta	37
Pennfine	17	S-321	37
Dasher	18	NK-200	38
Score	19	Loretta	38
Exponent	20	Citation	39
Sprinter	21	Derby	40
Manhattan	22	Player	40
NK-100	26	Omega	40
Venlona	26	Idole	41
Ranger	26	Acclaim	42
Blazer	28	S-101	44
Linn	29	Hunter	45
Arno	32	Yorktown II	49
Fiesta	32	Caravelle	49
		LSD 0.05	14

Diseases

Crown rust incited by Puccinia coronata Cda. frequently causes discoloration of the turf during the late summer and early fall. This is most likely to occur if growth is slowed by low fertility or moisture stress. Crown rust is seldom a serious problem of turf if growing conditions are favorable and fertility levels are adequate to promote good growth. Many leaves are severed by clipping before the rust, which can only grow on living tissue, has a chance to develop from a new infections to a pustule. Elka, Loretta, Prelude, Premier, Fiesta, Delray, Pennant and Palmer showed the best resistance in recent New Jersey trials.

Winter brown blight, incited by Drechslera spp. is frequently observed on susceptible varieties during mild, wet winters. It is reported to be a serious problem on sports turf in Europe.

In the summer, Rhizoctonia brown patch disease frequently causes serious damage to ryegrass turf and seedlings in warm, humid climates. It is favored by moderately hot, humid weather and high nitrogen fertilization.

Pythium damping-off is another disease which can severely effect ryegrass seedlings. It is favored by wet, hot, humid conditions. Treatment with Koban and some newer fungicides can be effective in the control of this disease and is widely used for fall overseeding in the South. When there is an excessive amount of nitrogen and a high seeding rate, these diseases are most severe.

Pathologists now report that the disease formally called Corticum red thread is actually two or more diseases. They are currently being referred to as red thread and pink patch. These diseases can damage ryegrass during periods of cool, cloudy weather especially when fertility levels are inadequate. Dollar spot can also damage ryegrass and is severe at low fertility.

Table 7. Reaction to crown rust at New Brunswick, NJ during 1979 and 1980.

Variety	Rust rating (9 = least)	Variety	Rust rating (9 = least)
Elka	9.0	Pennfine	4.9
R39A	8.5	Citation	4.9
Loretta	8.5	Yorktown II	4.5
Prelude	7.7	Barry	4.5
Sprinter	7.7	Diplomat	4.4
Premier	7.4	Regal	4.4
Fiesta	7.3	Lp 20	4.2
Delray	7.2	Clipper	4.2
Pennant	6.9	Caravelle	3.9
Palmer	6.9	Derby	3.9
Birdie	6.5	Eton	3.7
Dasher	6.5	Yorktown	3.6
Linn	6.1	Omega	3.5
Acclaim	5.9	Barclay	3.2
Blazer	5.6	NK-200	3.0
Belle	5.6	Manhattan	2.9
NK-100	5.0	Barcelona	2.5

Performance

Data in Tables 8 and 9 indicate that many of the newest varieties may be significant improvements over varieties available just a few years ago. Palmer, Manhattan II, Prelude, Premier, Blazer, Fiesta, Belle, Pennant, Barry and Dasher are doing well in New Jersey trials at present. Elka is also a very interesting, unique variety with many valuable characteristics but with a more erratic performance record. Pennant and Regal have looked very good in low maintenance trials which often receive severe summer drought stress.

Varietal Substitution

Recent laboratory and field grow-out tests show that we have a serious problem of varietal substitution. In some instances, one improved turf type variety is substituted for another good variety. In other cases, an inferior common-type ryegrass is sold and labeled as a popular improved turf type variety. Such substitution can subject the grower to very disappointing performance and the seed dealer to possible legal difficulties and unfavorable publicity. State seed officials and alert, quality conscious buyers can help prevent such practices.

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Table 8. Turf performance of perennial ryegrass varieties at Adelphia, NJ*

Variety	Turf performance** (9 = best)	Variety	Turf performance
Palmer	7.4	Citation	5.6
Prelude	7.1	Pennfine	5.5
R-39A	6.9	Derby	5.5
Premier	6.9	Goalie	5.5
Blazer	6.6	Trimmer	5.3
Fiesta	6.5	Jackpot	5.3
Belle	6.4	Bellatrix	5.3
Yorktown II	6.4	Delray	5.3
Elka	6.3	Yorktown	5.3
Pennant	6.2	Barcelona	5.2
Barry	6.1	Manhattan	5.1
Acclaim	5.9	Caravelle	5.0
Dasher	5.9	Arno	4.9
Diplomat	5.9	Lp20	4.8
Loretta	5.9	Capper	3.9
Regal	5.8	Servo	3.5
Omega	5.7	Cropper	2.3
		Linn	2.3
		LSD .05	0.8

* This test was mowed frequently at 3/4-inch, irrigated to prevent severe drought stress, and was maintained at a moderately high fertility level.

** Average of 20 visual evaluation ratings taken during 1979 and 1980.

Table 9.
Performance of perennial ryegrass varieties and selections in turf trials seeded September 1980.

Variety	1981 average	Variety	1981 average
BT-1	8.3	Diplomat	6.4
Palmer	7.9	Barclay	6.2
R39A	7.9	Trimmer	6.1
Manhattan II	7.6	Acclaim	6.1
Prelude	7.5	Derby	6.0
HR-1	7.4	Loretta	5.9
Premier	7.3	Pennant	5.9
Yorktown II	7.3	Pennfine	5.6
All-Star	7.3	Manhattan	5.5
Blazer	7.2	Delray	5.4
Ranger	7.1	Goalie	5.4
Belle	7.1	Jackpot	5.3
Dasher	6.7	Caravelle	5.1
Fiesta	6.5	Rex	4.8
Regal	6.4	Cropper	2.1
Barry	6.4	NV1 909	2.0
		LSD .05	0.6

PERENNIAL RYEGRASS VARIETIES

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Outlook

The past 14 years have witnessed the birth and early development of the new turf type ryegrasses. The first certified seed of Manhattan perennial ryegrass was harvested in 1968. All other improved turf type ryegrasses were released after 1970. Considerable effort is presently being devoted to the further genetic improvement of ryegrasses in both North American and Europe. A number of exciting new germplasm sources are being discovered in old turfs or being developed in hybridization and recurrent selection programs. The next 14 years should bring as many new advances in ryegrass improvement as we have witnessed in the past 14.

Perennial Ryegrass Varieties

All-Star (JLA-RI) is a leafy, attractive, medium early, turf type variety. It was developed by J and L. Adikes of Jamaica, N.Y. and International Seeds, Inc., of Halsey, OR using germplasm obtained from the New Jersey AES. Most of the parental germplasm of All-Star originated from selections made from old turfs located in Baltimore and College Park, Maryland. All-Star has the ability to produce a fine, dense turf with a reduced rate of vertical leaf growth and an attractive bright, dark green color. The variety has shown good heat and drought tolerance and medium good cold hardiness. All-Star has demonstrated good resistance to the Rhizoctonia brown patch disease and some species of sod webworm.

Barry (BAR Lp76-1) is a leafy, attractive, late maturing turf type variety, developed in Europe by Barenbrug Holland BV. Its parental germplasm came from Manhattan and from selections made in Europe. Barry is capable of producing a fine textured, dense, medium low-growing turf with a dark green color. It has good resistance to the brown blight and Rhizoctonia brown patch diseases. Barry has good heat and cold tolerance and the ability to maintain good color into the cool temperatures of late fall. Mowing characteristics are above average.

Belle (Burlingham MP-1) is a medium early maturing variety currently being produced by E. F. Burlingham and Sons of Forest Grove, OR. Belle is a leafy, persistent, turf type variety capable of producing an attractive, dense, moderately low-growing fine-textured turf of a moderately dark green color. Belle has shown moderately good resistance to some races of crown rust, Rhizoctonia brown patch and winter brown blight diseases. It has shown medium good heat and cold tolerance, good wear tolerance and good mowing qualities.

Birdie (TS-222) is a medium early variety developed by Turf-Seed, Inc., of Hubbard, Oregon. Birdie has a moderately dark green color, medium fine texture, medium high density, and is a moderately low-growing turf type variety. Birdie has moderately good resistance to brown patch and some races of dollar spot. It is susceptible to the winter brown blight disease. Birdie has shown medium good heat tolerance and medium cold hardiness. It has relatively good mowing qualities except during late spring when the turf becomes quite stemmy.

Blazer (Pickseed R-34) is a medium late maturing variety currently being produced by Pickseed West, Inc., of Tangent, Oregon. Blazer is a leafy, persistent, moderately low-growing turf type ryegrass capable of producing an attractive, dense, fine-textured turf of a bright, moderately dark green color. Blazer has shown good resistance to the brown patch and winter brown blight diseases and moderate resistance to some races of crown rust. It has demonstrated medium good heat and cold tolerance and relatively good mowing qualities.

Caravelle (Mom Lp 9) is a medium maturing variety developed in the Netherlands by Mommersteegs Int. and distributed in the USA by O. M. Scott & Sons of Marysville, Ohio. Caravelle is a leafy, low-growing, turf type variety with a very dark green color, medium fine texture and medium density. It has medium poor cold hardiness and poor heattolerance. Caravelle is susceptible to the brown patch disease. This variety is used primarily for winter overseeding in the South.

Citation (Turf-Seed SynJ) is an early maturing variety with an attractive, bright, dark green color. It was developed and is being produced and marketed by Turf-Seed, Inc. of Hubbard, Oregon. Citation produces a low-growing turf with medium fine texture and medium density. The variety has medium cold hardiness, good heat and wear tolerance and good resistance to brown patch and Fusarium blight. Citation has moderate resistance to Corticium red thread and many races of dollar spot. It is susceptible to the winter brown blight disease. Citation has good mowing qualities except during its reproductive phase in late spring.

Cropper is an early maturing variety with a bright, medium green color, low density, an erect growth habit and very rapid shoot growth. It has fairly good heat and cold hardiness. Cropper is susceptible to the brown patch disease and has very poor mowing qualities.

Dasher (Pickseed R-33) is a medium early variety developed by Pickseed West, Inc., of Tangent, Oregon. Dasher is a fine-textured turf type variety capable of producing a leafy, dense, attractive, moderately low-growing, persistent turf with a bright, medium green color. Dasher has shown good resistance to brown patch and moderate resistance to winter brown blight. It has medium good cold hardiness and good heat tolerance. Dasher has relatively good mowing qualities except during the reproductive period in late spring.

Delray (NK K5-90) is an early maturing variety currently being produced by Northrup King. Delray has a medium dark green color, medium fine texture and medium density. It is a moderately low-growing, turf type variety. Delray has moderate resistance to brown patch and some races of dollar spot. It appears to be susceptible to the winter brown blight disease. Delray was developed for improved winter hardiness and appears to have moderately good heat tolerance. Delray has moderately good mowing qualities except during its reproductive period in late spring.

Derby (IS-72E) is an early maturing variety developed by International Seeds, Inc., of Halsey, Oregon. Derby is a moderately fine-textured, turf type variety capable of producing an attractive turf of medium density and a moderately dark green color. Derby has medium cold hardiness, good heat tolerance and good wear tolerance. The variety is susceptible to the winter brown blight disease but shows moderately good resistance to brown patch and some races of dollar spot. Derby exhibits a moderately good leaf appearance after mowing except during late spring.

Diplomat (Lofts Syn D) is a medium late maturing variety developed by Lofts Seed of Bound Brook, New Jersey. Diplomat is an attractive, moderately dark green, turf type cultivar that produces a leafy, persistent turf of greater density, finer texture, and a slower rate of vertical growth than most other perennial ryegrasses. It has moderately good resistance to brown patch and the winter brown blight disease. Diplomat has good heat and cold tolerance and relatively good mowing qualities.

Elka is a late maturing variety developed in the Netherlands by Cebeco-Handelsraad. International Seeds and Jacklin Seed Company are currently producing seed of this variety in the United States. Elka is a turf type variety with a medium light green color. It has soft, fine leaves and the ability to produce a turf with greater density and slower shoot growth rate than most varieties currently on the market. It has moderately good cold hardiness and shade adaptation, and fair heat tolerance. In preliminary trials in New Jersey, Elka has demonstrated good resistance to our present races of crown rust but the variety appears moderately susceptible to brown patch, winter brown blight and dollar spot.

Fiesta (Pickseed R-32) is a medium early maturing variety with a bright moderately dark green color, medium fine texture and medium high density. It has a reduced shoot growth rate and a turf type growth habit. Fiesta has good cold hardiness and good heat tolerance. The variety has good resistance to brown patch and moderate resistance to winter brown blight.

Game is an early maturing variety developed in the Netherlands. It is distributed in the United States by Willamette Seed of Shedd, Oregon. Game has a bright, medium green color, low density and produces a turf with an erect growth habit and a rapid shoot growth rate. Game has shown poor heat and cold tolerance and high susceptibility to brown patch. It has a very poor leaf appearance after mowing.

Linn has very poor mowing qualities.

Loretta is a late maturing variety developed in Germany. It is distributed in the United States by O. M. Scott and Sons of Marysville, Ohio. Loretta is a leafy, moderately low-growing variety with soft leaves and a turf type growth habit. It has a bright medium light green color, medium fine texture and medium high density. Loretta has medium heat and cold hardiness. The variety has good resistance to present races of crown rust, moderate resistance to brown patch and winter brown blight and is quite susceptible to dollar spot. Loretta exhibites a good leaf appearance after mowing.

Manhattan (Rutgers Syn M) is a later maturing variety developed by the New Jersey AES. Manhattan is a leafy, moderately low-growing, turf type variety with a bright, moderately dark green color, a medium fine texture and medium density. Manhattan has moderately good tolerance of heat and shade, improved cold hardiness and excellent wear tolerance when growing conditions are favorable. Manhattan has good resistance to the winter brown blight disease and moderate resistance to brown patch. It is moderately susceptible to crown rust, red thread and dollar spot. This variety shows relatively good mowing quality during cool seasons but only moderate mowing quality during heat stress.

Manhattan II (MMG-80) is a leafy, attractive, persistent, turf type variety of medium maturity. It was developed cooperatively by Pure-Seed Testing, Inc. and the New Jersey AES. It is capable of producing a dense, fine-textured, medium low-growing turf with a bright, dark green color. Manhattan II has the excellent seedling vigor, wear tolerance, winter brown blight resistance, and wide range of soil and climatic adaptation of Manhattan. In addition, Manhattan II shows improvements in resistance to stem rust, many races of crown rust, brown patch, and red thread. It also shows improvements in heat tolerance, summer performance and mowing qualities.

NK100 is a medium maturity variety with a bright, medium green color, medium texture and density, a semi-erect growth habit and fairly rapid shoot growth. NK100 has below average heat tolerance and cold hardiness. It has moderate resistance to dollar spot and Typhula blight. The variety is moderately susceptible to brown blight, brown patch, red thread, and crown rust. It can have a poor leaf appearance after mowing.

NK200 is a late maturing variety with a bright, medium dark green color, medium texture and a turf type growth habit. NK200 has improved cold hardiness but below average heat tolerance. It is susceptible to crown rust and brown patch. NK200 has good mowing qualities except during heat stress.

Omega (Turf-Seed Syn B) is a medium maturing variety developed by Turf-Seed, Inc., of Hubbard, Oregon. Omega has a bright,moderately green color, a medium fine leaf texture, a leafy turf type habit, a medium high density and a reduced rate of vertical shoot elongation. It has good heat, cold and wear tolerance. Omega has good resistance to the brown patch and winter brown blight diseases. The variety shows relatively good leaf appearance after mowing.

Palmer (Lofts GT-1) is a leafy, turf type ryegrass of medium maturity. It is capable of producing a persistent, dense, attractive, medium low growing, fine textured turf with a bright, dark green color. Palmer has shown good resistance to many races of crown rust, very good resistance to brown patch, and moderately good resistance to the winter brown blight disease. This variety has shown moderate resistance to some species of sod webworm in turf trials at Adelphia. It has shown good winter-hardiness where severe ice sheets are not a problem. Palmer has exhibited mowing qualities, heat tolerance, and summer performance characteristics which surpass most ryegrasses presently being sold. The variety has excellent seedling vigor and good wear tolerance. Palmer originated from germplasm collected from old turfs in Maryland, New Jersey, New York, Pennsylvania and Greece.

Pennant (Um Composite) is an early maturing variety currently being produced by Agriculture Service Corporation of Salem, Oregon. This turf type variety has relatively good mowing qualities and an attractive bright, moderately dark green color. It produces a turf having a medium fine texture, medium high density, and a reduced rate of vertical leaf growth. Pennant has good heat and shade tolerance and moderately good cold hardiness. It appears to require somewhat less nitrogen fertilizer for good performance than most other ryegrass varieties. Pennant has good resistance to brown patch, and moderately good resistance to winter brown blight, dollar spot and some races of crown rust. This variety also has good resistance to billbug and some species of webworm. Pennant was selected from an old lawn area in College Park, Maryland.

Pennfine is an early maturing variety developed by the Pennsylvania AES. Pennfine is a moderately low-growing turf type variety with a moderately dark green color, medium fine texture and a medium density. The variety has moderately good resistance to brown patch, Typhula blight and some races of dollar spot. It is susceptible to the winter brown blight disease. Pennfine has shown good heat tolerance and medium cold hardiness. It has relatively good mowing qualities except during late spring when the turf becomes stemmy.

Prelude (Lofts R-40) is an early maturing, leafy, turf type ryegrass capable of producing an attractive, persistent, low growing, fine textured turf of medium high density and a bright dark green color. Prelude has shown very good resistance to brown patch and many races of crown rust, good resistance to winter brown blight, and moderate resistance to red thread and pink patch. Prelude has the rapid germination, ease of establishment and wear tolerance characteristics of other improved turf type perennial ryegrasses. It has shown good winter hardiness and improved summer performance in New Jersey tests. Mowing qualities of Prelude are better than most varieties currently available. It has good tolerance to close mowing, shade and wear. Prelude has demonstrated medium good resistance to some species of sod webworm.

Regal (PR-731) is an early maturing ryegrass developed by International Seeds, Inc., of Halsey, Oregon. It is being produced and sold by North American Plant Breeders. Regal is a turf type variety with a dark green color, medium fine texture and medium density. It has medium cold hardiness and good heat tolerance. Regal has shown good resistance to dollar spot, brown patch disease and billbugs. It is susceptible to brown blight and crown rust. Regal mows reasonably well except during its stemmy reproductive period in late spring.

S-321 was developed by the Welsh plant breeding station. It has a bright, medium green color, medium texture, medium low density and a fairly rapid rate of shoot elongation. It has poor tolerance of heat and cold. S-321 is susceptible to brown patch. It has rather poor mowing qualities.

Venlona has a bright, medium green color, medium texture, low density and an erect growth habit with a rapid rate of vertical growth. The variety has shown poor tolerance of heat and cold. It is susceptible to brown patch disease. Venlona has poor mowing characteristics.

Yorktown (Lofts Syn C) is an attractive, leafy, moderately persistent, turf type variety producing a dark green turf of moderately fine texture and medium density. It is of medium maturity and was developed by Lofts Seed of Bound Brook, New Jersey. Yorktown has good resistance to the winter brown blight disease and moderate resistance to brown patch. It is susceptible to crown rust. Yorktown has moderately good cold hardiness and moderate heat tolerance. Yorktown has relatively good mowing qualities.

Yorktown II (Lofts Syn D-1) is a medium late variety developed by Lofts Seed, Inc., of Bound Brook, New Jersey. It has an attractive, dark green color, a fine texture, high density and a leafy, low-growing, turf type growth habit. It has shown good heat and cold tolerance. Yorktown II has good resistance to brown blight, Rhizoctonia brown patch and moderately good resistance to Fusarium and some races of crown rust. It has good mowing qualities.

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TALL FESCUE VARIETIES AND THEIR CULTURE FOR TURF

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Tall fescue (Festuca arundinacea Schreb.) is one of the most important grasses in the United States. Its adaptation to a wide range of soils and climatic conditions has made it one of our most widely used grasses for soil stabilization, forage and turf. More than 35 million acres of productive tall fescue pastures are vital to the livestock industries of Missouri, Kentucky and other states of the upper south.

Tall fescue has stabilized eroded and disturbed land and has helped restore fertility to the soil. Millions of acres gullied by the plow and row crop agriculture have been healed and restored to lush green pastures by use of this grass. Tall fescue provides excellent waterway protection and useful cover on both low wetlands and on steep slopes susceptible to drought. It is extensively used for conservation and erosion control on highway right-of-ways throughout much of the United States. Lawns of tall fescue are becoming increasingly common in cities such as Atlanta, St. Louis, Washington, D.C. and Los Angeles.

Origin and History

Tall fescue is found growing throughout most of Europe and extending into western Siberia. It is also widely distributed in North Africa and on mountains in East Africa and Madagascar. Various sources of tall fescue were introduced into the United States during the 1800's. Some of these plantings persisted and became naturalized in permanent pastures and old turfs. However, the species was not widely used until after the development and release of the varieties Alta and Kentucky 31 in 1940 and 1943, respectively. The widespread usefulness of Ky-31 throughout the transition zone of the United States is largely due to the merits of this improved variety. The continued development of varieties with improved palatibility and nutritional qualities will make tall fescue of even greater value for pasture and hay. Specialized turf type varieties having greater attractiveness, persistence, pest resistance, and stress tolerance will continue to expand its usefulness for turf.

Description

Tall fescue is a tall, deep-rooted, long-lived perennial grass with numerous wide, medium green, basal leaves. It is basically a bunchgrass although short rhizomes may occasionally occur on isolated plants, especially those growing in sandy soil. Types with more extensive rhizome development are frequently found in Spain and Portugal.

Thick stands can produce a tough, even sod when frequently mowed or grazed. However, scattered plants are coarse, clumped and objectionable in fine-textured lawn situations. Leaf blades are generally coarse with rough edges, heavily ribbed on the upper surface, and rolled in the bud-shoot.

Plants with finer, softer leaves occur rarely and are being selected in turfgrass breeding programs. Roots are tough and coarse with the ability to penetrate subsoil. This contribues to a tough sod, improved drought resistance, and tolerance of some soil insects. The branched panicle-type seed heads are 4 to 12 inches long and are borne on stalks that generally attain a height of 40 to 60 inches. Five to seven rather large seeds can be produced by each spikelet.

Adaptation (General)

Tall fescue exhibits its best growth under relatively cool, moist growing conditions. However, it is the only cool season turfgrass that will persist well through the hot summers. Lawns of tall fescue are abundant in southern California and similar climates. Tall fescue can be found in pastures and along roadsides in parts of Montana and southern Canada. However, when fertilized heavily and mowed closely, this grass is not entirely winter-hardy in some of the northern parts of the United States. We have oberved serious winter damage on adapted varieties under severe ice sheets in New Jersey, Pennsylvania, and Rhode Island.

Tall fescue will grow and persist on a wide range of soil types. It has above average tolerance of acidic, alkaline, saline and poorly drained soils. It is one of the more drought tolerant grasses suitable for humid regions. Its deeper root system, greater heat tolerance and more open turf allows tall fescue to remain green into dry periods.

Adaptation to Shade

Tall fescue can be a useful grass in shaded situations. The cooling effect of light shade permits it to be used in areas that would otherwise be too hot for it to persist under full sunlight. Leaves are considerably finer and softer in shaded environments, making the grass more attractive and more compatible in mixtures with other species. A number of the new turf type varieties appear to have improved shade tolerance. (Table 1).

Table 1. Shade tolerance of turfgrass varieties seeded under artificial shade at North Brunswick, New Jersey after 4 years.

Rank	Variety	76% shade	92% shade	Avg.
	best plot is 9			
	Tall fescues			
1	Rebel	5.9	5.2	5.6
8	Ky 31	4.1	3.9	4.0
	Hard fescues			
3	Reliant hard fescue	5.1	4.0	4.6
4	Scaldis hard fescue	5.3	3.5	4.4
6	Biljart hard fescue	5.0	3.4	4.2
	Chewings and creeping red fescues			
5	Jamestown Chewings fescue	4.7	4.0	4.4
7	Banner Chewings fescue	5.0	3.4	4.2
10	Fortress creeping red fescue	4.0	3.1	3.6
12	Highlight Chewings fescue	4.7	1.8	3.3
13	Ruby strong creeping red fescue	3.3	2.3	2.8
	Kentucky bluegrass ½			
2	A-34 Kentucky bluegrass	6.0	4.9	5.5
11	Nugget Kentucky bluegrass	3.9	3.9	3.4
14	Park Kentucky bluegrass	3.7	1.6	2.7
15	Glade Kentucky bluegrass	3.1	1.7	2.4
	Perennial Ryegrass			
16	Linn perennial ryegrass	2.4	1.3	1.9
	LSD at 5%	1.0	1.2	

Growth Habit and Turf Forming Properties

Tall fescue has a rapid rate of shoot and leaf elongation and requires frequent mowing, especially at high soil fertility levels. Alta and Kentucky 31 will not persist well at mowing heights below two or three inches. The new turf types are lower growing and have the ability to form a denser, finer turf, especially under conditions of close, frequent mowing, and adequate fertility. (Tables 2 and 3). Thatch accumulation is seldom a problem.

Table 2. Tiller density and leaf width of varieties at North Brunswick, N.J. Seeded August'75 and mowed at 3/4 inch until January 1980.

Variety	Tillers per sq.ft.	Leaf width
	no.	mm
Rebel	2271	2.4
Kenwell	806	3.4
Kentucky 31	789	3.4
Kenhy	724	3.5
LSD at 5%	163	0.4

Table 3. Tiller density and leaf width measurement of varieties in closely mowed turf at Adelphia, N.J. Seeded Sept. '78 and mowed at 3/4 inch, November '79.

Variety	Tillers per sq.ft.	Leaf width
	no.	mm
1. Olympic	1852	2.7
2. Rebel	1801	2.7
3. Falcon	1750	2.6
4. Galway	1378	3.1
5. Monaco	1297	2.5
6. Clemfine	1247	3.0
7. Kentucky 31	1156	3.4
8. Fawn	1102	3.7
9. Kenmont	1086	3.6
10. Goar	1062	3.5
11. Kenhy	1013	3.5
12. Kenwell	945	3.6
13. Alta	902	3.8
LSD at 5%	453	0.6

Establishment

Tall fescue seeds are about the same size as those of perennial ryegrass. However, they are a bit slower to germinate and require soil cover. Turf type perennial ryegrass seedlings also tiller much more abundantly giving a more rapid turf cover especially under frequent close mowing. Higher seeding rates of tall fescue can be used to hasten ground cover and produce a finer, denser turf. In a turf trial seeded September 1978 at Adelphia, New Jersey (Table 4), higher seeding rates produced significantly greater turf density on 14 month old plots of Ky-31 tall fescue. This difference in turf density was less evident when the seeding rates of Rebel tall fescue were increased. This was undoutably due to the greater tillering ability of Rebel, especially under conditions of adequate fertility and frequent close mowing. Ky-31 seeded at the higher rate tended to show better performance for at least three years after establishment. This advantage of higher seeding rates was less apparent with Rebel. It should be noted, however, that an excessively dense turf cover can be a disadvantage in low maintenance turfs subjected to severe heat and drought stress. Reduced seeding rates are often an advantage for such situations. Tall fescue varieties with increased tillering capacities should be expected to be less affected by seeding rate differences.

Table 4. Effect of seeding rate on tiller density and turf performance in turf trials seeded Sept.'78 at Adelphia, N.J.

Variety	Seeding rate	Tillers per sq.ft. Nov.1979	Performance score 1979	1980	1981
	lbs/1000 s.f.	No.	Best plot = 9		
Rebel	4	1801	6.4	7.0	7.5
	8	2031	7.0	7.6	7.6
	12	2013	7.2	7.5	7.5
Kentucky 31	4	945	4.3	4.3	4.2
	8	1558	4.9	5.0	4.9
	12	1512	5.1	5.3	4.7
LSD a5 5%		453	0.5	1.0	0.7

Seed Quality

The purchase of quality seed of an adapted variety is basic to the production of quality turf. Seed of the newer turf type tall fescues is produced in Oregon. Much of this seed is of excellent quality and free of undesirable contaminants; however, some has variable amounts of ryegrass as a contaminant.

Forage Characteristics

Tall fescue produces large amounts of palatable, nutritious forage during the cool months of spring and fall. Excess fall production is often "stockpiled" for winter grazing in much of the upper south. Excess spring production is often cut for hay or left to produce a seed crop. Tall fescue pastures are moderately productive during hot summer months. However, livestock grazing on tall fescue pastures during hot summers will frequently, but not always, show poor performance. This summer syndrome of low animal productivity on many tall fescue pastures is of substantial economic significance. Recent research strongly indicates that the poor summer performance of the grazing animals is due to a group of loline alkaloids present in some

tall fescue plants. A fungus endophyte, tentatively identified as Epinchloe typhina (Pers.) Tul., growing within the tissues of tall fescue is associated with the production of loline alkaloids. Tall fescue plants free of this endophyte are consequently free of these alkaloids. E. typhina is normally transmitted in the seed of tall fescue. Nearly all seed lots examined have shown the fungus to be present within a high percentage of the seed. Seed stored for two years is normally free of the living fungus and can be used to establish endophyte-free pastures on clean soil. Such pastures should give much improved animal performance. Efforts are being made to produce and certify seed free of this endophyte.

Disease Resistance

The two most serious diseases of tall fescue turf are brown patch and netblotch.

Helminthosporium dictyoides Drechs., netblotch, causes net-like patterns of streaks of dark brown tissue in young lesions on leaves. These streaks later coalesce into dark brown spots. Heavily infected leaves turf yellowish brown and die back from the tips. The fungus is most active and the disease is most evident during cool, moist periods in spring, fall and winter. Damage is most serious on seedling turf especially under conditions of close mowing and traffic. Some of the new turf type varieties, including Mustang, Brookston, Jaguar and Olympic have shown significant improvements in resistance. (Table 5).

The brown patch disease caused by Rhizoctonia solani Kuhn is most serious during moderately hot humid weather with warm nights and heavy morning dew, especially on dense turf subjected to frequent mowing and high nitrogen fertility. Shaded environments and other areas with reduced air circulation also provide favorable conditions for disease development. Turfs showing moderate drought stress immediately preceding conditions favoring disease are often damaged more severely. Recovery from disease damage has been rapid and complete in New Jersey turf trials as soon as cool weather and favorable growing conditions return in early September. Present varieties and selections vary from sucseptible to moderately resistant. (Table 6). Extensive screening of large number of plants from the limited world collection of tall fescues has failed to provide any source of high resistance. Varieties developed from germplasm collected from old turfs found in warm humid areas of the Mid-Atlantic states and the Upper South have generally shown the best resistance. Varieties showing the greatest resistance to drought stress, at the time conditions favor disease development, often show the least damage.

Crown rust, incited by Puccinia coronata Cda. is a typical leaf rust, appearing as light yellow flecks that enlarge and develop into reddish- brown pustules containing urediospores of the fungus. In late fall, the crown-like teliospores that give the rust its common name are formed in dark colored telia surrounding the pustules. Heavily infected leaves turn yellow as chlorosis progresses downward from the tip. Varieties developed in Western Oregon are normally selected for improved crown rust resistance as this disease frequently causes moderate damage in seed production fields.

Table 5. Reaction to Netblotch in turf trials seeded September 1979 at Adelphia, N.J.

Selections	Rating
no disease = 1.0	
Mustang	1.6
Brookston	2.6
Jaguar	2.8
Olympic	2.9
Adventure	3.4
Falcon	3.5
Houndog	3.9
Rebel	4.7
Kenhy	5.1
Galway	5.1
Kenmont	5.4
Clemfine	5.7
Kenwell	5.8
Beltsville 16-1	6.3
Kentucky 31	6.4
Beltsville TF-11	6.5
Kentucky blend	6.8
Beltsville TF-25	6.9
Beltsville KpH-1	7.3
Goar	8.3
most disease = 9.0	
LSD at 5%	0.9

Table 6. Reaction to brown patch in turf trials seeded September 1978 at Adelphia, N.J.

Selections	Percent disease July & August 1979
Rebel	22
Falcon	27
Galway	27
Kentucky blend	27
PHB 1-5	29
Clemfine	30
Missouri V-11	31
Kentucky 31	33
AG-125	37
Beltsville KpH-1	38
Kenmont	39
Kenwell	40
Beltsville Syn 16-1	41
Fawn	45
Monaco	46
Kenhy	47
Goar	48
Beltsville TF-11	49
Beltsville TF-25	49
Alta	53
LSD at 5%	10

A number of species of Pythium can cause either a damping-off of seedlings or a devastating disease of mature turf. Damping-off frequently involves a pre-emergence killing or the plants become necrotic and stems progressively deteriorate with the seedlings appearing water-soaked. These seedlings eventually collapse, shrivel, turn brown and die. Damping-off will attack all grasses. The resistance between different varieties is questionable due to the many different species of Pythium involved and the different responses that often occur between seed lots of the same variety. A test was conducted during July and August under hot, wet conditions very favorable for Pythium damping-off. New turf types including Rebel, RG-1 and AG-125 were not substantially different in their reaction to Pythium damping-off when compared with the standards. (Table 7). Higher seeding rates caused a dramatic increase in damage from damping-off (Table 8). A number of new fungicides such as Koban are very effective in the control of damping-off when used as seed treatments.

Pythium blight can quickly damage turf when conditions include heat, humidity, reduced air circulation, free water, and a dense, lush turf. A cool night or an appropriate fungicide treatment will stop disease activity.

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Table 7. Reaction to damping-off in a test seeded July 28, 1980 at North Brunswick, N.J.

Selection	Turf loss August 5, 1980
	%
Kentucky 31 (lot 2)	15
RG-1	22
Rebel	28
Ag-125	28
Kentucky 31 (lot 1)	44
Kenhy	44
Fiesta perennial ryegrass	59

Plots seeded at the rate of twenty pounds per 1000 sq.ft. in a low area having poor air circulation and receiving frequent irrigation.

Table 8. Damping-off severity as influenced by seeding rates.

Pounds per 1000 sq.ft.	Pythium damping-off		
	Rebel	Kentucky 31	Avg.
	%	%	%
5	5	8	6
10	8	21	14
20	28	44	36
40	41	68	55
Avg.	21	35	

LSD at 5% (between variety means) = 5
LSD at 5% (between reading rate means)=11

Plots seeded July 28, 1980 in a low area having poor air circulation and receiving frequent irrigation.

Turf Performance in New Jersey

A number of the newer turf types including Jaguar, Mustang, Adventure, Rebel, Olympic, Brookston, Falcon and Houndog have shown improvements in performance in New Jersey (Table 9). Alta, Fawn and Goar show poorer performance.

Table 9. Performance of varieties in turf trials in New Jersey

Variety	Test 1 planted September 1978 3 yr. avg.	Test 2 planted September 1979 2 yr. avg.	Test 3 planted September 1980 1 yr. avg.
best plot = 9			
Jaguar	-	7.3	-
Mustang	-	7.1	7.1
Adventure	-	7.2	6.9
Rebel	7.0	7.0	7.0
Olympic	-	6.8	6.5
Brookston	-	6.6	-
Falcon	6.8	6.4	6.1
PS 579	-	6.4	-
Houndog	-	5.9	-
Galway	5.3	5.4	-
Clemfine	4.7	5.3	-
Kenhy	3.9	4.5	4.5
Kentucky 31	4.3	5.1	3.6
Kenwell	4.0	4.4	-
Kenmont	3.4	4.7	-
Alta	2.9	-	-
Fawn	2.8	-	-
Goar	1.8	2.6	-
LSD .05	0.7	0.5	0.6

TALL FESCUE VARIETIES

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Adventure was developed by Pure-Seed Testing, Inc., of Hubbard, Oregon. It is an attractive, vigorous, leafy, turf type with a medium dark green color, medium texture, and medium density. It has shown good vigor and color at low fertility levels. It has good resistance to the Rhizoctonia brown patch and Hemlinthosporium leaf blight diseases. Available following the 1982 harvest.

Alta tall fescue, 1940, was developed by the Oregon AES, with the cooperation of the ARS, USDA. Plants were selected out of two introductions from Germany and one commercial seed lot on the basis of improved winter survival, ability to remain green during dry summers in western Oregon, high forage yields and ability to persist. Alta has been used extensively for turf in California. It produces a rather coarse, upright turf of moderately low density and rapid leaf elongation. Alta has shown above average susceptibility to Helminthosporium blight and Rhizoctonia brown patch in New Jersey trials.

Brookston was developed by North American Plant Breeders and International Seeds, Inc. It will be produced and marketed by AMPAC Seed Co., of Tangent, Oregon, and Stanford Seed of Buffalo, New York. Brookston is a leafy, moderately low-growing turf type with a medium dark green color, medium texture and medium density. It is reported to have improved low temperature hardiness. Brookston has good resistance to Helminthosporium blight. Available after 1983 harvest.

Clemfine (exp. designation LFA-Syn-1) was developed and released by the South Carolina AES and Lofts Seed, Inc. from germplasm of three clones selected from old turfs. Clemfine has a medium green color, coarse texture, and a medium-low density. It has moderately good resistance to Rhizoctonia brown patch but only fair resistance to Helminthosporium blight. Clemfine closely resembles Kentucky 31 tall fescue in many characteristics but has generally shown improved performance and increased persistence in turf trials. Available after 1982 harvest.

Falcon, 1980, (exp. designation NJ 78) was developed cooperatively by Pure Seed Testing, Inc. and E. F. Burlingham and Sons from germplasm obtained from the New Jersey AES. Plants collected from old turfs in Alabama, Georgia, New Jersey, Pennsylvania, and Virginia contributed most of the parental germplasm of Falcon. Parental clones were selected from spaced-plant nurseries on the basis of attractive appearance, freedom from disease, ability to resist leaf roll during hot dry weather, softness of leaf, and acceptable seed yield. Single plant progenies were evaluated in closely mowed turf trials. Seedlings from clones exhibiting the best progeny performance were subsequently screened for resistance to crown, rust, uniform maturity and improved seed yield. Falcon is a leafy, moderately low-growing turf type. It has the ability to produce an attractive, more persistent turf with finer texture and higher density than most of the currently available varieties of tall fescue. Available since 1980.

Fawn, 1964, (exp. designation OR Syn E) was developed at the Oregon AES. Fawn produces a coarse, open turf with a rapid rate of leaf elongation. It has shown susceptibility to the Helminthosporium blight and brown patch diseases and appears to be less winter hardy and less tolerant of adverse summer conditions.

Forager is a hay and pasture variety developed by Farmers Forage Research Co-operative, W. Lafayette, Indiana.

Fortune, 1968, (exp. designation Oregon B) was released by the Oregon AES from germplasm derived from PI 231,563 and PI 231,564. It is not available commercially.

Galway (exp. designation K5-27) was developed by Northrup King. It is a medium dark green turf type variety with medium density and a medium coarse texture. The variety has good heat and drought tolerance and improved cold hardiness. It does well in light to moderate shade as well as in full sun. Galway has shown moderate resistance to Rhizoctonia brown patch, crown rust, and Helminthosporium blight. Galway is a moderately low growing variety with a reduced rate of vertical leaf extension. Commercial seed production has been initiated.

Goar, 1946, is an early maturing, vigorous, rather coarse bunchgrass adapted to heavy textured alkaline soils. It has performed poorly in turf with high susceptibility to Helminthosporium blight, crown rust and Rhizocotnia brown patch.

Houndog, (Exp. designation TF 791)was developed and released by International Seeds, Inc. of Halsey, Oregon. Its parental germplasm originated from plants selected from old turfs in Kentucky and Tennessee and from plants selected out of Rutgers T-1 and Missouri 96. Houndog is a leafy, persistent, moderately low-growing,turf type with a medium dark green color, medium texture, medium density and a semi-prostrate growth habit. It has good heat and drought tolerance, performs well in shade and shows good color retention in late fall. It has moderate resistance to Rhizoctonia brown patch and Helminthosporium blight. Available following the 1982 harvest.

Jaguar (exp. designation PS Syn 572) was developed by Pure Seed Testing, Inc. of Hubbard, Oregon. Jaguar is an attractive, leafy, turf type with medium density and texture, a medium dark green color and a moderately low growth habit. It has good heat and drought tolerance, good shade adaptation, and very good low temperature color retention in late fall. Jaguar has very good resistance to crown rust and good resistance to Rhizoctonia brown patch and Helminthosporium blight. Available following the 1983 harvest.

Kenhy, 1976, (exp. designation Gl-296, Gl-298) was developed cooperatively by the Kentucky AES and the ARS, USDA. It is a synthetic of eleven 42-chromosome derivatives of annual ryegrass x tall fescue hybrids which were selected for vigor, soft lax leaves, and high moisture content of forage during drought stress. Kenhy produces a rather coarse, moderately open turf with a rapid rate of leaf elongation. It has shown improved tolerance of heat and drought and improved overall turf performance in Kentucky trials.

Kenmont, 1963, (exp. designation Gl-32) originated as an ecotype selection discovered growing in southeastern Kentucky. It was developed by the Kentucky and Montana AES. Kenmont is similar in appearance to Kentucky 31, but is reported to develop a slightly denser sod and produce slightly higher forage yields.

Kentucky 31, 1943, originated as an ecotype selection in Kentucky where it had apparently been growing since 1887 or earlier. It is adapted to a wide range of soil types and shows a better tolerance of climatic extremes than most other fall fescues. It produces a rather coarse, moderately open turf with a rapid rate of leaf elongation. It has moderate tolerance of Helminthosporium blight and Rhizoctonia brown patch showing less damage from these diseases than Alta, Fawn or Goar.

Kenwell, 1965, (Exp. designation G1-291) was developed cooperatively by the Kentucky AES and the ARS, USDA. Kenwell was developed for improved palatability to grazing animals and improved resistance to leaf diseases. The parental germplasm originated from naturalized strains collected in Kentucky. Kenwell produces a rather coarse, moderately open turf with a rapid rate of leaf elongation.

Missouri 96, 1977, (Exp. designation I-96) was developed by the Missouri AES out of a broad based seed source received from France. It has not performed well in New Jersey turf trials. It has shown reduced winter hardiness, less persistence and high susceptibility to Helminthosporium blight disease.

Mustang (Exp. designation RP-1) was developed by Pickseed West, Inc., of Tangent, Oregon, using germplasm developed at the New Jersey AES. It is an attractive, leafy, moderately low-growing turf type with medium texture and density. The variety has very good shade adaptation and good fall low temperature color retention and spring green-up. It has shown excellent resistance to Helminthosporium blight and moderately good resistance to Rhizoctonia brown patch. Mustang has good tolerance to close mowing with a minimal thatching tendency. Available following the 1982 harvest.

Olympic, 1981, (Exp. designation AG-125A) was developed and released by Pure Seed Testing, Inc., of Hubbard, Oregon, using germplasm developed at the New Jersey AES. Most of its parental germplasm was collected from old turfs in Alabama, North Carolina and New Jersey. It is an advanced generation synthetic variety derived from the progenies of eight clones. These parental clones were selected from spaced-plant nurseries because of attractive appearance, freedom from disease, softness of leaves, ability to resist leaf roll during hot dry weather, dark green color, and promising seed yield potential. Single-plant progenies of selected clones were evaluated in closely mowed turf trials in New Jersey and Oregon. Seedlings from clones showing the best progeny performance were screened for resistance to crown rust, uniform maturity, attractive appearance, and acceptable seed yield. Breeder seed was harvested from the 1004 preferred plants. Olympic is an attractive, leafy, persistent turf type with a dark green color, medium texture and density and a moderately low growth profile. It has good heat tolerance, performs well in moderate shade and has very good color retention into late fall. It has moderately good resistance to Helminthosporium blight, crown rust and Rhizoctonia brown patch. It retains an acceptable green color at low nitrogen fertility levels. Olympic has shown less iron chlorosis than other tall fescues on alkaline soils in California. Available following the 1982 harvest.

Rebel, 1979,(Exp. designation Lofts T5, T6) was developed by Lofts Seed, Inc. from germplasm obtained from the New Jersey AES. Plants collected from old turfs of New Jersey and surrounding states contributed most of the germplasm. Part of the parental germplasm was obtained from a number of accessions received from the Plant Introduction Program and from trispecies hybrids of tall fescue, meadow fescue, and perennial ryegrass obtained from the Pasture Research Laboratory, University Park, Pennsylvania. Clones of the original accessions were intially evaluated in nurseries subjected to frequent close mowing. Single plant progenies on the most promising selections were subsequently subjected to three cycles of phenotypic recurrent selection for persistence, attractiveness, disease resistance and performance in turf trials maintained at 3/4-inch cutting height. Rebel is a turf type capable of producing an attractive, leafy, persistent turf of good density, fine texture and a slow rate of vertical growth.

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SEED PRODUCTION AND PROMOTION

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At conferences we often talk about research and its results, then concentrate on the final product - the varieties. Seldom is there discussion about the intermediate steps necessary to bring a variety onto the market. However, to do so requires considerable effort, thought, money, and time. The intermediate steps following research include seed stock increases, production, and many marketing functions. There are various procedures followed, but essentially they must all cover the same steps. From the time Research suggests a new variety, to the time it is actually made available to the consumer, a period of six to eight years may ensue, as well as a tremendous amount of effort.

The first step in the release procedure is usually taken by Research. The suggestion that an improved variety is available is conveyed to the Product Manager. He is responsible for initiating the decision-making process. Once the decision is made that the variety will be marketable and should be increased, the Product Manager carries the further responsibility of developing the actual plans for the release of the variety. Once released, there must be continual follow-up and reevaluation of the worthiness of the variety in the marketplace.

Concurrent to the plans being developed by the Product Manager, there needs to be coordination of initial seed production research and seed increases by the Foundation Seed Stock Division. Once foundation seed is produced, we are ready to initiate production of what we believe will be the initial seed requirements of the improved variety.

Research Suggests Availability of A New Improved Variety

It is Research's responsibility to determine: 1.) the purpose of the new variety, 2.) its adaptation, 3.) its anticipated use, and 4.) provide a summary of performance data.

1. Purpose

   It is Research's responsibility to suggest where and how the new variety fits to satisfy customer needs and into the product mix. Will the variety replace an older variety, or fill a niche not presently covered by the varieties available?

2. Adaptation

   The United States is a large area. It covers many soils, topography and climates. Research needs to determine whether the variety will be adapted to a limited area, or be adapted over a broad area. This allows the Marketing Department to determine the anticipated number of pounds which will be required and the area in which advertising and sales will be concentrated. There is little value in selling a variety in a region where it is poorly adapted.

3. Use

   Here we must become more specific. For example, does the variety have attributes that make it useful on sports fields, for industrial turf, for home lawns, and/or meets the needs of the landscape industry? This type of information helps determine how a variety should be marketed.

4. Data Summary

We, like other commercial firms, conduct our own experimental and testing programs. However, to really obtain a good understanding of the performance, it is necessary to evaluate varieties under more conditions. Fortunately, the turf specialists at the experiment stations have been most cooperative in aiding industry in testing new varieties.

To help make a decision, data needs to be obtained on the performance of each variety under various turf management conditions; its insect and disease resistance, its fertility and irrigation needs, as well as the influence of climate and soils on the variety. Then, finally, preliminary information on the seed yield potential is essential.

The Decision Making Process

The Product Manager has the responsibility for determining whether a new variety fits into the product line. The first determination is whether there is a need for a variety of the type suggested. Will the variety be a replacement for one or more present varieties, or will it fill a new niche? If there is a need, the Product Manager will then request a name be given to the experimental variety. At the same time, he will discuss with the Sales Manager, and others, the potential areas in which the variety will be marketed and determine the segment of the market where the variety can best be utilized. Perhaps the variety is for sports fields, or perhaps for general turf and/or home lawns. When this is determined, it is possible to decide where the variety is most likely to be marketed in volume.

With this information, it is possible to plan the preliminary marketing strategy. Will the variety first be introduced in formulas and blends,or by itself? Should the variety be limited in the initial volume of seed available, or marketed on a more extensive scale? A preliminary seed stock, production, and marketing schedule can now be developed, including the potential release date.

Product Manager Develops Marketing Plans

As the seed increases are being made and further research data is being compiled, the Product Manager has the responsibility for developing sales estimates from the time of introduction through the time of maximum expected sales.

As information flows in, the Product Manager can then request from Production adequate seed supplies to meet the marketing plan. It is his responsibility to coordinate the marketing plan to the production schedule. Usually, initial seed supplies are limited when compared to the marketing potential. This often means allocation of seed supplies is necessary. Allocation may be by regions, or by anticipated use.

In cooperation with Research, the Product Manager will determine how the new grass will be blended to meet the various use-oriented formulations which Northrup King offers its customers. These blends and mixtures are developed to meet specific consumer requirements, such as the landscape trade, school and sports field requirements, or for general landscape use.

As decisions are made and the program falls into place, it is possible to develop the advertising and promotion program which will be initiated just prior to release of the variety. This is done in conjunction with an advertising agency. There is little good in developing the best variety in the world if the potential customers do not hear about it and know how it fits into their turf management scheme. Initial information on the variety and its potential use is then provided to the Sales Department, to our distributors across the country, and to NK customers.

Followup and Reevaluation

Even assuming a scucessful introduction, the new variety cannot be ignored. Data on performance will continue to be accumulated and fed to the Marketing Department. Input from the Sales Department on successful use will be forthcoming. Needless to say, it is essential that the customers accept the variety as being valuable to their management scheme.

As more is learned about the variety and the formulas in which it is used, it is necessary to reevaluate the marketing strategy and determine whether it should be shifted, left alone, or expanded. Future production of seed must be planned based on market acceptance and it is anticipated that sales activity will increase as the variety becomes better known and its agronomic values are better understood. Reevaluation continues throughout the life of the variety.

Seed Production

Concurrent with the above market planning will be the seed increase efforts. Research is responsible for developing and maintaining the genetic purity of the proposed variety. This is accomplished through the selection of the parent plants and evaluation of the progeny through two or three generations. A variety which is not sufficiently uniform in vegetative habit and/or flowering will be abandoned or reformulated. Research also maintains the parent vegetative material as long as it is needed.

Initial small seed increases used primarily for testing are produced by Research, often in cooperation with the Foundation Seed Stock Department. During this stage, seed yield potential and production techniques are carefully evaluated.

The Seed Stock Department, in conjunction with the breeders, is responsible for the production of the breeder's seed generation in addition to handling the production of the foundation seed generation. Breeders seed is planted to produce Foundation seed which is planted to produce Certified seed, which consumers plant for turf. Individaul field areas may be harvested on a three to six year basis, depending on many factors and must meet specific cleanliness and uniformity standards and inspections. Breeders seed needs are 150-400 pounds for Kentucky blue and 300-600 pounds for fine fescues and ryegrasses initially and every three to four years thereafter. Foundation seed needs are 15-20,000 pounds every three to four years. Annual production may be used to spread the special seed handling demands as field use is scheduled. One million pounds of certified seed could be the target for ten, and perhaps twenty years.

It takes a minimum of four years and often longer to produce the breeders and foundation seed increases. It is not possible to increase commercial seed supplies in two years, and usually three years must be planned for this purpose. This means a total of seven years from the initial decision to produce breeder's seed to the introduction of the variety. This delay is on top of the ten to twenty years it takes to develop and evaluate a new variety.

Once the decision to release a new variety has been made and the timetable established, it is then necessary to request acreage from the Production Department. They must determine where the production will be contracted and at what price. They must take into consideration the volume of seed requested for initial production, plus the first five years of estimated sales. The length of the contract period, the most economic production methods, as well as the price paid to the growers must be considered.

Some species, and even varieties, are more economic to produce under one environmental condition than is true in other regions. Often it is wise to plan to distribute production throughout several different areas to assure a more constant and adequate seed supply. The risk for both the producers as well as Northrup King must be considered.

Some fifteen companies in the USA and another fifteen in Canada and Europe are competitively involved in providing turf seed to you. When a company's price list quotes Parade Kentucky bluegrass at $2.00 per pound rest assured its availability to you is a major achievement!

ZOYSIA INTO FAIRWAYS

C. Thomas Brehob
Hyde Park Golf and Country Club
Cincinnati, Ohio

Last year during this conference I described a program of converting our fairways to Meyer Zoysia. Let me briefly go over why we went that way. Fairways at Hyde Park consisted of fifty percent Poa and fifty percent bentgrass. Overseeding programs with bentgrass made some advances but were usually wiped out in the following summer.

In September 1980, the Board of Governors voted in favor of going to zoysia fairways. Zoysia on a fairway was not new to Hyde Park since #14 fairway has been in zoysia for the past ten years. The installation was contracted out to Southern Turf Nurseries, and the installing was going to be done by means of planting sprigs in rows. This process was not an uncommon procedure for installation of Bermudagrass, but it had never been tried with zoysia on established fairways.

In preparation for installing the zoysia I sprayed our fairways with Embark growth regulator and Timec herbicide. This was done to reduce the heavy growth of Poa annua after installation. Embark was sprayed at 3/4 rate and did a very good job. During this time soil temperatures were being taken to insure that the temperatures would be high enough to activate rooting.

On May 13 Southern Turf Nurseries started installing zoysia on #1, 2, and 9 fairways. The the rains hit and delayed all work for about a week. On May 21 they started sprigging again. At this time the temperatures were in the 80's and the soil temperatures were 65°. At seventeen days after installing sprigs some started showing hair root activity. On May 23 they finished sprigging the fairways. We continued to roll the fairways and to water lightly as needed. From April 14 to June 1 fairways were not mowed. On June 2 we started mowing fairways at 1-3/8". At a two day interval we mowed fairways, setting them gradually lower each time until we had them down to 1/2". On June 11 we started spraying MSMA + 2,4-D on the fairways for crabgrass and goosegrass control. MSMA was sprayed at 1 lb. ai/acre and 2,4-D was at the rate of 1/4 lb. ai/ acre. During this spraying the high temperature reached 90°. The Poa died quickly and about fifty percent of the bent was

killed. The young goosegrass and crabgrass suffered and was eradicated after the second spray made within a week. The zoysia was tip burned and recovered within three days. During the season we put eleven total sprays of MSMA + 2,4-D on the fairways. The best results were when we sprayed at a two-day interval.

Fertilizer was started on May 26 at 400 lbs/acre of 5-10-15. We then continued to fertilize during the season with 33-0-0 ammonia nitrate and 19-5-9. For the total season we put down 5-1/4 lbs. nitrogen, 1-1/3 lbs. phosphorus, and 3 lbs. potassium. The last amount of nitrogen was applied on August 18. On September 22, 1 lb. of potash was applied to give the zoysia good winter hardiness.

A test plot was set aside in our driving range to test chemicals. On August 21, Atrazine was applied to the test area. We mixed it at a rate of 1/2 oz./1000 sq.ft. Within seven days Poa started showing the results of the spray. By fourteen days all grasses except soft crabgrass had been eradicated. The zoysia had some damage but recovered very quickly. In the fall no germination of any Poa had been noticed. Under close inspection green leaf tips plus very sturdy root and stem structures were noticed this spring after the snow came off.

My schedule for the 1982 season is to apply 5 lbs. N, 1-1/3 lb. P, and 3 lbs. K. Again the crab and goosegrass will be controlled with MSMA + 2,4-D. Also, during the season a fairway spiker will be used to help the fertilizer and water. We will continue to use a hand plugger to place zoysia in areas that are thin.

If Mother Nature gives us a warm and sunny season our fairways could have pretty good coverage by the end of the season in 1982.

BENTGRASS AFTER ROUNDUP

Bill Ward, Superintendent
Morris Park Country Club
South Bend, Indiana

I would like to share some thoughts and experiences on our approach to the fairway problems we have had at Morris Park Country Club.

In recent years our fairways have consisted of Poa annua, bluegrass and a small amount of bentgrass. I would estimate that over the past seven to eight years of overseeding we have been able to establish a maximum of only five percent bentgrass on these fairways. The Poa annua is too aggressive and is able to reestablish itself before the new bent seedlings put in their appearance and become strong enough to survive.

We have an up to date two-row automatic fairway irrigation system which should allow us to have any type of turf we desire. In the past, our efforts to hold the Poa annua in the hot months have required much watering, and this has caused wet spots and even ponding in certain spots on our fairways. During the past summer we attempted to hold back on the water and dry up these wet spots. This resulted in the loss of our Poa annua. We had enough dead grass to be objectionable to the golfers, and we decided to take some action.

In July 1981, it was decided to make a permanent correction for this situation. Several methods, such as tilling, heavy aerification, and slit seeding were considered to establish some desirable grass on these fairways. Several people had mentioned the success Joe Himburg had with the Roundup program at Woodland Country Club in Carmel, Indiana. Joe invited me to look at his operation. I was impressed with the results on this heavy clay soil in the warmer climate 125 miles south of our location. Joe gave me many good ideas from his experience.

We at Morris Park decided to go with the Roundup program, but for a final reassurance we asked Dr. Bill Daniel to visit our course. He came and toured the course on August 17 and checked soil conditions, etc. He recommended we make an immediate experimental application in an out-of-the-way place for quick evaluation of the results. He agreed with our decision, and since there were no negative points the Roundup program was assured.

All fairways were measured and we determined that we had 25.4 acres of fairway. The estimate to do the entire job with Roundup, seed, starter fertilizer, and fungicide (in case of damping off) totaled just under $10,000. This did not include labor. This amount was agreeable to our Board of Directors, so the word was "Go!"

We designated a test area in front of #5 tee at the start of the fairway. We applied Roundup and seeded at varying rates and methods. We even made some tests of pre-germinated seed, which proved to be very difficult as we are not equipped for this type of application. However, these experimental plots were able to show rates for the entire job. The membership was impressed with the growth and quality of turf in a short period of time.

Our club members were notified through mailings about what would take place and the scheduled time for the entire operation. They were instructed that after the Roundup was applied and before the new seed germinated, they could still drive and play off the fairways. We explained that a swath the width of the mower would be cut in the rough, and when the seed started to germinate, they would have to remove their ball from the new seed and hit from this area.

Ed Jordan, of Monsanto Chemical Company, the manufacturers of Roundup, contacted me and offered some very useful ideas regarding the timing of the seed application versus competition with Poa annua. I had wondered if it would be necessary to have a second application of Roundup to get the second germination of Poa annua. Ed stated this was not necessary.

We had originally intended to start about August 20, immediately after the Morris Park Country Club Invitational. Ed had suggested that we apply the Roundup some time from the middle to the end of September. However, I decided to apply it on September 8, the Tuesday after Labor Day which was a closed day for the club. We did not want any cart or foot traffic on the freshly applied Roundup.

It is important that cart and foot traffic be kept off this material until it has dried on the turf. When the vehicle applying the chemical tracks through the adjacent rough, it transfers chemicals and kills. We felt we could handle this situation by accompanying the Roundup sprayer with another sprayer containing clean water to wash off the tires before the applying tractor traveled any rough. This worked in most cases.

We selected our 500 gallon spray tank to apply the Roundup. We determined that 2 quarts per acre of Roundup in 50 gallons of water would serve our needs. On this basis, we would be able to do the entire job with two and a half tanks. We had to shut down operations when wind increased on September 8, so we finished the two remaining fairways the next morning.

My assistant, Donald Creed, Jr., did an excellent job of defining the contours of the fairways and covering the areas to be treated. The missed spots started to show up two days after application. We were able to spot-treat skipped areas that day, and this completed the Roundup phase of the renovation.

From observing our test areas on #5 fairway, we knew that it would require seven to eight days for the Roundup to totally brown off all the grass in the fairways. The bentgrass and Poa annua are the first to die back and these will start to discolor in about two days. The bluegrass will require the full seven days to appear totally brown.

After three days we started aerifying, running two machines over the fairways two times. The grass and mat was fairly riddled after this treatment.

On the basis of our experimental seedings on #5 fairway we had decided against pre-germinating the seed and slit seeding. The seed was dropped with an Olympia Model 88 drop spreader, plus a homemade scatter board which dispersed the seed. We stationed a man on the seeder with an Easy Marker paint gun and he would intermittently spray a mark along the edge of the seeder swath and notified the tractor operator when the seeder needed a refill. The entire seeding operation took two full days. The front nine was seeded on Friday (third day) and the back nine on Monday (sixth day).

All of the seed was mixed with Milorganite to act as a carrier and give bulk, spread at 3/4 lb. bentgrass per 1000 sq.ft. This is considered a light rate, but it was heavy enough as we have a good dense coverage. As it turned out, we used about 1000 lbs. of Penncross and about 15 gallons of Roundup. The total cost for these items was about $7,000.

After the seed was applied we went over the fairways with two Jacobsen 584 aeroblades set at approximately 1/4 inch depth and they really kicked up the dirt behind them. This depth setting helped reduce thatch which escaped our aerification. Any areas where thatch remained did not germinate the bent seed as well as the other areas even when the thatch had been killed with the Roundup. The seed will not germinate in that thatch so the aerification or slicing is a very important part of this operation.

We pulled flexible dragmats behing the aeroblades and these helped to level and fill the areas, cover the seed, and move the debris around. The fairways were watered and kept moist as was necessary.

We could see germination in four to five days. In seven days the entire fairway had a greenish cast and growth was evident. The temperatures turned cooler which was good for the germination. Germination and development was much slower as we moved later into the fall.

There were about three acres of fairway which had always been flat and poorly drained and developed wet spots as we watered. These were not seeded with the original seeding. We had a heavy amount of rain before we could totally disc and smooth

these areas to get the contour and surface drainage we desired. We weeded on September 23, which was the first frost in our area. There were several heavy rains after this time and some of our seed was washed into the low spots but we do have a stand of grass in these areas. This was actually about two weeks later than our original seeding. By the end of three weeks we had enough growth on the fairways to be able to cut them for the first time. On September 25 we applied Scott's starter fertilizer at half rate to the seeded fairways. By the end of six weeks we had almost one and a half to two inches of root growth and we were ready to cut for the second time. This was after a heavy frost that had come on October 3. In spite of the early and heavy frosts, the young grass plants continued to grow and harden off for the winter. Two light applications of Actidione RZ were made to these fairways in the middle of October and early November. I don't feel that the grass is dense enough to worry about snow mold.

We have not allowed cart traffic on the new fairways. What was originally planned as a three-year program will, for the most part, be completed. We will have some Poa annua in the fairways. It will encroach wherever we have turf weakness, but we will be better able to manage our water now with the permanent Penncross in the fairways and will seek to reduce the Poa annua by restricting water use during the warm months.

FAIRWAY CLIPPING REMOVAL - MY STORY

Cal Gruber, Superintendent
Coldstream Country Club, Cincinnati, Ohio

Eight years ago I began catching clippings on a fairway. It was a par three, 15,000 sq.ft., which had been cut with a tractor and a set of seven gang mowers. The fairway was 90 percent Poa annua, most of which we would lose each year. After mowing with the Jacobsen Greens King at 7/16" and catching the clippings for one season, we had very little loss of turf and could see a substantial gain in the population of bentgrass.

The next season we started mowing about 90 feet out in front of all greens which was about 90 percent Poa annua in the turning areas where we would lose the most grass. In one season we had the same results as on the par three fairway. In two seasons we were 80 to 90 percent bentgrass with very little loss of turf.

In 1979 we mowed two par four fairways, #1 and #18. In one season we had the same results. 1979 was one of those hot, humid, wet summers. We had lost quite a bit of turf on fairways where we were cutting with Jacobsen HF 15-gang mowers. In September the greens chairman asked me how much it would cost to mow all the fairways like #1 and #18.

To mow twice a week with a Jacobsen Greens King and haul clippings would take sixty man hours compared to twenty man hours required for mowing four times a week with the HF 15, which is the approximate difference on one additional employee per week. Two new Greens Kings would need to be purchased also. Three weeks later the greens chairman approved this mowing program for 1980.

In October we began mowing all the fairways at 7/16" with the Greens King we had so they would be at the right height for the following year. Later that fall we discovered that the Toro Turf Pro 84 would fulfill our needs with its available grass catching kit. Also we were assured that it would mow at the height of cut desired for our fairways, and then I requested a demonstration to see if this mower would be suitable for our future mowing program. After using it for a couple of weeks, we decided it would be the mower that would give us a good clean cut at 7/16" and would be able to pull a couple of good sized trailers. That winter we purchased two Toro 84's and hand built three trailers 4 ft wide by 6 ft. long by 2 ft. deep to haul clippings.

The clippings are hauled to a one-acre field which we are fortunate to have behind the woods alongside our 17th fairway. We drag and disk every two to three weeks and plow twice a year to keep down the odor and mess.

We have completed two full seasons, 1980 and 1981, of this program on all fairways. In that time, we have gone from 35 percent to 90 percent bentgrass without overseeding. The big bonus of this mowing procedure is that we can mow nine holes each day, starting at 6:00 a.m. and can finish by 9:30 or 10:00 a.m. which enables us to get out of the way of the golfers and to avoid the heat of the day. This procedure also makes it possible to change mowing directions each time we mow. We have a close, clean-cut, playable turf which pleases the members.

FAIRWAY MAINTENANCE - A NEW APPROACH

Alfred Muhle, Superintendent
Country Club, Inc., Pepper Pike, Ohio

In 1969 the members of The Country Club, along with the USGA Greens Section, made a decision to try to eradicate Poa annua from the fairways. The method used at that time was to apply tri-calcium arsenate twice a year. It was applied to the par 4 and par 5 fairways. At the same time, the par 3 fairways and the upper half of #15 fairway, a par 4 hole, were being mowed with tri-plex greensmowers with grass catchers.

The reason for using the tri-plex greens mower on the par 3 fairways was to see what result there would be from catching the grass clippings and at the same time capturing the seed heads of the Poa annua. From the result we were noting what was what was happending to our bentgrass, so that in the future we might consider using this operation on a large scale.

The Chip-Cal program was in use until 1979. At that time there was no more tri-cal available, so now we had to try some other method. The par 4 and par 5 fairways had 65 percent bent generally. Some fairways in the deep woods had much less.

The summer of '79 was a wicked one for growing grass. Our #3 fairway, the most difficult one for grass development, suffered quite a turf loss. After the third year we noticed the rapid development of bent. At the same time we were mowing aprons at least 70 to 100 feet out in front of the greens, which became all solid bent.

As the members and guests saw the results, they wondered why we couldn't mow the entire course and catch the clippings with some type of mower. They wanted the

fairways to look like the upper half of #15 which was our largest area of tri-plex mowing. One day a group of members called me into the club and asked me to get facts and figures and let the trustees and membership know what it would cost to mow all the fairways and a large back lawn with tri-plex mowers. So now I started to look for someone who could give me some advice.

With the help of the USGA I contacted Cal Gruber at Coldstream Country Club in Cincinnati, who in 1980, mowed all the fairways at his club with tri-plex mowers. He was using Toro 84-inch Turf Pros. In September 1980, my greens chairman, co-chairman, a Toro salesman, and myself, visited Coldstream. To our amazement, the fairways we saw had to be without a doubt the most beautiful fairways we had ever seen. We spent the entire morning and asked many questions. I would like to give credit to Cal Gruber, the "father" of tri-plex fairway mowing. Other superintendents are trying this program. Tom Vogel at Portage Country Club has cut seven holes with a tri-plex mower and the remainder of this fairways with gang mowers, so he can show his members the difference in the grass condition. Ron Boettger, Brookside Country Club, Columbus, has mowed his entire course with tri-plex mowers this past year, as has another superintendent in the Cincinnati area.

We had to figure out what it would cost to buy the mowers, purchase trailers, and how to dispose of the clippings. We chose the Toro 84-inch Turf Pro because it was the largest machine which had baskets. The cost of three machines was close to $30,000. In addition to the mowers, we bought six trailers at a cost of $16,000 to haul the clippings to a 12 yard dump box.

One cost we didn't anticipate was the clipping removal. This cost was about $2,800 in 1981. At first we thought we could bury the clippings, but after a month, there was no way we could find enough space to bury all the debris. Our largest cost is manpower, near $12,000. During the months of July and August, and the first two weeks of September, added dumping resulted from the rapid growth of grass. We are hoping the equipment will last four years so we can spread the cost of the mowers over that period. The additional expense was never questioned by the members when they saw the resulting improvement to our fairways.

My personal feeling about this program is that one could start on a small basis like Tom Vogel did at Portage. Use one machine and maybe two trailers and do two or three fairways each day.

Let's talk about the mowing procedure. First, we reduced the size of our fairways from 36 acres to 30 acres. We did this by shortening the length by approximately 25 yards. Then we contoured the sides. In one month the members were used to the size of each fairway, and there were few complaints about their reduced size. The attractiveness of the contouring made a more pleasant appearance than the so-called bowling alley style.

We used three machines to cut fairways each day. On Monday, Wednesday, and Friday we cut the front nine. On Tuesday, Thursday, and Saturday we mow the back nine. Mowing begins at 6:00 a.m. and is finished by 9:30. We mow in a pattern where the first fairways mowed are 1, 2, 3 and the last mowed are 7, 8, 9. Mowing in early morning leaves little abrasion to the grass plant and no build-up of heat from the rollers. A Toro Turf Pro pulling a trailer built in Canal Winchester, Ohio, will handle the clippings for the two or three fairways the men are cutting that day. When the trailer is full it will weigh about 600 lbs. The ramp was built the same height as the 12 yard dump box so the operator can easily back and dump.

The mowing pattern uses three angles - left, right, and longways. Our 17th fairway was one of our poorest turf areas. Today the condition of the grass is amazing. I firmly believe taking the clippings off and catching the Poa seed heads in the spring and early fall makes a difference like night and day. It has to help the spread of bent on the fairways.

We are noticing no build up of clippings. After a rain in humid weather, there is no musty smell like we had in the past. Our fertilization has been the same. The spray program was watched very closely and we applied fungicide as in the past.

In summary, the program we are using is not affordable to most clubs. If you have a problem fairway or two, try somehow to catch clippings from that area. I think you will be surprised with the results. It is not an easy task; it takes a lot of hard work, but the satisfaction of the members and the sense of accomplishment you will enjoy will make this hard work worthwhile.

CHOOSING THE CORRECT AMOUNT OF NITROGEN FOR GOLF GREENS

John R. Hall, III, Extension Agronomist
VPI and State University
Blacksburg, Virginia

There is a fair amount of discussion in agronomic circles about how much nitrogen is appropriate on golf greens. It seems to be in vogue to reduce nitrogen applications to levels that five years ago would have been unthinkable. It is difficult to take a level of nitrogen that is providing good putting quality on one course and achieve equal results on another. This is primarily true because several factors influence efficiency of nitrogen use, nitrogen level alone does not create good putting turf and the production of good quality putting surfaces remains about 75% art and 25% science. Scientific principles and ideas can be moved from one golf course to another but you cannot take what is an art (being created by an artist - the superintendent) and move it from one golf course to another without also moving the artist.

Each golf course superintendent must examine the factors affecting nitrogen use on his golf course and determine the level of nitrogen that must be used, based upon the budget he has available to provide supplementary management practices and the limits of his professional ability.

The following factors will affect the determination of the amount of nitrogen that is appropriate for a particular golf course.

Past Fertilization Programs - There are courses that have used urea formaldehyde for so many years that they could probably not fertilize for two or three years without seeing significant decline in growth. Urea formaldehyde and natural organic fertilizers will provide carry-over nitrogen from year to year.

Quality Goals and Who Pays the Bill - If one wants golf greens of the very highest quality, a strong budget is needed. If 75% of the paying golfers like greens fast and of the highest quality, then grind the bed knives, lower the mowers, increase the frequency of mowing, topdressing, fungicide and herbicide spraying, aerifying, verticutting, watering and send the bill to the Clubhouse. However, if 75% of your paying golfers are carrying handicaps from 9 to 36 and don't particularly like to watch four foot putts go seven foot past the hole, then give them what they want within the limits of Agronomic Common Sense. Fast greens are not necessarily quality greens. Greens should provide a smooth putting surface on which the ball rolls easily and does not bounce when stroked. They do need to have a good combination of compressibility and resilience which allows a properly hit ball to "bite". This is best provided by an adequate topdressing program coupled with a reasonable irrigation program. Do not lose sight of the importance of appearance to the paying customers. They have been raised playing golf on "greens" - not "browns", and like it or not, they are not likely to be favorably impressed by greens which look to be 20% soil and 80% chlorotic grass.

Species, Variety and Age of Green - Grasses such as Penneagle, which appear to be less aggressive than Penncross, may require higher levels of nitrogen to sustain adequate recuperative potential. Bermudagrass appears to be less detrimentally affected by high nitrogen levels than bentgrass. Old greens with accumulated organic matter from annual root sloughing will require less nitrogen.

Soil Physical Condition and Irrigation - Sandier greens are definitely going to require higher levels of nitrogen and more frequent irrigation. Older greens with higher silt and clay contents are going to bind the ammonium nitrogen providing higher levels of efficiency.

Mowing Frequency and Height - Intensive mowing frequencies (6 to 7 times per week) and low mowing heights (less than 3/16") are likely to increase total nitrogen removal in clippings and reduce the amount of root system available to absorb nutrients and water. This will tend to reduce applied nitrogen efficiency and increase irrigation requirements.

Length of Growing Season and Amount of Traffic - The length of the growing (and therefore golfing) season can vary from six to ten months and therefore the total amount of nitrogen required in these two extremes vary widely. On the "pay as you go" public and semi-private daily fee courses, traffic is money and therefore the superintendent has to have a turf that can recuperate and heal ball and spike marks rapidly. This potential for healing has to be there when the traffic is there. That may be in July and August on some courses when it is hot and dangerous to apply nitrogen.

Source of Nitrogen - There is little doubt that nitrogen recovery in the grass plant is most efficient from soluble sources of nitrogen applied at low rates. Therefore equivalent nitrogen recovery from a slow-release source like urea formaldehyde will require higher levels of nitrogen application. Three pounds of nitrogen from a soluble source applied in six applications of 1/2 lb. each may provide the same turf quality as 4 or 5 lbs. of slow release nitrogen applied in two 2 lb. applications. Slow, steady growth is desirable and can be achieved with either slow or fast sources.

Shade - Greens not receiving full sunlight are not likely to be able to utilize as much nitrogen as greens in full sunlight. Limited sunlight means limited carbohydrate production and therefore limited growth of roots, shoots, rhizomes and stolons.

Obviously, more than just applying the right amount of nitrogen is necessary for quality putting greens. The real art of golf green management is in cultivation and grooming. Aeration, topdressing and verticutting are the management practices that are seldom successfully "cookbooked". The effect of timing, frequency and severity may vary from green to green. These effects are learned by the golf course superintendent through valuable experience. Supplementary management tools like Wiehle rollers, brushes, rubber and metal combs, slicers, spikers, groovers, and triplex verticutters are all integrated into the total management program to produce "quality" greens.

If you are going to experiment with low nitrogen levels on golf greens, consider the factors above which determine the proper amount of nitrogen for your greens. Realize that there are advantages and disadvantages to low nitrogen programs. Advantages that have been observed are: less overall disease activity, less grain, lower nitrogen cost, less thatch deposition and a less dense turf that putts faster. Disadvantages that have been observed include: ball marks and spike marks lasting longer, slower traffic recovery and therefore less ability to take heavy play, more pressure from goosegrass (Eluesine indica (L.) Gaertn.), greater color contrast between Poa annua and bentgrass, slower recovery from cultivation practices and possibly increased Poa annua invasion.

Today's professional superintendent should never bind himself to a "cookbook" nitrogen program. He should take these suggested programs and alter them in a fashion which takes into consideration the factors that influence the efficiency of nitrogen use and his financial and professional ability to utilize supplementary cultural practices.

THATCH-NITROGEN STUDIES

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Serious thatch problems often develop in quality Kentucky bluegrass turf. Although many factors may cause thatch buildup, surface acidity is often determined to be critical. This acidity is favored by nitrogen fertilization and irrigation.

Incorporation of soil into the thatch has been a successful management practice on golf greens for several decades. Because of the labor involved in topdressing, it has not been extensively tried on lawns and fairways. Several tests were initiated to determine the effects of lime and certain mechanical treatments on the rate at which thatch could be decomposed by natural means and to determine the effects of nitrogen on thatch buildup. Although this research has not been completed, some conclusions can be made:

1. pH was significantly reduced in the thatch and top inch of soil as nitrogen was increased from one to five pounds of nitrogen per 1000 sq.ft. applied annually for four years. No pH differences occurred below the one-inch soil level.

2. Thatch accumulation was directly related to increasing nitrogen rates.

3. Earthworm activity was reduced drastically as nitrogen rates increased.

4. A correlation between earthworm activity and water infiltration could not be made using the double infiltration method.

5. Summer quality was reduced as the nitrogen level increased.

6. Lime moves very slowly through the thatch layer and is physically bound in the surface.

7. Reaction time for fine lime is slightly faster than for coarse agricultural lime.

8. Light rates of fluid lime (20 lbs/1000 sq.ft.) is insufficient to significantly alter pH of the thatch.

9. Mechanical treatments (coring, topdressing and vertical mowing) diluted the thatch but had little effect on thatch thickness during the first year of the experiment.

NIMBLEWILL MANAGEMENT AND CONTROL

A. J. Powell, Jr.
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Nimblewill (Muhlenbergia schreberi) is a serious problem in bluegrass lawns and pastures throughout the transitional climatic zone. Since it is a warm season grass, brown nimblewill patches are most distracting from early October through April. Although it is not an aggressive species, it is very competitive with Kentucky bluegrass and begins appearing most often in low maintenance turf.

We initiated several management tests to determine the influence of mowing heights, species competition, nitrogen fertilization, pre-emergent herbicides and spring cultivation on the long-term nimblewill population in a Kentucky bluegrass turf. After five years, it is evident that nimblewill is most competitive when maintained at high mowing heights (3 inches or greater). Nimblewill has been most competitive when no nitrogen was applied to the turf or when excessively high rates of nitrogen (10 lbs. N/1000 sq.ft.) were applied. The moderate levels of nitrogen (2-3 lbs. N/1000 sq.ft.) are probably best for the Kentucky bluegrass.

Spring vertical mowing significantly reduced the nimblewill population the first year but had little effect in later years. Certain genetic strains of the nimblewill may be more susceptible to this mechanical treatment.

Pre-emergent herbicides have had little influence on nimblewill. Interseeding with Manhattan perennial ryegrass (and to some extent with Kentucky-31 tall fescue) has shown enough competitiveness to greatly reduce the nimblewill population.

Selective chemical control of nimblewill has not been possible since Zytron was discontinued several years ago. However, chemical tests conducted at U.K. in 1979 indicated that linuron could be used to selectively remove nimblewill from Kentucky bluegrass turf. In 1980 and 1981 additional tests were conducted to determine the optimum rate and time of application of linuron to result in nimblewill control with the least injury to Kentucky bluegrass. This work is being continued at the present time. Even with optimum rates of the linuron applied during the summer months, some serious discoloration of Kentucky bluegrass can be expected.

NITROGEN LOSS AND ITS SIGNIFICANCE

Dean Mosdell, Graduate Student
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With escalating costs of nitrogen fertilizers and increasing concern over water quality new emphasis has been placed on the reduction of nitrogen loss from turfgrass rootzones. Turfgrass roots absorb nitrogen primarily in the nitrate (NO_3^-) form. In well aerated soils nitrogen (N) is broken down by soil microbes to nitrate. Since soils have very little capacity for anion adsorption, this anionic N form is subject to movement with percolating water down to the groundwater. Concentrations of NO_3^- in drinking water greater than 10 ppm are considered hazardous for human consumption. Losses of NO_3^- through leaching not only increase the possibility of contamination of groundwater but also reduce the amount of applied N available for plant uptake.

The tendency to leach NO_3^- is greatest under the following conditions: highly permeable soils; high N rates; high rates of soluble N carriers; intensive irrigation and/or rain. Water moves through large pore spaces very rapidly and the amount of large pore space increases with sand content and size of sand particles. Nitrates moving with this water can be lost from the rootzone. High N rates and high applications of soluble N increase the concentration of NO_3^- in the soil above plant utilization thereby increasing leaching losses. Intensive rain and/or irrigation increases the amount of water percolating through the soil which can carry the NO_3^- out of the rootzone.

Complete prevention of leaching losses of NO_3^- is not possible but management practices can help reduce the amount of N lost from the rootzone. Reduction in the concentration of NO_3^- in the rootzone at a given period by lighter and more frequent N applications can reduce leaching losses. Proper selection of N carriers is also important in reducing NO_3^- concentration in the rootzone. Generally, soluble N fertilizers should be applied at less than 1 lb. N/1000 sq.ft. in one application, and for higher rates of application a less soluble N source should be used. Judicious irrigation practices should be employed to reduce the amount of water moving through the profile. We cannot control the amount of rainfall, but we can use irrigation water wisely to prevent losses of NO_3^- from the rootzone with downward percolating irrigation water.

VERTICAL DRAINAGE

Thomas Wilkins, Superintendent
Doe Valley Country Club, Brandenburg, Kentucky

My presentation today is a new experience for me, the same as the type of vertical trenching we did.

Our course was built in 1972. Since then the golf course has improved, except for the tees, so we decided to undertake a tee improvement program. Our tees were built of clay and were rough and uneven. A golfer could hardly get a tee into the ground except in the early morning hours after watering.

We decided to start topdressing our tees with nothing but sand the same as we have topdressed our greens since 1972. The first thing we did was to level the water trenches with sand. Following this we topdressed all the tees with a half inch of sand. After this we came in with a Rogers seeder and reseeded all the tees with a mixture of ryegrasses. We came back three weeks later and applied another half inch of sand, giving us approximately one inch of sand on the tees.

Soon after this we attended a superintendents meeting at which Dr. Daniel was the guest speaker, discussing vertical trenching. After listening to his presentation, we decided vertical trenching was the thing to do to our tees.

The first thing we did was to purchase a trencher which we had rented for $600.00 a month in the past. After shopping around we found a used trencher, priced at $17.00, which would satisfy our needs. After purchasing the trencher we found a supplier and purchased 4000 feet of 2" ID narrow slit tubing. After this we ordered 200 tons of sand and had it located next to the tees.

We set up our transit and shot the grade. Then we took our line marker and laid out the trench pattern. We laid out one line parallel with the tee and the rest perpendicular to it on five foot centers.

We started trenching at a depth of fourteen inches and picked up the dirt from the trench as we went. After a few trenches were made we started putting three inches of sand in the trench and laying our two-inch slitted drain tile. After this we finished filling the trench with sand to the top.

In this 4000 sq.ft. tee (#1) we laid 980 feet of two-inch slitted drain pipe which cost .19 per foot. We used 20 tons of sand which cost $7.00 per ton. The labor cost for putting in the tile equalled 64 man hours at $280.00. The total cost of #1 tee was $606.00.

On the next tee we needed to enlarge and raise the rear of the tee three feet. We built a railroad tie wall to the height we wanted and filled in with dirt. After it settled for two weeks we came back and put in drain tile.

We did half the tees last year and will complete the rest this year beginning as soon as the weather permits. In 1982 we will be trenching nine three inch trenches. We think the six-inch trench was too wide for good fast grass recovery. In addition, there will be less dirt to remove from the trench and less to put back in, thus saving on both labor and sand.

Presently in our sand traps we have four-inch perforated tile covered over with gravel. We are removing that and retrenching and installing the two-inch slitted drain tile. We are looping the tile and teeing in every three feet with a cross drain and backfilling the trench with sand only.

The traps where we have done this are draining faster after a rain than the older traps.

Editors Note: In sand traps, exit both ends of the loop for regular traps; for larger traps use more loops and exits.

ARSENIC - 1982 PROGRESS

W. H. Daniel, Turf Specialist
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West Lafayette, Indiana

There was a period, 1951-1977, when various formulations of arsenic were tested and tricalcium arsenate was widely used. It was estimated one thousand golf courses had some areas treated with successful Poa annua restriction. In 1960 there were eight companies selling formulations for turf treatment. By 1970, the Chipman formulation of 48% granular tri-cal was the main material available. When OSHA standards were enacted, granular formulators could not meet the clean air within the plant requirement, and production was terminated.

During those days we learned that continued uniform applications would build up a toxicity of arsenic within the rootzone and that it would selectively prevent Poa annua, crabgrass, goosegrass, chickweed, and several other weeds. It also served as an excellent soil insect control. We also learned that repeat, light overseedings with improved cultivars of the desired grass were necessary.

There has been some work, particularly in the Northwest, in using sulfur, with some restriction of Poa annua, and currently there are a couple of materials, including EL500 and EL222, which can reduce the vigor of Poa annua. The preemergent materials sold primarily for crabgrass control can, at times, inhibit Poa annua. However, repeat treatments are required and prevention of any seedling development is necessary for suitable control.

During 1980-81 we have new research using a flowable wet powder, labeled 'Turf Cal', made at Fort Valley, Georgia. That material can be dispersed in liquid so that uniform applications can be made. The standard rate appears to be one gallon per 1000 sq.ft. when phosphorus levels are low to medium, and perhaps a second treatment of one-half to a second gallon when phosphorus supplies are high. Treatments made 15 August 81 gave 95% control by 15 October 81. We know that the material is more available than the old tricalcium arsenate because of the finer grind.

It is our opinion now that such materials, when available commercially, could be applied where Poa annua control is desired. A proposed procedure is to apply the liquid slurry early in the morning when there is ample dew present, then to turn on the irrigation system, and immediately wash the material from the foliage onto the soil surface. This would fit ecology needs, it would give storage of the arsenic, and it would fit in with management programs currently in use on golf courses.

Our research is promising, the procedures seem to be economically feasible, and the product may appear in the marketplace.

C-15 DECISIONS DURING 1981

Dudley Smith, Superintendent
Silver Lake Golf Club, Orland Park, Illinois

In September 1958, after a very successful growing season, Norman Kramer, Superintendent at Silver Lake, past president of GCSAA, applied calcium arsenate to the 38 putting greens. Kramer's objective was to retard the Poa annua, and to halt its invasion into the existing Washington bentgrass greens. When the snow melted in 1959, the potent arsenic had done its job; however, the population of bentgrass had been overestimated, and the result was thirty greens unfit for golf.

Our plans then in 1959 were to overseed with Seaside bentgrass and Redtop, hope for some volunteer Poa annua, and get through that golf season. The long range plan was to erase the factors that had encouraged the Poa annua, scrap the small saucer-shaped greens and rebuild larger putting surfaces with adequate surface drainage. Raymond Didier, retired superintendent at Tam-O-Shanter C. C., was contracted to design and rebuild several of our worst greens each year.

It was mandatory that any construction started in September be completed, and that the course be open for play on May 1st. This ruled out the use of Seaside bent seed, or the use of stolons.(Penncross and Penneagle seed were not then available). Consequently, each fall we sodded our new greens with "Chicago's Pride", Toronto C-15 bentgrass.

Between 1959 and 1971 we rebuilt 28 greens at Silver Lake, all sodded with Toronto C-15. This would provide uniformity for the golfer, and ease the maintenance practices for the superintendent. These C-15 greens performed satisfactorily until the spring of 1981 when, one by one, they succumbed to the mysterious bacterial wilting, popularly called "C-15 Decline".

Many questions needed answering:

1. Was the culprit a new fungus? a virus? a bacteria?
2. Was there a positive cure on the horizon?
3. Would the remedy be economically feasible? require weekly or even daily chemical applications?
4. Would the disease become resistant to the antibiotic at a future date?

Whenever we patched out putting greens after vandalism, pipeline repairs, hydraulic oil spills, etc., the sod we used from our nursery was always Penncross. We noted that these patches were disease-free. The Penncross was immune to whatever was killing the Toronto C-15.

At a "summit" meeting in May, our directors agreed on this format:

1. Try to control the spread of the disease by isolating the machinery used on the infected greens; mow these greens less frequently; stimulate the turf with extra nitrogen.
2. Nurse the C-15 greens through the 1981 playing season.
3. After the last tournament in late September sod the infected greens with Penncross.

In May the South Course had five greens infected with the bacteria. I measured the diseased greens and reserved ample Penncross sod at the H & E Nursery in Momence, Illinois. NEVER did we anticipate that all 28 Toronto greens might fall prey to the scourge.

As the season progressed it was common for my cupchanger to say, "Dud, you better check No. ___ South. I think it's got "IT"."

By Labor Day weekend eleven greens on the South Course had become diseased; seven remained clean and healthy. We stuck with our game plan. Close the front nine on Monday, September 21st; strip and resod these greens. Anticipate the machinery, manpower, and supplies necessary, plan the procedure the renovation would follow, but Get Organized!!

Since my student labor had returned to school, it was imperative that I hire some experienced help to do the sodding. I was fortunate to obtain a crew of six men from Walter Stern, landscape contractors, in Mundelein, Illinois. It was impossible to estimate the man-hours, overtime, rainouts that lie ahead; so we agreed to pay Stern one dollar for each roll of sod delivered. The amount due would be calculated easily from the truckdriver's slips.

Now that we had to maintain only 27 holes for the golfers I asked some of my regular crew to strip and grade some of the pockmarked Poa annua tees on the South Course. We transplanted the C-15 sod from the seven "disease free" greens to these tees.

It was apparent H & E Nursery could not supply us with sufficient Penncross sod to complete our project. Ben Warren tipped me on another source of sod, but I laughed when he told me. On August 24 I flew to Beeton, Ontario, Canada and walked the sod fields of Gunter Beder. Beder Turf Ltd. agreed to send me unlimited Penncross sod that would be fertilized, treated with Chlordane for the "dew worms", and mowed at 5/16 inch.

The Canadian Penncross would be harvested at 4:00 p.m.and loaded 1800 metric yards to a truckload. After traveling fourteen hours at night when the temperature was cool, the sod was at our doorstep in Chicago at 7:00 a.m. The scheduling ran smoothly. Example: Sod ordered at 10:00 o'clock this morning would be cut, delivered, laid, and watered by suppertime tomorrow.

After the first four greens were stripped and prepared I decided to phone for the Canadian sod first. I was curious what shipping problems would arise and what condition the sod would arrive in. It might be wise to hold the local sod in reserve in case of rain or frost at the more northern site.

When the first few greens had been shaved clean of their diseased turf we saw that we had a BIG problem. On the surface there remained a 3/4 inch layer of ugly red THATCH! Slicing aerifying, and verticutting proved fruitless; the thatch remained bonded to the soil surface.

The work procedure:

1. We acquired an additional sod cutter, set it deep enough to reach soil level, and recut all the greens in a different direction. The thatch was then peeled off by hand using wide aluminum scoopshovels and wheelbarrows. No heavy equipment with lug tires was permitted on the putting surface. I wanted to keep the original contour firm and intact.

2. With the thatch removed, each green was aerified six or eight directions with a Dido fairway aerifier to bring fresh soil to the surface.

3. The greens were then spiked with a spiker mounted on the rear of a Sand Pro. The hydraulic downpressure on the spiker tore loose any remaining thatch layer.

4. Two bags of starter fertilizer were applied to each green with a Cyclone spreader.

5. The aerifier cores and loose dirt were than pulverized with the verticut reels that had been installed in a Jacobsen Greensking.

6. The entire surface was slowly dragged smooth with the power sandtrap rake. It did a remarkable job.

7. Finally, each green was covered for the night with 40 x 200 ft. sheets of polyethylene. The seams were overlapped like roofing shingles, and the plastic weighted down to stay in place. This kept the surface firm and dry until the sod arrived. No rain, if you please!

When Friday afternoon arrived, nine greens and five tees had been sodded. On Saturday we stripped the two practice putting greens and covered them with plastic until Monday.

The second week we were rained out one day. The Bedar farm in Ontario was deluged the following two days. While the Canadians were mired in I phoned H & E Sod to send the local Penncross, and keep the show moving. By midweek I had a difficult decision. The eighteen greens on the South Course would NOT be completed by Saturday, but surely would be by next Tuesday. So, let's quit work for the week on Friday afternoon and avoid the overtime hours on the weekend. Then, plan a full six days work for the following week, maybe even cut up a few of the diseased greens over on the North Course. (Yours truly must be insane!)

My logic was that to renovate five infected greens on the North Course in mid-October would cost us 800 rounds of golf in 1981. To do the same five greens in May 1982, we would probably lose 8000 green fees. Besides, we had the labor, the equipment, and the routine down pat, and the weather was cooperating. It might be very wet next spring.

On Saturday afternoon, October 10, we gathered up the scoopshovels and opened up the tequila bottles. After seventeen hectic days we had sodded 25 greens and 10 tees! There are twelve Toronto C-15 and Poa annua greens left on the North Course to rebuild. One thing is for sure - the job will be a "piece of cake".

Equipment used on sodding project:

2 Ford one-ton dumptrucks, for hauling junk sod and thatch
3 Ryan 18" sod cutters with extra V belts and spare blade
3 sod slicers or sod lifters
8 aluminum scoop shovels
2 wheelbarrows
1 John Deere front-end loader
1 Ford tractor with Didoes fairway aerifier
1 Toro SandPro with spiker
1 Jacobsen Greensking with verticut reels installed
1 Toro SandPro with power rake for dragging
1 Rollpac power roller
3 Cushman trucksters hauling hose, ropes, stakes, etc.

Costs of sodding project at Silver Lake in 1981:

10 rolls, 40 x 100' 4 ml polyethylene	$ 870.00
2500 lbs. starter fertilizer	500.00
30 rolls, 1500 ft. snowfence	900.00
16 spools, 8000 ft. yellow rope	224.00
160 6 ft. steel stakes	448.00
64 cu. yds. topdressing	1,768.00
Sod:	
10,100 metric rolls Penncross sod	27,000.00
Duty on imported sod	694.00
10,600 yds. Penncross sod	15,582.00
2,100 yds. XL100 bluegrass sod	1,690.00
Labor:	
6 men for 17 days, rate $1.00 per roll of sod	20,700.00
Extra hours by the Silver Lake crew for the period Sept. 21-Oct. 30	5,608.00
Total cost	$75,984.00
Costs per green, for all 25 greens sodded	$ 3,040.00

IRRIGATION, A MODEST EXPANSION

Allen Wehr, Superintendent
Huntingburg Country Club and Owner, Green Carpet Lawn Service
Huntingburg, Indiana

I'm going to give a little different version of golf course maintenance. Our nine hole golf course, with a small budget, made a major improvement without developing a financial problem. A fully automatic irrigation system around all greens was installed.

Probably the most important factor in the success of the system was doing many hours of homework. For my Board of Directors to approve such a project I needed all the facts and figures which would prove a net financial savings and pay back program.

When I was hired at Huntingburg there were many problems needing attention. After the first summer, I decided the most important major change needed was an irrigation system. The original system was one of small lines feeding each green. To make matters worse, these lines had been spliced and run to the next tee.

The watering was done in the early morning. We would rise and shine at 2:00 a.m., get out on the course, and begin battling the hoses, fighting kinks and knots, and finally be able to turn on the water. The course uses city water, operating from four city meters, using no additional booster pumps for pressure. Needless to say, the only city pressure coming from 1" lines connected to 3/4" faucets, then running through 100 ft. of 3/4" hose made for a very insufficient watering system.

In order to water each green the sprinklers would need to run one hour per setting with three locations on each green. The tees were turned on with the third setting with the greens, again dividing the pressure and volume further. The watering operation took five hours every day.

I'm sure many of you are facing this same problem. Well, here is what I did to improve the system and the problems associated with it without taking away all the money that was needed to maintain everything else on the course.

First, I surveyed all existing line sizes, making plans for those needing replacement. Then I determined the four meter sizes to be sure sufficient volume and pressure was going to be available. Next, I totaled the amount of irrigation lines to be needed, types of sprinklers and valves to be used. With the help of my irrigation equipment representative we were able to predict exact costs.

After figuring the costs of the project I was able to compare those figures with the current labor-consuming system, which was the only thing the Board was interested in.

The plans were approved and the project began in March 1980. I contracted with a company to pull in all irrigation lines and wire. The machine was a modified Ditch Witch with a steel bar which had a vibrating motion. On the lower section of the bar there was a 3" steel bullet attached and from this bullet there was a chain with a wire mesh finger about 4 feet long. As the machine advanced the bullet made an opening for the pipe to be pulled along to its destination. One of the longest pulls we made was approximately 350 feet. This was done in one complete section.

Since the system was going to be automatic we had to plan 24,000 feet of wire to connect the valves to the clock located in the maintenance area. The plowing of 3,000 feet of pipe around the greens took eight hours. 24,000 feet of wire was in the ground in twelve hours. Keep in mind the pipe and wire were buried to its destination, all to be connected later.

The plowing of pipe and wire was a great savings from the fact that there were no open trenches anywhere which must be backfilled, no problems of settling or need to resod the trenched area. There was little damage to sod surface. Within two days following the plowing we could hardly see where the lines had been installed.

We installed 41 Rainbird sprinklers with 1-1/2" electric valves all controlled by a 12 station clock located in the maintenance building. We have one green with one valve and three sprinklers, and the rest have four sprinklers off of two valves.

In April the system was ready for operation. The cost of the system was $5,400 for the materials, plowing pipe and wire. Most of the setting of sprinklers, valves, and wiring connections were done with our own personnel.

In the summer of 1980, with its record shattering heat and humidity, the greens were of the best quality they had ever been. I credit the fact to the new irrigation system.

A lot of irrigation people will say this is not the best way to have an irrigation system, but I feel for the small clubs it is the only way they can improve the most troublesome of turf maintenance problems - the proper use of irrigation water.

NEW IRRIGATION, 54 HOLES

Donald Paakala, Superintendent
Medinah Country Club, Medinah, Illinois

It's a pleasure to be here. I have been in the Chicago area for three years, and have not yet had an opportunity to come to the Purdue Conference. I'd like to thank the Foundation for the opportunity and for the fine program which they have put together.

When I came to Medinah in 1979 I found an irrigation system which was installed in 1935. In my opinion, it was one of the first things we needed to change. We had a 40 acre lake which is certainly enough capacity to irrigate 54 holes. The average depth was probably two to three feet. There were two pumping stations; one could supply a thousand gallons per minute with a sixty hp and a forty hp turbine pump. The other had two sixty hp pumps and a 75 hp pump; however, we could never run the 75 hp pump along with the two sixties because we would pump the wet well dry. I later found out that the intake to the wet well was only ten inches in diameter. The greens had center sod cups and any of you who have worked with them in the past know what they are. We had no pressure control. If we had to reduce the pressue we would open the gate valves located in low spots to release the pressure so we

wouldn't blow the lines out of the ground. We had no isolation valves so any time there was a break or a malfunction we had to shut the whole system down before we could go out to repair it. I'm sure you can imagine the problems involved when you are trying to operate three courses!

One of my first thoughts was that there had to be a way to install an automatic system for this club. Of course, with the large facility we had, I felt we had to transform the whole place at one time to stave off the rising costs of irrigation that are occurring over the years. So my attempt was to sell the project, i.e., installing all 54 holes at one time. The Green Committee had been aware of it for a number of years; my predecessor had made several attempts to sell the idea to the club.

So I must say the Committee was aware we had a need for an automatic system. I decided to contact some influential people in the club who were soon going to be in high places and influence those people and thus, with their influence, get approval. We had a very strong, aggressive vice president in the club, and I convinced him that we needed the automatic system and he went to work selling the idea to the Board and other members that he saw from time to time.

In the summer of 1979 we began inviting irrigation companies, equipment suppliers to make plans and present themselves at Green Committee meetings. We had one a month and these people would show products and present plans and give us a rough cost estimate of installing such a system. I had investigated other clubs and talked to many superintendents. I had looked at installation work done in the Chicago area and knew the kind of system needed.

The financing of the project and selling it to the membership began in late summer and fall of 1980. We needed to have a special membership meeting since this would involve such a large capital outlay. The Board had already been sold by the then vice president of the club, and had found financing. We called a meeting and about 250 members were present, which I felt was a good attendance. Many of these members were already convinced of the benefits of such an irrigation system and were ready to vote in favor of it. I showed some old pieces of pipe with breaks which we had pulled out of the ground, and I had a series of slides showing geysers and other malfunctions of the present system. Then the equipment people described how a new system would remedy the problems inherent in the present antiquated equipment and how it would improve the grass and provide much better conditions for the golfer. Then the president of the club described the financing arrangements and assured the members that the cost would not come out of their individual pockets.

Essentially what we did was average back over fifteen years and found that the attrition rate was about fifty members per year. With those openings with an initiation fee of $10,000, that's $500,000 and that's a lot of money. We also felt that we did not want the club's capital funds to be depleted over the next few years while we were putting in the system, so we did get a short term loan which we could fall back on this year and next year to take up the slack to get some equipment and other things necessary so the remainder of the club wasn't neglected while we are putting in an automatic irrigation system. When the members found out they were not going to have to finance this project and that new members coming into the club would help to finance it, we had no real difficulty in selling the system.

With all the plans presented by irrigation equipment suppliers we had a lot of information and a lot of drawings. We knew what equipment we wanted, but which was the right plan? We decided we needed to hire an irrigation engineer as a consultant who would be qualified to analyze the drawings and specifications and tell us which was the best plan. We needed to find an engineer who could select the proper materials, and be able to look over the project with a professional eye and tell us how the project should be installed. When you have differences between yourself and the contractor there should be one person who can play referee and help you make decisions. I feel really comfortable with that concept. Also, when that system is installed it is not just the Superintendent's system, it is the system he helped to install. If there are problems, then you can go to the engineer for assistance. He's responsible! So I would advise anyone who is considering a large project to consider the employment of an engineer. Of course, you need to decide the qualifications of an engineer - what experience, what degree(s), references, is he insured? This seemed like a big job and we were in a hurry to begin. We found out that Dave Tooley at Lakewood Country Club in Denver and his club had gone through this long process of selecting an engineer. They had chosen an individual from Tempe, Arizona, Bob Oltman. Bob is familiar with equipment, he has sold irrigation equipment, has an engineering background, grew up in Illinois, and is a Bradley graduate. Bob has been in the consulting business about five years, and he has put in a number of systems, and believe me, since he started the project at Medinah, he has had a lot of work.

Bob looked at the drawings and his opinion was that they all needed some work. Immediately I was glad I had an engineer. So I told Bob what we wanted - a double row electric irrigation system that would supply an inch and a half of precipitation per week under the most stressful conditions. I wanted the ability to irrigate all 54 holes in one night between the hours of 9:00 p.m. and 5:00 a.m., and I wanted to be able to apply a minimum of two-tenths of an inch in that irrigation time. Two tenths of an inch is a lot of water, and I don't imagine we will ever have to do that, but it's nice to know that I could put down a tenth and after the system has run through come back and put down another tenth later and that way get that water going down into the rootzone.

So Bob Oltman designed plans in about three months. The plans are quite extensive - eight pages. For three golf courses you have a big project. He wrote very detailed specifications. Bob designed for us a double row Rainbird system, all 51 SAM heads throughout. All the main line is in the rough, all the pressure pipe is in the rough, the valve boxes are in the rough. Each valve operates four heads. On the approaches we have two heads on a valve, and on the greens there are two heads per valve - two valves per green. The plans are very detailed about the controllers and wiring operation, how valve boxes are to be set, e.g., two pieces of redwood are set under each valve box so it will not settle. There is a snap valve located at each green, tee and two on Par 4 and three on Par 5 fairways. Each snap valve had a ten-inch square piece of redwood to hold it straight and steady. We have electro-mechanical control. I wanted to stay away from a computer controlled system. Ours is a MC3S Rainbird master controller with syringe capability. The system requires an A and B program for greens, tees and fairways on each course. This necessitates two master controllers per course.

The system will deliver 3200 gallons a minute at 125 psi at the pump and during eight hours will provide as much as two-tenths of an inch of precipitation in twenty two minutes of sprinkler operation on all 54 holes.

We then selected a contractor. Again, I feel the engineer is very important in that selection. Mr. Oltman came to Chicago and sat down with the contractors bidding on the job, went over the specs briefly, and told them what he wanted so all bidders had the same information.

I talked to a number of superintendents and formed a list of attributes I wanted in a contractor. I wanted a local contractor. The club required a union contractor with union help. I talked to suppliers to get their impressions about the reputations of some of the contractors, and I had in-depth discussions with them to find out if they were the kind with whom I could get along and work. I checked into the kind and amount of equipment, the experience they had, and how many contracts they had completed in the past and how successful they had been. I checked their references and whether they were insured and solvent.

The irrigation engineer opened the bids when they were all submitted, reviewed them with the committee, and selected the top contractor and bid. We started with the number three golf course in June 1981. We have finished number three and are about fifty percent finished with number two, and would expect four or five weeks more on that course in the spring. We'll then begin on number one and should finish that about the middle of August, with good weather. I am really happy about the work as it has progressed.

We kept the members informed. Wooden signs were put on each hole where irrigation was in progress. The contractor was not allowed to open up any ditches or holes during the day which he could not close by the end of the day. He was not allowed to be on more than one golf hole at a time. So there was a sign on any hole where work was in progress asking the players to recognize this fact, pick up their balls, and move a-round the equipment, take a drop and play on. The members have been very nice about it.

A sign in the pro shop, one in the men's locker room and one in the ladies' locker room told the golfers the status day by day so they know before they go out to play. I keep the membership up to date with a news brief which is circulated weekly to the membership. I don't think you can over-communicate on a project of this sort.

The contractor placed the main lines in the rough. A little flag was placed where each head would be, and he would come along with a sod cutter and take out a couple of strips, the backhoe would come along and take out two scoops for the valve box, then the plumbers would come along behind that and put in the swing joints and set the head, and then would come the gophers and they would fill up the holes and tamp and replace sod.

We upgraded the pump house and controls. A large intake was extended out into the lake where a cavity was dug and lined with rock and walled with rock so water moved through the opening in the wall. That cavity can be cleaned of mud as needed.

The contractor was required to use parts as specified. The total job uses 400 miles of wire and 250 miles of pipe. The unit of a fairway was a 2" riser, a 2" PVC union, a 90° elbow, a 2" cut-off valve, a 2" electric valve, a U-shaped pipe extension so the four sprinklers were 70' apart to side and 80' apart down the fairway. Each valve serves 16,000 sq.ft. of fairway. At each green two electric valves serve two sprinklers each.

To summarize briefly - If you plan to install a new irrigation system:

1. Determine the needs of your turf under most severe conditions.
2. Choose the equipment to best fit your needs and your personal desires. You have to operate it.
3. Choose a reputable engineer/consultant.
4. Consultant designs system which you specify.
5. Sell the system to your committee and membership.
6. Choose a contractor who is experienced, capable, reputable - one you can work with.
7. Install the system.
8. Communicate on and off the course with membership, board, committee, staff and other departments.
9. Be ever thankful and express thanks for your success, health and happiness every day!

SHATTERCORE AERIFICATION

Leonard Schnepf, Superintendent
Chevy Chase Golf Club, Wheeling, Illinois

Aerification. We never seem to hear the end of it or its importance to growing fine turf.

Over the years I have aerified like everyone else. Although some good results occurred, I've never been completely satisfied with the specified practices. The standard coring practice is very time-consuming, and receives too much flack from golfers when it is being done. However, it is a cultural practice we must continue. For many years I searched for a better, more efficient way of coring.

It all started with a problem at Chevy Chase Golf Club. The green had perfect nutritional, watering and pH factors, but also no growth response previous to shatter-coring. I gathered various professional opinions. The recommendations ranged to the point of reconstructing the entire green, which was out of the question.

During the winter of 1980 I stopped at the Arlington Club to discuss aerification with Superintendent George Weidner, and he showed me something different. George had been using a home-made tine for approximately eight years, two and three times per season without any problems.

My curiosity was aroused, so I decided to make a set to try out myself the next spring. If you remember, for many years we had a hand unit with solid tines to take care of localized dry spots which took forever to correct a very limited problem. With this premise, I made the decision to use solid tines in the Ryan WG-24.

My first experiment was on a beat-to-death tee with about 30 percent bare ground. While coring, the ground felt like a small earthquake was occurring around my Ryan WG-24. The soil was totally fractured and the bare areas became perfect for overseeding. The process not only left the ground slick with round holes, but fluffy as well.

My second experiment was on a problem green using a 5/8 inch homemade solid tine. I proceeded to aerify. The same quaking action loosened up the green, even in between the holes. The aerifier was followed by a man with a roller, which is a must. I applied Indiana dune sand from Old Dutch Sand Co. as Dr. Daniel prescribed. I continued the practice on the green once a month for the entire 1981 season. The result was a 180 degree reverse of the problem green's condition which now played as well as the other 17 holes.

With this good result, I decided to do the same to the balance of my greens, continuing to use by 1-1-1 mix of topdressing. The result, using only two men, was outstanding - far more efficient and very economical.

The first thing to do when using this coring method is to pull the cup. Then make one pass, replace the cup, and continue aerifying. The golfers are able to use the green, and the aerification is completed.

I noticed an unexpected side benefit concerning the wear pattern a riding greensmower gives us. The problem is eliminated due to the aerification while still providing cost saving efficiency.

I made a second set of tines. Art Cleason happened to have a lathe to turn down one set of tines to the exact size of a standard 3/8 inch Ryan tine for me. Enough gratitude cannot be expressed. I used the tines in mid-June, in 90 degree weather, obtaining perfect results.

The practice works on the principle of ballistics, shattering the entire area around the hole, and, believe me, there is no compaction due to the type of tine. The surrounding ground explodes and becomes soft and fluffy, while taking water normally and the turf responds far better. The practice even works for wear and tear areas.

The standard 5/8 inch cold rolled steel rod needed to make the tines is available at your local hardware store and costsless than fifty cents per tine. You need to cut the rods to the same length as a standard tine and put a rounded tip on one end with a grinder. It takes about twenty minutes to make one tine. With a lathe you can make any size tine you desire.

Now let's take a closer look at what happens. With a standard hollow tine, you remove a nice clean core, leaving the surrounding ground very firm. Poa annua seed heads are also being propagated throughout the surface area and the cores must be broken up or taken off the green. With a solid tine, the speed with which the soil is penetrated produces shock waves like a miniature earthquake, breaking up the area around the tine penetration and between the other tines, slightly raising the surface area. The surface area becomes soft like a plush carpet. Rolling immediately to smooth and firm the surface has been useful.

You are all familiar with the uneven wear pattern occurring from the use of hollow tines, and in turn causing uneven depth patterns and penetration. The solid tine produces more uniform wear patterns and gives more control of depth patterns.

From the slides you can see the wear is very uniform on both the 3/8 and 5/8 inch shattercore tines. The moisture content of a green is important. You will find the drier it is, the better the break-up of the soil. Furthermore, the larger the tine, the greater the increase of softness in an area.

At this point, I know there is a great deal of skepticism in some minds. All I know is, for the first time in all the years I have aerified, I am finally satisfied with the practice. It works for me without adverse effects.

Think about it; try it; evaluate it; and the appraise the cost-saving results. I believe you will then be pleased.

PROMOTING GOLF IN YOUR COMMUNITY

Lorraine Abbott, Great Lakes Region Director
National Golf Foundation, Oak Park, Illinois

When taken literally, all of you here today can consider your presence a measure of interest toward promoting golf in your community. Every bit of information disseminated by the speakers finds worhtwhile purpose in helping you as golf course owners, managers and superintendents to improve the one real product we have to offer a recreation-minded person who seeks a life-long, outdoor challenge: the golf course itself.

How well these turf care messages are assimilated into our reservoirs of knowledge and selectively utilized in the maintenance programs we've built at home reflects the degree of commitment within each of us to make golf in 1982 an experience that will leave the player wanting more after the first autumn frost appears.

It's true that this commitment we feel may be one envisioning a more ideal course setting than our resources can allow (without pricing ourselves out of business) but the effort toward coming as close as we can while keeping the golfer's investment reasonable is what really counts.

If we can provide him a rewarding lie in the fairway, a fair chance of locating his ball in the rough, an equitable challenge in the bunker, a clean cut cup on the green, accurate yardages marked at convenient intervals for ease of club selection, varied and challenging tee and pin placements, a set of local rules that adapt the course to a desired standard of fairness, a rain shelter, comfort station and, where indicated, a half-way refreshment house at convenient points on the course - then we will be providing in a sense an additional "insurance policy" for the golfer - that of "enjoyment insurance."

Further, by introducing your players to ball mark repair tools and simply diagrammed procedures for green and sand bunker maintenance, you will be showing them how to preserve the course for <u>their own</u> enjoyment the next time they play.

The product we have to offer - the golf course itself - is the best tool we have to promote the game today. It provides man one of the few links left between his populated, industrial working environment and the therapeutic tranquility of the natural outdoors - all right there in his own community.

We know that the quality of our product, the golf course, reflects two components: design and maintenance. The designer of your course charted its future, and to a large extent determined the kind of success its owner would experience in the golf business. Robert Trent Jones, in his Foreword message for readers of that just published masterpiece entitled, <u>The Golf Course</u> (Cornish and Whitten), refers to the golf course architects as "men who have been responsible for providing the very cornerstone of the game." Jones makes another significant statement when he says,

"Golf today, in all honesty,is what the golf course architects have made it -- a game of relaxation and limitless enjoyment for millions and a demanding examination of exacting standards for those few who would seek to excel -- depending on the requirements of the moment."

Whoever was the designer of your golf course, whenever it was constructed, it contains individual features of the game's challenge that can capture the player time after time, after time. Your commitment to maintaining the route along which those challenges appear make his journey rewarding and enjoyable. Your commitment provides the necessary complement to the architect's design.

This commitment in itself will succeed in promoting golf to your community; for that golfer will not be content to play alone, or even with the same companion time after time, for the most part. He's going to at some point feel the urge to invite other friends and family members to join him in this experience. Here is where your management can provide the kind of encouragement that newcomers need. You can provide dynamic, fun-filled learn-to-golf programs for the beginner as well as provide improve-your-golf type events for existing players. Keep in mind that your goal is to turn non-golfers into beginning golfers; beginning golfers into more experienced players; and your casual once-a-month player into the reliable regular. Matching the quality of your maintenance on the course with quality management and service in the clubhouse will accomplish this goal.

Here are some programs, some ideas that have found success in attracting new players as well as stimulating existing players:

-- Stage a golf swing clinic-demonstration with simple skill testing contests at a popular community function or gathering place. A local golf professional did this at a newly opening shopping mall in Ottawa, Illinois last spring. The demonstration clinic, combined with other kinds of demonstrations by the town merchants, attracted the town to the grand opening of the mall and resulted in some potential golfers for the local course.

-- Hold free "learn-to-golf" clinics at your course for school age students just before school ends in the late spring. Then sponsor a series of group lessons at reasonable cost. Have equipment on hand for those without clubs. Show them the challenge of golf through films and tours of your course. This could grow into a new junior league.

-- This same clinic-lesson program can be offered to adults with perhaps a special program for senior citizens. (If you don't have a teaching professional at your course, you might contract with a qualified instructor to come in for, say, a two week period offering a concentrated program of group and individual lessons during that time. One course owner in Tennessee is doing just this using one of our NGF consultants who happens to have summers free to take such assignments.)

-- Offer to give a short talk and film/slide presentation to local schools, community and industrial recreation gatherings during the off-season. Convey the joys and challenge of golf to these groups and you will find new interest in learning the game as well as new leagues being formed.

-- For a new twist in your league program or as a special annual event, try setting your course up backwards. The Reischls of Crystal Lake Golf Club in Bulah, Michigan decided to lay out their nine hole track in reverse, moving the tee markers from #9 to a place in front of #8 green, moving #8 tee markers to the front of #7 green, and so on until the course now challenged the golfer to a backward track. Of course, the name of the game had to be reversed too. The one day event became known quickly as the "Flog Scramble". This unique Scramble took hold so well everyone now looks forward to it as an end of the season highlight. The owners remarked that, "It takes the players two hours after finishing play just to relate all the stories of their round before we can begin serving the meal." Now how many non-golfers in the community do you think will get wind of this kind of fun? That's promotion.

-- Here's another illustration of an end-of-the-season idea that worked. Sensing a reluctance on the part of his golfers to end the season, this Indiana nine hole course owner decided to stage a "One More Time Tournament". It was held the second Sunday in November last year. Six three-man teams entered at $10.00 each ($5.00 went for fees and the other $5.00 for prizes). Play was stroke play without handicaps, with closest to the pin, longest drive and longest putt on hole #18 winners recognized with the giving of a Thanksgiving turkey to each. To carry out the "one more time" theme, players were allowed on one occasion during their round to replay a poor shot - in a sense, hitting the shot "one more time". You can imagine the fun watching for the longest putt on #18, which, by the way, was won by a gentleman who decided to use up his "one more time" shot for that last putt that dropped. Needless to say, the "One More Time Tournament" will become an annual fixture at this new nine hole course.

-- Where no practice range is available, but a sizeable practice green is, how about staging a putting tournament, run as a competition between two-man teams. La-Crosse, Wisconsin professional Dick Cotter did this to punctuate his junior program. Soon the adults approached Cotter asking if they could have one of their own.

-- Or you might find this an appealing way to say "thank you" to your golfers at a point in the season, as one course near Chicago does each year. It's called, "Have One On Us". One full day is set aside as "customer appreciation day". A special fun-filled tournament is planned with a myriad of contests awarding $10,000 in prizes. Free range balls are provided and, following the tournament, anyone can play twilight golf at no charge. This novel event is now in its fifth successful year. The extra business that this promotion generates more than pays for the effort and expense that goes into it. Much of the extra staff required is met by volunteers who give two hours of their time during the day to work behind the scenes - helping on the first tee, at the contest holes, at the scoreboard, and as caddies on the course. The course opens one-half hour earlier this day so it will be capable of handling nearly 700 players in the tournament (27 hole course) and several hundred more for twilight golf. What "Have One On Us" really spells is FUN for the golfer while the course management at Village Links in Glen Ellyn, Illinois is saying, "Thanks for your support." Think about it, and remember, the extra play generated by this event more than pays for the expense to stage it.

-- Making golf fun is perhaps the greatest job you as managers have in drawing new faces to the course and keeping the ones you have. Perhaps you share my observation that golf is not as compelling a sport to watch for the non-player as are the more vigorous, fast-moving sports of baseball, football, basketball, tennis and racquetball. These more visibly active endeavors thus tend to motivate a spectator youngster more so than does golf - the comparison bringing to mind the all too frequent impression that golf is a "dull and boring game".

What if these same respondents were to be encouraged to pick up a golf club, mimic the swing of a friend, a father or brother or sister or mother; and on one early attempt see the ball soar over that backyard field. What would be the chances of that youngster feeling exhilarated while watching in wonder the ball flight as it descended and disappeared in the tall grass - of feeling compelled to run swiftly to its landing spot just to tee it up and make it happen over again - a ball traveling higher and farther than any other ball that youngster had been able to throw before.

Give the opportunity to youngsters in your community by working through your schools, and on up the age ladder so hundreds of new faces are coming to your course each season, finding others just as "scared", just as apprehensive and shy as they are, but then feeling more and more comfortable as they watch and learn what this club and ball game is all about - from one who knows what it's all about.

Learn-to-golf clinics, for juniors and adults alike, open free to the public with instructors donating their time on behalf of promoting the game can happen in your community. It did happen in Chicagoland last summer at eleven different locations throughout the suburbs, made possible by the local PGA professionals and the Suburban Tribune newspaper. Over 800 people came. You, and whomever you ask for help, can be the catalyst.

Promoting golf simply means:

-- Understanding the game and what it has to offer the player;

-- Finding out the recreational needs that exist in your community, based on its economic makeup of the work force, and the resouces available for recreational enjoyment;

-- Determining what services you can offer at your golf course that will best meet these needs;

-- Obtaining the professional help and materials required to provide those services, and finally,

-- Letting the community know you've got them.

Knowing when to call on outside help for ideas and answers to operational problems that could interfere with your accomplishment of these services is all part of sound management. Someone once said to me, "If you don't know something, ask somebody." "I'll see what Joe thinks", or "I'll give Dr. Daniel a call on this", or "I think I'll see what NGF has to say."

Promoting golf may come as a special kind of challenge when it comes to planning instruction programs, leagues, tournaments, or outings in newly converted picnic areas from unused field space. For any of these as well as for other operational concerns, whether they be clubhouse food and beverage, pro shop merchandising, or whatever the area of your golf business, there are sources of outside assistance as close as your telephone. For the last 46 years one of these sources at your hand has been the National Golf Foundation. As its regional director, I hope you will utilize the wealth of its resources.

May the weather be kind and the rewards of your efforts to promote golf in your community be surprisingly rich. May your investment in this great "game of a lifetime" always find a healthy return.

EL-500, A NEW GROWTH REGULATOR FOR USE ON ESTABLISHED TURFGRASSES

D. Johns, D.F. Frank, E.M. Hayes, E.V. Krumkalns, A.T. Perkins & R.G. Thompson
Lilly Research Laboratories, Greenfield, Indiana

EL-500, formerly 72500 (α-(Methylethyl)-α-[4-(trifluoremethyoxy)phenyl] -5-pyrimidinemethanol) is a new growth regulator for use on established turfgrasses. Pure EL-500 is a white crystalline solid which melts at 94-96° C. It is soluble in such organic solvents as acetone, ethanol, methanol, dimethyl sulfoxide and ether. Preliminary toxicology studies indicate that EL-500 has a low order of mammalian toxicity. These studies are only preliminary in nature, and the user should exercise caution in handling formulations of this compound.

EL-500 has demonstrated excellent growth regulator activity on most commercially grown cool and warm season turfgrass species. Most contaminant broadleaf and grass species have also exhibited similar responses. Applications of EL-500 should be timed to coincide with the initiation of new vegetation growth in the spring. Irrigation or rainfall is required to move the compound into the rootzone of the turfgrass. Efficacious rates of application range from 0.56 to 1.68 kg/ha depending on species, cultural practices, climatic conditions and duration of response desired. The biological activity of EL-500 is expressed in plants by a reduction in internode length. EL-500 does not inhibit flowering in plants. EL-500 is formulated as a 1% granular and a 50% wettable powder and is available to turfgrass researchers.

TOXICOLOGY: EXPOSURE TO PESTICIDES

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Although pesticides cover a very wide range of materials and chemical types, I will limit my comments to essentially one type, that is organophosphates. The control measures for such compounds are quite similar to other high volume pesticides. The toxicology is, however, quite different.

Although the structure of all organophosphates (OP's) have some similarities, there may be some striking differences. There is always a central phosphorous atom linked to a double bonded sulfur or oxygen. Those that contain double bonded oxygen are considered direct inhibitors where those with sulfur require activation by some organ to oxygen, thus being referred to as indirect inhibitors. OP's may be either ring compounds or straight chain. The acute toxicity attributed to any one compound, in general, is a function of the tendency of the OP to hydrolyze,which, in turn, is a function of the stability of the resulting species. A look at acute oral LD_{50}'s indicates a wide variation in values from less than 1 mg/kg up to 1500 kg/kg. The more toxic of the OP's (those having LD_{50}'s below 50 mg/kg) are restricted to special uses. Compounds having LD_{50}'s above 50 mg/kg are used more extensively but limitations are placed even on their use.

The danger of exposure to organophosphates is centered around their ability to chemically react with an enzyme known as cholinesterase. There are essentially two types of cholinesterase in the human body. One is referred to as plasma cholinesterase

or pseudocholinesterase. This enzyme is found primarily in the blood plasma (the liquid portion) and is not a single entity but a combination of esterases. Its function in the plasma is not know as it does not take part in nerve impulse transmission. However, it is readily tied up (phosphorylated or inhibited) by activated organophosphate insecticides. The second type of cholinesterase is that which does take part in nerve impulse transmission. This is called acetycholinesterase and is found in the brain, nerve ganglia and neuromuscular junctions. It is also found in the red blood cells where, through blood tests, the concentration can be determined.

Normal functioning at the neuromuscular junction goes something like this. A nerve impulse is transmitted electrochemically when the substrate, acetylcholine is secreted at the juncture of a nerve-nerve or nerve-muscle. The appropriate functioning takes place and the excess acetylcholine is destroyed by the enzyme acetylcholinesterase. If the enzyme is in short supply, as might exist in the case of gross exposure to the oranophosphate, the impulse would continue to arc leading to eventual muscle collapse. This secretion and neutralization process takes place in milliseconds and is the basis for normal muscle functioning. Should the muscles of the involuntary system shut down, death will ensue through heart failure,or more often, respiratory failure.

Although the potential for serious harm exists when handling OP's, statistically their occupational use has not led to an abundance of problems. Some individuals have died as a result of gross negligence and others from suicide. Despite a relatively low number of fatalities, plasma cholinesterase inhibition is fairly common among handlers of OP's. However it should be noted that symptoms of overexposure to OP's is rare. Most exposures will result in full recovery after the individual has been removed from the exposure.

There are essentially four routes of exposure to any material. Ingestion is normally not much of a problem except through suicide. Good personal hygiene will reduce the chances of ingesting a pesticide. The eye is the second route of exposure. Although OP's readily absorb from the eye, this is not normally considered an important route for systemic poisoning. Chemical workers' goggles are appropriate, however, when handling the concentrate. The third route of exposure is inhalation. Inhalation of airborne pesticides by lawn applicators exists, but is of minor consequence. Four separate studies in our lab (Dow Chemical Company) indicate time-weighted average (TWA) exposures of lawn applicators to chlorpyrifos varied from 0.001-0.02 mg/m^3. The current Threshold Limit Value (TLV) for chlorpyrifos is 0.2 mg/m^3. The TLV is defined as an acceptable occupational exposure 8 hours/day, 40 hours/week, throughout a working lifetime. No adverse health effects would be expected from exposures at the TLV level.

The TLV is not a sharp definition between safety and danger as there is a large safety factor built into the number. Inhalation exposure may be of significance if application is made on windy days. Aerosol particles may be inhaled if thrown or blown up into the breathing zone. The most significant route of exposure is through skin absorption. Our experience indicates that the greatest exposure occurs when spray is allowed to contact and sometimes soak the pants legs. Daniel et al, found taht the thigh/scrotal area was the area of greatest exposure from spray mist followed by skin absorption. Daniel also found, as we have, that airborne exposures to applicators during application of liquid sprays are well below acceptable concentrations. Maibach et al, several years ago, learned that skin absorption of pesticides varies, depending on several factors. One factor is the location of the exposure. The scrotal area appears to be a very vulnerable area for absorption of OP's.

One hundred percent of a given dose of parathion was recovered in the urine when applied to the scrotum area. One the other hand, only 8.6% was recovered when the same dose was placed on the forearms. Other factors affecting absorption were condition of skin, occlusion of the material to the skin, length of the period of occlusion and the absorption parameter of the given pesticide.

The most popular way of determining the extent of exposure to OP's is through testing of the blood plasma and to a lesser extent the red blood cells. Baseline cholinesterase values should be determined in advance of anticipated exposure and then every two weeks until confidence is established that work practices are succesful. However it must be understood that work practices are the first line of defense against OP exposure. There are established ranges for "normal" cholinesterase. The cholinesterase value may be used as a guide to determine if the individual should be removed from the source of exposure. If an individual's plasma cholinesterase is 50% of his baseline, he should be retested and his work practices supervised. If 20% of normal (80% depression), the individual should be removed from application procedures and not allowed to return until his plasma cholinesterase is normal. Normally this will take about two weeks.

The first line of defense is proper work practices which imply proper protective equipment. Since skin absorption is the primary route of concern, steps must be taken to cut off exposures. A good pair of neoprene footwear is essential to keep liquid off the feet and ankles. Boots with holes must be destroyed and then discarded. Because of spray drift it is necessary to protect the thigh-scrotal area and the area above the knees. A cloth-backed rubber apron, waist tied, is strongly recommended. A pair of close-knit pants are recommended. A clean uniform each day prevents pesticide build-up in the uniform. Gloves will probably help reduce exposre to some extent. Neoprene gloves offer the best protection. Washing uniforms should be conducted separate from clothing of other members of the family. Strong soaps chemically destroy the OP.

A final step in any program and possibly the most important is education of the employees. If the employer does not take the initiative, the employees won't either. It is their right to know what they are working with and how to minimize the exposure to these materials. Frequent safety meetings which reacquaint the employee with safety practices reap high rewards.

INSECT PESTS OF TURFGRASS: AN INFORMATION UPDATE

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Every year thousands of acres of turfgrass in home lawns, golf courses and other urban areas are damaged or destroyed by insects. Homeowners and professional turf managers expend considerable time and money in combatting these pests, but it seems that each year they are back in force. With current restrictions on the use of highly residual insecticides and with pesticide resistance on the increase, it is more important than ever that turf managers understand a pest's biology before attempting control. This report deals with the life history and management of white grubs and greenbugs on turf. White grubs have long been a problem throughout the Midwest, whereas the greenbug is a relatively new and poorly known turf pest.

Masked Chafer Grubs

Most grub problems in the midwestern and north central states are caused by northern and/or southern masked chafers. Adult masked chafers are small brown beetles about one-half inch long, similar in appearance to the familiar May beetles, but smaller. Biology of the two species is similar. Adults emerge from the soil in June and July, mate, and begin laying eggs just below the sod. Mating occurs at night on the sod surface. Recent studies showed that virgin females produce a potent air-borne attractant which allows males to locate them in the grass. Identification of this chemical may provide a useful means of trapping or monitoring masked chafers.

Eggs hatch in two to three weeks, and young grubs begin feeding on grass roots. Research has shown that chafer eggs absorb water from the soil, and that egg-laying and hatch are affected by soil moisture. Grubs feed and grow until late October, when cold temperatures cause them to move deeper into the soil for overwintering. In spring, grubs migrate back to the sod zone and resume feeding. Feeding ends in late May, when grubs transform to adult beetles to start the cycle again. Adult beetles do not feed.

Trapping studies show that in most years, adult activity is finished by late July. This means that the best time to treat for grubs is early to mid-August, when the eggs have hatched and the grubs are small and easy to kill, but before they have done much damage. Although spring treatments will kill grubs, this generally affords no protection from the lawn being reinfested with beetles flying in later in the season. Also, feeding damage is usually not as serious in spring.

Turf managers often ask what the economic threshold is for white grubs, that is, how many grubs must be present before damage will be unacceptable and a treatment is warranted. Recent studies have shown that on established Kentucky bluegrass turf, at least 9-10 grubs per sq. ft. are required before any damage will be evident. Irrigated turf or turf with adequate soil moisture can tolerate as many as 15-20 grubs per sq.ft. before showing damage.

In University of Kentucky research trials, Diazinon 14G and 5G have given consistently good control of masked chafer grubs if applied at a rate of 5.5-6.0 lbs. ai/acre and watered in. Proxol (Dylox) 80W has also worked well, but Dursban 4E has been less effective. A new turf insecticide, Oftanol, will also control masked chafer grubs. Oftanol offers a longer residual activity, which means that timing of applications and immediate watering are less critical. A major drawback of Oftanol is that it may require three to six weeks to kill grubs. This delayed toxicity could be a problem when "fire-fighting" grub problems in August and September.

Milky disease is a naturally occurring bacterial disease of white grubs. When a healthy grub swallows soil containing the spores, the bacteria multiply in the host's blood, turning it milky white before killing the grub. Unfortunately, the commercial milky spore preparations are effective only against Japanese beetle grubs, and their use on masked chafers is a waste of time and money. Research is underway on a different strain of milky disease specific for masked chafer grubs.

Greenbugs

The greenbug, long a serious pest on small grains, sorghum and forage grasses, has become an important problem of the turf industry within the last ten years. The adult greenbug is a soft bodied, pear-shaped aphid which damages turfgrass by piercing the grass blade with needle-like mouthparts and then sucking out the phloem sap. A single grass plant may be infested with several hundred aphids, the combined feeding of which can seriously weaken the plant. The greenbug also injects toxic salivary secretions which give damaged plants a burnt-orange color.

Damage on home lawns usually begins in shaded areas under trees, but often spreads into sunny areas as well. Active greenbugs will be most dense in live grass around the edges of damaged turf, and may number 5000 or more per square foot. In Kentucky, greenbug problems begin to appear in early June and may continue until late fall. In fact, the most severe damage in 1981 occurred in November.

The fact that the same lawns are reinfested locally year after year strongly suggested that the greenbug overwinters locally. In 1981, overwintering eggs were discovered on the grass blades. This finding helps to explain why some lawns develop a greenbug problem year after year.

Greenbugs may be spread by wind, on shoes or equipment or in bagged clippings. We have encountered severe infestations on sod farms.

Feeding preference, survival, and reproductive rate of greenbugs were studied on three diseased Kentucky bluegrass cultivars (Kenblue, Vantage and Adelphi) and six other cool and warm season turfgrasses. In greenhouse tests, greenbugs thrived on all three Kentucky bluegrass cultivars and also on 'Ky 31' tall fescue and 'Jamestown' chewings fescue. This suggests that fescue lawns are not immune to attack. Greenbugs did not survive or reproduce on ryegrass, bentgrass, zoysiagrass, or bermudagrass.

Within the past five years, some greenbug populations have apparently become resistant to chlorpyrifos, diazinon, and malathion. Orthene emulsifiable concentrate is now registered for greenbugs on turf, and is effective at the 1 lb. ai/acre rate.

RHIZOCTONIA-INCITED DISEASES ON KENTUCKY BLUEGRASS

Presented by Jeff Lefton, ChemLawn Corporation
Copy prepared by B. G. Joyner and J. W. Rimelspach,
ChemLawn Corporation

The first recognized turfgrass disease problem was observed in Philadelphia in 1914. The disease causing organism (pathogen) was identified as Rhizoctonia solani, and the disase was named Brown Patch. Since that time, this disease has been observed in most areas of the world where turfgrass grows. In the past, Brown Patch has been especially severe on high maintenance turfgrass such as that on golf course greens. The disease has also become an important problem on home lawns as new turfgrass varieties and the intensified cultural practices required to maintain them are employed. Recently, a second Rhizoctonia incited disease, Yellow Patch (cool season Brown Patch), has been observed on numerous lawns in the midwest.

Confusion appears to have developed concerning the occurrence and the significance of Rhizoctonia incited diseases on Kentucky bluegrass. This is due in part to a lack of information concerning Rhizoctonia problems and to frequent misidentification. This talk is aimed at clarifying some of this confusion by discussing disease diagnosis and the factors influencing disease development. The scope or magnitude of problems that Rhizoctonia diseases can potentially cause will also be discussed.

Disease Diagnosis

Unfortunately, diagnosis of a turfgrass disease is often based on matching the actual symptoms exhibited with the classical stereotyped symptoms a pathogen is "supposed" to produce, without consideration of other factors. This often results in misdiagnosis as several pathogens may produce similar symptoms under the right circumstances. For this reason, accurate diagnosis of Yellow Patch or Brown Patch can be complicated due to the range of symptoms that may be expressed by either under different environmental conditions or maintenance regimes. The Kentucky bluegrass variety affected may also influence the range of symptoms expressed. Diagnosis can be further complicated by the possibility of more than one pathogen being involved.

Accurate diagnosis of any disease is based on several factors, including symptoms expressed, host affected, time of occurrance (weather and cultural conditions) and pathogen identification.

Symptoms

Brown Patch - Brown Patch symptoms will occur on Kentucky bluegrass as circular patches ranging from several centimeters to several meters in diameter. The center portions of these patches may, and often do, recover to give rings or 'frog-eyes'. These 'frog-eyes' are generally larger than those of Fusarium blight. The advancing edges of the patches may be a light, yellowish-green color before turning a light brown to tan color . These symptoms primarily occur when temperatures are in the range of 26-29 degrees C (80-85 degrees F) and when plenty of moisture is available.

Yellow Patch - Yellow Patch symptoms occur on Kentucky bluegrass at temperatures from 15-25 degrees C. Abundant moisture also favors Yellow Patch development. Circular patches range in size from 35-50 cm. Again, the circular patches may contain healthy green grass in the center surrounded by a circle of light brown grass. These patches often look very similar to Fusarium blight in size, color and shape . However, in some cases these patches remain free of grass or weeds in the center. Often during the later stages of disease development, the circular patches are greatly depressed. In the last two years, a reddening or purpling of the leaf blades (especially on the tips) has been associated with this problem. The coloration may either be directly or indirectly associated with this problem.

During development, the lower leaf sheaths often turn brown and the leaf collapses. The crown and lower leaf sheaths are often covered with a network of fungal mycelium and sclerotia. These signs of the fungus can be observed with the naked eye or with the aid of a 10X hand lens, and often are used as a diagnostic aid.

Lesions have been noted on most turfgrasses, including Kentucky bluegrass. The leaf spot generally begins as an irregular water soaked area. Later the center of the leaf spot turns a straw-brown or an ash brown in color. Most often the leaf spot is surrounded by a dark border. The size of the leaf spot will vary but generally it is slightly smaller than the leaf blade width. It appears much like a dollar spot lesion, except with darker and more irregular margins.

Host

Very little information is available on the susceptibility of the various cultivars to Brown Patch. Similarly, information on symptoms expressed by the various cultivars is lacking. One can only speculate that the various bluegrass cultivars vary in their susceptibility.

Brown Patch occurs on turfgrasses whether seeded or sodded. However, Yellow Patch has only been observed in newly sodded areas (perhaps 1-3 years after sod placement). Full establishment of sod usually has not taken place when Yellow Patch occurs.

In the past, diseases were considered problems during warm, wet weather (spring and fall in the South and summer in the North). Temperatures that generally favor rapid Brown Patch development occur between 26-29 degrees C (80-85 degrees F). However, recently various reports indicate that other Rhizoctonia-incited diseases occur during much cooler temperatures. Yellow Patch symptoms have been observed on Kentucky bluegrass at temperatures of 15-25 degrees C (60-78 degrees F). Rhizoctonia spp. have also been shown to cause problems on zoysia and bentgrass at lower temperatures.

Apparently moisture is still important in disease development. The disease can occur at relatively low atmospheric humidity, but a moisture saturated atmosphere greatly enhances disease development. Both Brown and Yellow Patch tend to be more of a problem during wet years or where automatic irrigation systems are used.

Pathogen Identification

Because of the lack of identification of the pathogens, in the past identification of R. solani has been very crude and based on factors that vary. The misidentification of Rhizoctonia pathogens has also been a problem in other areas outside of turf. This has led to some excellent work on the identification of Rhizoctonia and Rhizoctonia-like fungi. Identification now is based on the perfect stage and/or the nuclear condition, as well as the standard cultural characteristics.

Rhizoctonia cerealis is associated with the disease Yellow Patch. The pathogen, R. cerealis has been reported to occur on other turfgrass species by Burpee. In comparing these two R. species, one can see differences. Isolates of Rhizoctonia solani generally have maximum growth at a temperature of 25 degrees C (77 degrees F). However, isolates of R. cerealis generally grow best at 20 degrees C (68 degrees F). The nucleate condition of R. solani is multinucleate (3 nuclei or more per cell). The hyphal cell of R. cerealis is predominatly binucleate (2 nuclei per cell). The identification of the pathogen, coupled with symptomatology, host range and environmental conditions should make diagnosis a more meaningful art.

Scope of Problem

The relative importance of Rhizoctonia-incited diseases (as well as other turfgrass diseases) on bluegrass is determined largely by the frequency of occurrence and the degree to which the affected areas are damaged. Based on these criteria Brown and Yellow Patch would be considered two of the most important diseases of bluegrass. Brown Patch is a potential problem of any bluegrass lawn receiving ample moisture during warm weather. The pathogen rarely kills the affected plants however, and the damaged grass often recovers. Yellow Patch, to this point appears to be more limited in occurrence than Brown Patch. It has been found primarily during the cool, moist spring and fall months on newly sodded lawns in the northern half of the midwest. Bluegrass damaged by the Yellow Patch pathogen is usually killed and fails to recover.

Conclusion

Rhizoctonia Brown Patch and Yellow Patch are both major diseases of Kentucky bluegrass. In many ways these two diseases are just as important as Fusarium blight. Correct diagnosis of the problem is important and should be based on all factors: symptoms, timing, host and pathogen identification.

CERTIFICATION AND LAWN CARE OPERATIONS

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All of you who are involved in the lawn care business are aware of the fact that, whether you like it or not, regulation has become an important factor in your business.

In Indiana, the Indiana State Chemist is the state agency for the regulation of the application of pesticides, as outlined in the Indiana Pesticide Use and Application Law. This law provides that (1) anyone applying a restricted pesticide must be certified; (2) anyone applying a pesticide for hire must be certified and licensed and/or supervised by a certified licensed applicator. That's a brief review of the background of certification. Now I would like to discuss how certification involves the lawn care business in relation to what we are finding in almost five years of operating under the law.

Like all things, progress calls for changes. We have made a few procedure changes and a new regulation or two since the beginning; however, very little that has much direct effect on the lawn care industry. The biggest change which I believe will be of interest to you is a revision of Regulation 2 concerning the supervision of non-certified applicators. The revision is entitled "Site Awareness and Direct Supervision of Non-Certified Applicators". This change in Section 1 of Regulation 2 defines direct supervision as (1) The physical presence of the supervising certified applicator at the work site under circumstances which permit continuous direct voice contact with the non-certified applicator, or (2) Written or otherwise verifiable instructions covering:

A. General and site specific precautions to prevent injury to persons or damage to property.

B. The mixing, handling, application and disposal and on-site storage of the pesticide.

C. The establishment of direct voice communication with the supervising certified applicator while the application of the pesticide is in progress.

The term "work site" shall mean and include any location at which pesticides are handled, mixed, stored, disposed, applied or used.

Section 2. Pesticides may be applied by a non-certified person if that person is a competent person working under the direct supervision of a certified applicator as defined herein.

Section 3. The supervising certified applicator shall be physically present as defined in Section 1(B)(1) if:

A. The label of the pesticide being applied so stipulates, or;

B. The non-certified applicator has had no prior experience with either the pesticide or the application methodology in use.

Section 4. Written or otherwise verifiable instructions as defined in Section 1(B)(2) plus the complete label of the pesticide being used shall be in the possession of the non-certified applicator at the work site and shall, upon request, be produced for inspection by any properly identified agents of the State Chemist.

Licensing procedures remain pretty much as they have been.

A question that continually keeps coming up is: Where you have two or more products containing the same active ingredient but having different labeled uses and usually different brand names, can the products be used interchangeably? The answer is NO! Pesticide products must be used according to label directions regardless of the active ingredient. Several chemical manufacturers produce similar products for use in agricultural, turf or indoor situations. These are labeled separately and often sold under different brand names in different container sizes. Nevertheless, they may NOT be used interchangeably between the specific crops or sites unless the label specifically allows such uses. This is not a new concept.

Another question is whether or not a particular competitor is licensed. The most effective way for us to get them licensed is for you to advise us of evidence that an individual is operating without a license.

Another problem which I think you should be aware of is someone impersonating a representative from our office. In one particular case, a licensed applicator contacted a competitor and indicated he was from the State Chemist's Office and wanted to check their equipment, etc. I am aware of the guilty party, and should any more incidents occur, you can rest assured action will be taken. You should question anyone who says he is representing the State Chemist's Office and ask to see his credentials.

In spite of what you may have heard about using chlordane on turf from an old turf-labeled container, forget it. First of all, most of the grubs are resistant to chlordane, and secondly, it is no longer legal to use chlordane for any purpose other than for subterranean termites. Also, it is my understanding the manufacturer has now added a dye to all chlordane manufactured. This dye will even show up in chlordane residue samples.

Unfortunately, anyone in business invariably will have a few customer complaints. Some may be justified, but many are not. Those which you feel are not justified and you feel you have not violated the Use and Application Law you should advise the customer to contact our office and file a complaint. In many situations such as this we have determined the problem was caused by some other cause than the materials the applicator was using. However, in situations such as this it's important that complaints be filed within 60 days. The sooner lab samples are collected after damage is noticed, the more reliable they will be.

In conductingan investigation we contact all parties involved, normally take samples. Everything is done with the possibilty that the incident could end up in court. Our conclusions in an investigation are made after reviewing all factors including the labels of materials used, and whether or not a violation of the Indiana Pesticide Use and Application Law has taken place. If a violation has taken place, the past record of the applicator is considered when action is taken.

If at any time our office can be of assistance, please feel free to contact us.

FLORICULTURE, ANNUALS, BULBS

Michelle M. Muller
Jack Nicklaus Sports Center, Cincinnati, Ohio

During nine years with Taft Broadcasting Company, I worked at Kings Island Amusement Park for seven years with responsibility for purchasing, designing and maintaining all annual and perennials. Presently, I am at the Jack Nicklaus Sports Center where responsibilities include purchasing, designing and maintaining all annuals and bulbs at the Golf Course and College Football Hall of Fame, and Kings Island Inn, pruning on the Golf Course, and purchasing, designing and maintaining all indoor plants, flowers and dried arrangements. In my spare time I work with home-owners and give seminars.

Summary

A run-down on how to prepare for the flower season and some techniques that I use to keep maintenance down, flowers lasting longer, and looking beautiful.

Jack Nicklaus Sports Center Season

The course opens March 2. All indoor plants and spring flowers must be ready.

June 7. The LPGA begins; televised by NBC. All annuals must be in full bloom and looking good.

August 16. ATP begins; televised by CBS. All flowers must be in perfect shape on the Golf Course as well as the additional 750 mums planted inside the Tennis Stadium.

To begin

Decide where flowers will enhance the area, then decide:

Style - informal; contouring lines (natural)
- formal, straight lines

Design - massive; one color
- geometric; two or more colors in straight line patterns
- border; two or more different heights of flowers of either the same color, variety or net, as long as they compliment each other

Varied - mixing color and variety in one bed

Color - complimenting colors are important in order to give the beds mass, brillance and unity

Annuals

In dealing with mass quantities of flowers, make sure the varieties can endure the weather: wet to dry; show brilliance of colors; resist disease, and can be maintained easily.

I have found for my area that these flowers are the best to use, especially since the LPGA is in the first part of June, early blooming plants are needed to provide full color and mass, in four weeks, because I can't plant until around May 15, which is the end of the frost date.

Salvia, geranium, marigold, petunia, dusty miller. All of these plants come in various sizes and colors .

For splashes of colors (as in an area already landscaped)

Ageratum, impatiens, begonia and geranium

Remember

A flower bed is important only when used to maximize its effectiveness in complimenting what's around it; otherwise it will look out of place.

Ordering Flowers

Measure the area of the bed. Larger plants like marigolds, geraniums and salvias will be planted every 8". Otherwise, plant 1' apart (foliage to foliage).

If bordering plants, leave a definite 1' between the sizes of plants to keep the distinction in the later part of the season.

Leave a 2' border bewteen grass or well traveled paths and the first plants so lawn mowers and stomping will not cause death and ruin the design.

I order about 14,000 plants in September. Geraniums cost roughly 95¢ each and the others about 43¢, depending on the amount ordered; it will vary with the cost of plants.

Takes about two weeks to plant with 4-5 helpers, starting 10 May.

Preparation of Beds

Fall - till beds 6-8" deep. For preventive measures you can spread Ronstar, an insecticide, to get a jump on early germinating weeds in the spring.

Spring - Check soil. If too much clay, add peat moss and perlite. This helps aeration.

Till beds 6-8". Edge beds about 3" deep.

Spread Ronstar. Use Ronstar only on beds where plants are established or will be. Ronstar stops seeds from germinating.

Planting

May 15, end of frost deadline. I take chances and plant one week before. If frost is forecast, cover all plants with plastic. Use stakes to hold up plastic and prevent it from touching plants. Plant growth could really be set back if it gets really cold.

When ready to plant, till bed once more (makes it easier and faster to plant). Make sure soil line of plant ball is even with the surface of the bed. If planted too deep the stems rot; if too shallow, plants dry out fast. Both deep and shallow cause stress and invite insects to feast on them.

Water thoroughly, at least 4" deep after each bed is planted. Be sure water soaks in slowly and doesn't get on leaves.

Spread Treflan and renew every three months.

Mulch - the darker the better so colors show off more. At least 3" to retain moisture and help ward off weeds.

Fertilize one week later with 20-20-20 and every four weeks thereafter. Make sure it doesn't get on foliage - may cause it to burn if sun is out.

Maintenance

Water - never let dry out.

Peat moss is hard to moisten once it has dried.

Always dig down at least 3" to see if it needs watering.

Do not water foliage.

Use 5' piece of plastic pipe with a spray nozzle on end; water slowly near ground.

Insects, insecticides, and fungicides

Red spider - pin-point size spiders that can be seen when shaken onto white paper from marigolds. Signs are reddening of foliage, wispy white webs on blooms.

Removal - Metesystox R, Kelthane, Diazinon and Malathion. It is a good idea to change insecticides after two applications as insects might become immune.

Spray after planting as a preventive from transferred greenhouse insects.

Alternaris leaf spot and Botrytis - affects marigolds, geraniums and dusty miller. For preventive measures, drench plants with a mixture of Truban and Benlate one week after planting. During very humid weather, spray plants with Chipco 26019 every two weeks as another preventive measure.

Jap Beetle - affects marigolds and geraniums. When seen, spray with Sevin.

Grooming

Once a week - remove faded or fading blooms, and yellowing or browning leaves. Be selective, don't remove most of the color.

Geraniums - remove bloom and its stem down to the stalk. If stem is left it turns brown and unsightly.

Salvia - pinch bloom and stem right above top leaves.

Marigolds - pluck blooms right off.

Grooming is important because if you leave faded bloom and yellowing leaves they take away the nutrients that should go to the development of new blooms and foliage and when you finally clean the bed, color will be slight and it will take a week or so for full color to return.

Bulbs

1980, November 1, I planted 5000 bulbs between the golf course, College Football Hall of Fame, and Kings Island Inn. November 1, 1981, 1000 were planted. Each year they multiply. They bloom until late May. Order in May or June; delivered in October, and planted in November before ground freezes.

Daffodils, tulips, hyacinths, plant 6" apart. Crocus, plant 1" apart. These come in all sizes and colors. Tulips and daffodils should be no higher than 10" lest they fall over in rain and wind. Hyacinths - 6" blooms make plants top-heavy so if they are any taller they fall over.

After flowers stop blooming let foliage turn yellow naturally before cutting off. Nutrients are stored in the bulb through photosynthesis and the process isn't complete until the foliage is yellow and brown. If bulbs are in an area where yellowing foliage is unsightly and you have to plant annuals, transplant to another area where they can grow naturally and beautifully.

SELECTION OF NITROGEN SOURCES FOR LIQUID LAWN CARE

Richard G. Rathjens, Agronomist
The Davey Tree Expert Company, Kent, Ohio

Introduction

The importance of nitrogen fertilization as an integral part of turfgrass culture is well recognized by turfgrass managers and documented in turfgrass research literature. Applications of N to turfgrasses can result in dramatic improvements in color, density, and shoot and root growth. For this reason major emphasis is placed on N fertilization in the care of recreational (golf course, athletic fields) as well as ornamental turfs (home and commercial lawns). Criteria for the selection of N source can be broadly categorized into agronomic, economic and handling and storage considerations. (Table 1)

Agronomics

Agronomic considerations include N release rate, salt index or burn potential and environmental properties.

One method of predicting the rate at which a fertilizer will release its N is based on its water solubility. Sources of N such as urea, ammonium nitrate and ammonium sulfate have high water solubility and exhibit a relatively quick release of N over a short period of time. Sources of N such as ureaformaldehyde (UF), sulfur-coated urea (SCU) and isobutylidene diurea (IBDU) have limited water solubility and give a relatively slow release of N over a long period of time.

In addition to water soluble N (expressed as %) UF fertilizers contain N which is cold and hot water insoluble. The portion which is water soluble will release N quickly while the remaining insoluble N will release N slowly because of its dependence upon microbial decomposition. The N from the water insoluble portion releases over a period of several weeks (cold water insoluble) to several years (hot water insoluble). The nitrogen activity index indicates the amount of N in a UF fertilizer which is hot water insoluble. The lower the activity index, the greater the amount of hot water insoluble N.

Dissolution rate is used to describe the rate at which urea is released from SCU. Dissolution rate is determined by placing SCU in 100^{o} F water for a seven day period. SCU products which have a 30% dissolution rate are considered acceptable as a slow release source of N for turf.

Particle size has a strong influence on the rate at which N is released from IBDU. In general, the smaller the particle size, the quicker the release of N.

Salt index indicates the potential for a fertilizer salt to cause dehydration of plant cells (commonly known as "fertilizer burn"). Salt index is a measure of a fertilizer's ability to raise the osmotic potential of soil solution and is based on sodium nitrate being equal to 100.

Significant losses of N can occur through the leaching of N with ground water and the escape of N as a gas (volatilization) to the atmosphere following N application. As a rule of thumb, sources of N which are water soluble or are quickly available to the turfgrass plant are most subject to these losses.

The sources of N which have the strongest acidifying effect on soil are those fertilizers which contain sulfur, either as a component, i.e., ammonium sulfate, or as a coating, i.e., sulfur-coated urea. For this reason, these sources of N are often recommended for use on alkaline soils.

Table 1. CRITERIA FOR SELECTION OF NITROGEN SOURCE FOR TURFGRASS FERTILIZATION

I. Agronomics

A. Nitrogen release rate
1. Per cent water soluble
2. Per cent water insoluble
3. Per cent hot water insoluble
4. Activity index
5. Dissolution rate
6. Particle size

B. Salt index or burn potential

C. Environmental properties
1. Leaching
2. Volatilization
3. Acidification effect

II. Economics

A. Availability
1. Cost per pound of nitrogen
2. Freight cost
3. Quantity which must be purchased

III. Handling and storage

A. Physical state
1. Liquid or solid
2. Particle size

B. Product quality
1. Hygroscopic point
2. Salt-out temperature
3. Biuret content
4. Cleanliness
5. Uniformity
6. Shelf life

Economics

Whether turfgrass managers need to be competitive in the marketplace or to stay within a limited budget, economics will play an important role in selecting a N source. Not only is there the "upfront" cost per pound of nitrogen but also the additional costs for transportation and storage of the fertilizer. A limiting factor in the use of a N source might be the quantity which must be purchased.

Handling and Storage

The physical state (liquid or solid) of a N source will determine the method of application needed to apply the fertilizer. Use of ureaformaldehyde-type solutions (i.e. Formolene, GP 4340, Nitro-20 Plus) will require liquid application equipment. In order to use a solid like SCU a centrifugal or gravity dry spreader is needed.

Knowledge of a fertilizer's hygroscopic point is important if a N source is stored in a solid physical state. Hygroscopic point is the percent relative humidity at which a fertilizer begins to absorb water at 86^{o} F. Fertilizers with a high hygroscopic point will minimize "caking", which is the absorption of moisture by the fertilizer upon exposure to the air.

A low salt-out temperature is required when using liquid N sources. Salt-out temperature is the temperature at which the dissolved salts precipitate out of a fertilizer solution. In general, the lower the salt-out temperature, the more easily a fertilizer solution can be stored.

Other essential handling and storage characteristics include freedom from contaminants, uniformity in amount of N (urea, ammonium nitrate, methylol urea, etc.) contained in the final product, long shelf life and a low biuret content of less than 2% of the total urea. Biuret is formed in the manufacture of urea and can be toxic when applied to plants.

Desirable Characteristics of N Source From A Lawn Care Perspective

Both recreational and ornamental turfgrass managers desire a N source with a low salt index, minimal leaching, volatilization and soil acidification properties, low cost and good handling and storage characteristics.

Unique to ornamental turfgrass managers and in particular the lawn care industry is the requirement of a fertilizer which will release its N over an eight week period. Unlike golf courses and athletic fields, where it may be economically advantageous to minimize the number of fertilizer applications, lawn care companies routinely treat a lawn on an eight week cycle with fertilizers and pesticides. Therefore, the need for a fertilizer to release N beyond an eight week period is unnecessary.

The criteria used and the characteristics given for the N sources which follow are specific to liquid lawn care applicators who apply fertilizers using traditional positive displacement spray equipment with tank agitation and a multiple hole nozzle with .04-.05" diameter openings.

Classification Of N Sources For Liquid Applications To Lawns

The sources of N for liquid applications to lawns may be classified according to their physical state, either solid or liquid, prior to tank mixing (Table 2). Solid (granular) N sources may be further classified into those which are suspended or solubilized during tank mixing.

Table 2.

CLASSIFICATION OF NITROGEN SOURCES
FOR LIQUID APPLICATIONS TO LAWNS

Prior to Tank Mixing

Solid	Liquid
Powder Blue (Ureaformaldehyde)	Urea Liquor
F-8426 (Methylene urea)	Formolene (Methylol urea, urea)
Urea prills	GP 4340 (Urea, methylol urea, methylene urea)
Ammonimum nitrate	Nitro-26 Plus (methylol urea, methylene urea, urea)
Ammonimum sulfate	Urea-Ammonimum nitrate

During Tank Mixing

Solid (Suspended)	Liquid
Powder Blue (Ureaformaldehyde)	Urea Liquor
F-8426 (Methylene urea)	Formolene (Methylol urea, urea)
	GP 4340 (Urea, methylol urea, methylene urea)
	Nitro-26 Plus (methylol urea, methylene urea, urea)
	Urea-Ammonimum nitrate

Solid (Solubilized)
Urea prills
Ammonimum nitrate
Ammonimum sulfate

Characteristics of N Sources For Liquid Applications To Lawns

Table 3 lists the characteristics of ten N sources for liquid applications using several of the agronomic, economic and handling and storage criteria discussed previously and the classification scheme given above.

Excluded from Table 3 is Cleary's FLUF which is a UF type of liquid fertilizer. This product was not included because it is only available for purchase in the open market in a 50 gallon drum.

Agronomic

With the exception of ammonium sulfate and urea liquor, all the sources have a N content of 27% or greater. Among those sources where salt indices have been determined, urea, ammonium nitrate and ammonium sulfate all have relatively high salt indices which require careful application management to minimize fertilizer burn. For those N sources which do not have a salt index listed, with the exception of Nitro-26 Plus, all have a urea content of 50% or greater, which like urea prills or liquor, necessitate application monitoring to avoid fertilizer burn. With the exception of Powder Blue, all the N sources have a length of N release within 4-12 weeks.

Economic

In general, the N sources which have the highest salt indices and shorter length of N release are also the most economical on a cost per pound of N basis. F-8426 has yet to be actively marketed by O. M. Scott and a projected cost per pound of N is given.

Handling and Storage

For thosesolids where hygroscopic points are given, ammonium nitrate has the lowest hygroscopic point (59%) or the most caking problem. However, because ammonium nitrate is considered an explosive hazard by many insurance companies, warehouse insurance costs may prohibit its use.

F-8426, urea prills and ammonium sulfate have a hygroscopic point which is greater than ammonium nitrate and these fertilizers will store satisfactorily if kept in a closed container.

Desirability of Marketed N Sources For Liquid Application To Lawns

Considering the criteria of low burn potential, approximate eight week N release rate and a cost of 70 cents or less per pound of N, only Formolene, GP4340 and Nitro-26 Plus would be desirable. However, the other sources of N (Powder Blue, F8426, urea, ammonium nitrate, ammonium sulfate and urea-ammonium nitrate) may still be used by the lawn care industry even though they do not meet all three of the criteria above. For example, urea may be utilized because its burn potential can be minimized with proper application management and its cost allows a lawn care company to realize a significant savings in fertilizer costs.

Summary

In selecting a N source for liquid maintenance programs, a lawn care company must consider agronomic, economic and handling and storage characteristics together in making the best choice. Success in the marketplace will to a great extent depend on selecting a N source which will provide clients with a green, dense, uniform lawn at the lowest possible price.

Table 3. CHARACTERISTICS OF NITROGEN SOURCES FOR LIQUID APPLICATIONS TO LAWNS

Classification	Nitrogen Source	Product Name	Agronomic				Economic	Handling & Storage	
			Nitrogen Content % (1)	Partial Salt Index (2)	Urea Content % (3)	Length N Release Weeks	Cost/lb. of N $ (4)	Hydroscopic Point %	Minimum Shelf Life Months
Solid, Suspended									
1.	Ureaformaldehyde	Powder Blue (BFC)	38	0.15	--	52+	0.66	--	--
2.	Methylene Urea	F-8426 (O.M. Scott)	41	0.86	--	6-8	1.20	72	--
Solid, Solubilized									
1.	Urea Prills	Various	46	1.63	--	6-8	0.22	73	--
2.	Ammonium Nitrate	Various	34	3.08	--	4-6	0.23	59	--
3.	Ammonium Sulfate	Various	21	3.29	--	4-6	0.32	79	--
Liquid									
1.	Urea Liquor	Various	16	1.63	--	6-8	0.21	--	1.0
2.	Methylol urea, urea	Formolene (Hawkeye)	30	--	50	8-12	0.58	--	4.0
3.	Urea, Methylol urea	GP 4340 (Georgia Pacific)	30	--	51	8-12	0.52	--	3.1
4.	Methylol urea, Methylene urea, urea	Nitro-26 plus (C.P.)	27	--	17	8-12	0.70	--	3.0
5.	Urea, ammonimum nitrate	Uran + (Allied)	28-32	--	51	6-8	0.20	--	6.0

(1) Percent by weight
(2) Based on equal rates of N
(3) Percent of total N
(4) F.O.B. shipping point
\+ Several manufacturers of urea-ammonium nitrate solutions exist

RESEARCH ON PRE-EMERGENCE

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Preemergent activity of a herbicide is the actual activity on the germinating seedling either by root or shoot uptake. Thus the small seedling is controlled as it begins the early stages of soil dependent growth. This emphasizes the importance of adequate herbicide activity in the soil immediately surrounding the seedling.

With the term defined, let us look at the past history, present use, and future of preemergent control. A literature survey shows little use of the preemergent concept until the early 1950's. At this time the potential of the inorganic arsenates (either lead or calcium) for preemergent control was evaluated. They were both effective. The lead arsenate had been used since the early 1930's, primarily for grub control. Eventually the calcium arsenate predominated, due in part to greater activity, lower rates and cost.

Eventually a dry granular formulation 'Chip Cal' was developed and continued on the market until the OSHA (Office of Safety and Health Hazard) ruled that arsenic dust in the air during manufacturing be reduced to a lower safer level. Because it was not economically practical to make the major processing changes required, the production of arsenic was stopped.

There were other preemergent herbicides introduced to the market in these early years. One, Zytron, gave acceptable pre and post emergent control of nimblewill (Muhlenbergia sp) as well as annual grass control. As there were other problems related to its use, it was taken off the market.

It was at this time that the DCPA 'Dacthal' appeared on the market. Other preemergent controls that followed and are still available include the benefin, product name BALAN; bensalide, product name BETASAN, PRESAN, LESCOSAN, etc.; siduron, product name TUPERSAN, and oxidiazon, product name RONSTAR.

When we look at the efficacy of preemergent herbicides one of the major concerns is that of its residual activity in the soil. Factors that influence the disappearance or degradation in the soil include volatilization, degradation by ultraviolet light, microbial decomposition and chemical decomposition. The relative importance of each of these factors is influenced by soil type, moisture content, temperature, microflora and method of application.

The soil residual of DCPA, Dacthal, is greatly influenced by higher soil temperatures and moisture as these determine the rate of chemical breakdown. For example, under controlled conditions the half-life of Dacthal at 90° F. was 105 days; at 70° F., 155 days,with no significant breakdown at 50° F. As Dacthal has also been shown to serve as a source of carbon for soil microbes, the soil microbial population can also contribute to its breakdown.

The term, half-life, refers to the time required for breakdown and degradation of one-half of the herbicide applied. At this time a threshold concentration or level is reached where late germinating seedlings may not be controlled. Then it becomes necessary to apply additional herbicide to reestablish an adequate control level.

For example, Dacthal W-75 applied at the recommended rate (14 lbs. fromulation or 10.5 lbs. ai/A) will usually provide effective season-long control of crabgrass and goosegrass in the northern states. In these areas the half-life may be 90-100 days. However, microbial activity is increased and the half-life of Dacthal decreased by high moisture and warm soil temperatures. Under warm moist conditions the half-life may be as short as 45 days.

Studies on the loss of benefin, BALAN, from soil surfaces have established volatilization as an important source of herbicide loss. The greatest rate of loss from volatilization occurs during the first few hours of application. High soil temperatures increase the rate of loss. Balan is also degraded by ultraviolet light. Losses through volatilization and photodecomposition are minimized with the granular formulations. Balan is strongly adsorbed by the soil and is extremely resistant to movement by water. Organic matter in the soil is the most important factor in determining the rate of Balan required for seed control. Adsorption on the clay fractions of the soil is of less importance. Under normal conditions recommended application rates give 120 day weed control. Under extreme weather conditions the application of a half rate may be required to maintain adequate season long control.

The bensulide includes the products BETASAN, PRESAN, LESCOSAN, etc. Residual is influenced by clay soils and soils high in organic matter (35% or more clay; 10% or more organic matter). Residual activity is prolonged in alkaline soils where the pH is 7 or higher. The faster the percolation rate the shorter will be the residual activity. Therefore, in pure sand the residual activity may last only 55 days, whereas clay or high organic soil residual activity may last 180 days or more.

Siduron, product name TUPERSAN, is a urea herbicide of low water solubility. It is readily adsorbed on clay and tends to remain in the upper one inch soil layer. Soil persistence is about 60 days. Principle decomposition in soils is by microbial activity. Volatility and chemical decomposition contribute little to the loss. Photodecomposition may occur when the herbicide is exposed to sunlight for several days or weeks under hot, dry conditions. Other preemergent herbicides are somewhat restricted in their area of use, principally on the warm season grasses such as Bermuda, Zoysia, Saint Augustine, centipede or Bahaiagrass. These include products such as atrazine, Aatrex, metribuzin or Sencor, pronamide or Kerb, simazine or Princep, and oxidiazon or Ronstar.

Several products already near or approaching the market have promise. These include such products as pendimethalin or Prowl, napropamide or Devrinol, Nortron, bifenox or Modown and metolachlor or Dual. DuPont currently has under evaluation a product identified as Glean, and yet another in an even earlier stage of development. Both of these are active at very low rates. They have potential for broadleaf weed control as foliar application. They also have the potential for preemergent control of annual broadleaf weeds, as well as that of perennial grass growth regulation.

As products are developed for other agricultural markets they eventually become available to us in turf.

GROWTH REGULATOR RESEARCH UPDATE

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The growth of turfgrass or other plants may be regulated by repeated mechanical trimming, controlling the level of nutrition, breeding for desired dwarf growth characteristics, or with growth control chemicals. Much more needs to be done by turfgrass breeders to develop dwarf turfgrasses with necessary vigor and disease resistance.

Chemical control of turfgrass growth continues to offer potential for effective reduction in costs related to equipment use and depreciation, labor and fuel through the inhibition, retardation, or regulation of turfgrass growth. Growth regulators currently available have some use limitations due either to their phytotoxicity, potential to thin, or to cause excess periods of inhibited growth due to some unforeseen environmental stress.

The first effective inhibitor in the turf industry to control plant growth and to inhibit seedhead formation was maleic hydrazide (MH). It was available as the MH30 (a dimethyl amine salt) and MH40 (a sodium salt formulation).

Maleic hydrazide has several special uses:

- seedhead control
- fruit thinning in orchards
- decrease loss of sugar in stored beets
- extend the life of cut flowers
- decrease frost damage to citrus trees
- prevent corrosion of steel
- reduce sprouting in potatoes

There are several problems common to turfgrass growth inhibitors-retardants. The following, identified for MH, are an example. It is slowly absorbed through both the upper and lower leaf surfaces. Also the MH would penetrate the leaf surfaces faster if the leaf cells were turgid, under conditions of high humidity. Wilted plants absorb little, if any. However, once inside the plant it is quite mobile, which explains its ability to maintain a prolonged state of dormancy for many months. Later afternoon applications have been more effective than early morning applications.

MH is more effective on young plants. Also, the higher the temperature, the faster and more vigorous the effects, and the shorter duration of plant response to MH. In addition, more MH is absorbed when a wetting agent is used. It is estimated that by 1965 approximately three million pounds of growth regulators were used in the U.S. Maleic hydrazide accounted for about 90%. By 1975, newer growth inhibitors-retardants were estimated to have accounted for more than 50% of the total market.

The new growth retardants for use on turf include a family of compounds identified as chlorofluorenols. There are available in formulations such as Po-San A and CF125. Another compound, Sustar, was eventually replaced with Embark.

The chlorofluorenols effectively retard many grasses, and many broadleaf weed species. Most activity is on the young, tender parts of the plant, those which develop after treatment. In broadleaf species it act systemically and is translocated from the leaves and throughout the plant to younger developing tissue. Movement in grasses tends to be upward. The fluorenols can also interrupt the growth of trees, shrubs, and vines.

Recently a combinatino of MH with the chlorofluorenols has been used to inhibit seedhead development in Poa annua, annual bluegrass. Combinations are available as Po-San A + B, as Maintain 3 + CF125. Under optimum conditions there is almost total seedhead inhibition. Applications are made in spring to Poa annua to prevent a spring seed crop development. Additional late summer-early fall applications can further reduce the seed production. There is also evidence that foliar development in Poa annua is retarded more than that of the other perennial grasses, thereby reducing somewhat the ability of the Poa annua to compete.

The most recent growth retardant made available to the industry is Embark. An advertisement from the formulator, 3M Company, states: "12 years and 12,325 compounds later... a triumph in grass growth supression", indicating that Embark was the 12,325th compound synthesized by the 3M chemists over a twelve year period.

The three commercially available turf growth inhibitors-retardants, maleic hydrazide, chlorofluorenols, and Embark are recommended for use on sites where regular mowing and trimming maintenance are difficult and expensive, such as under security fences and guard rails, around sign posts and trees, culverts, rights of way, and median strips on roadsides, around ponds and ditches and on steep banks, sites where some moderate discoloration or thinning would be acceptable.

Growth control may be for a period of four to six weeks under normal growing conditions. With weather stress such as drouth and higher temperatures, this period of control may be eight weeks or longer. Excess or undue periods of inhibition may be overcome with an application of gibberellic acid which, at low rates (7-28 grams/A) acts as a turfgrass growth stimulant. Additional nitrogen applications to stimulate regrowth have also been effective in reducing the effects of growth regulators.

Disease and insect problems as well as drouth and hot weather associated with plant growth restriction can result in excessive turf thinning. This is especially a problem on fine turf where uniform color and density are so important.

Turfgrass growth control has not been acceptable on recreational sites where turf wear is evident. The inhibited grass is not able to produce adequate new growth to recover from foot traffic, and so is gradually thinned until there is little or no remaining vegetation.

Another problem that needs to be resolved is related to mixed stands where the perennial ryes, bluegrasses and red fescues are found to respond differently.

Turf growth regulators should permit active growth of roots, rhizomes, tillers, as well as horizontal leaf growth, yet retard upright or vertical leaf growth. This would then permit continued new growth, including new leaves that are essential to maintain a uniformly green dense turf resistant to wear, disease and insect damage, and able to overcome hot weather or drouth stress, and also reduce or eliminate the need to mow.

Although new products are scarce, there is a continued interest on the part of industry in the development of turfgrass growth regulators. In a ten year period at Purdue, 32 formulations have been evaluated. Embark was one of the most promising. There are now currently three compounds undergoing evaluation in our turf trials.

THE SPORTS TURF MANAGERS ASSOCIATION - YEAR POINT FIVE

Erik Madisen, Jr., Executive Secretary
Appleton, Wisconsin

Year point five means the Sports Turf Managers Association has been active for only about half a year, and we have made a good start. You would not be here if you didn't feel that athletic turf is special. Just as today's sophisticated golf course superintendent, the Association is on its way toward the same expertise and dedication, as well as recognition, for athletic turf managers.

Coaches are looking for a trouble-free surface as something they can take for granted as part of the equipment provided for the game. Players want performance under all conditions as well as safety. In the case of high stakes sports, turf is part of the insurance which should prevent multi-million dollar players from being injured. The public wants a good field both for esthetic value and to insure a good game.

How did we get to the modern stadiums where half the country watches the prima donnas and the troups in the trenches move about on some marked grass? Take it back 60-70 years and it was mostly a small fervent group of players and spectators centered on an old pasture, just mowed to keep the grass down. Sports increased in complexity, and crowds of spectators grew. Certain dimensions and marks were introduced. Now there was a definite "place" where a sport was played. As soon as this was defined, the area was put in charge of someone who knew about growing things. A lot of experimenting went on.

Defined by use, athletic turf is much different from that on school grounds, in park areas, and on campuses. The general purpose grass was mainly for background, good to look at, it set off the other features, was good for a pick-up game. But as sports were taught, and as in the last few years, spectators became participants, sports turf areas boomed.

Parents wanted decent turf for the Little League and soccer on Saturday mornings and demand went on and on. Someone had to know about varieties and how they stood up, programs of fertilization and watering, how to reduce watering (and other expenses) as costs went up, how to control weeds and pests, how to meet varying needs for different sports using the same area. All this pressure resulted in turf managers needing to become specialists for at least the sports portion of their system.

The way it worked was to read books,magazines, talk to the guy in the next town, talk to suppliers, try to get to a turf conference. Even it it was about golf courses or lawns, there would be some good ideas which could be used on athletic areas. At the same time some products and equipment were being sold specifically for sports areas.

Meeting the pressure for good areas meant learning to lobby for more budget in addition to learning what to do. In the case of the big money college and pro operations, the money wasn't hard to come by, so long as you got results. In fact, good athletic turf was also a good investment and had a part in bringing in the revenue.

The pro stadiums hired the best turf managers they could find. Eventually these men established and "old boy" network, meeting occasionally at conferences like this or at games, calling, writing letters. Dick Ericson, Harry Gill, George Toma and the others had a lot in common and sharing information was the best thing for everyone. One of their dreams was of some kind of organization where they could get together and discuss their own problems and learn about things which could be of help.

And it came to pass that this happened, last year at this conference. Bill Daniel put together some guidelines, a few votes were taken, and the new Sports Turf Managers Association was formed. It had the structure, but everyone already had a demanding job which took time. Bill had a lot of irons in the fire too, but wanted the Association to go.

At the same time, the National Institute on Park and Grounds Management had, in the course of its turf management program, held many single sessions on athletic turf. The Institute has PARK MAINTENANCE magazine as the principal underwriter of its conference. Because of the intense interest in athletic turf as a specialty, an Athletic Turf Management Seminar had been planned in the fall of 1980, to be held early in 1981. Bill Daniel was invited to be a speaker, on the premise that he knew a little more about this type of turf than most of the delegates. (Turned out he did, too.) This contact resulted in our association management services being considered for the Sports Turf Managers Association. Things progressed and in the late summer of 1981 we started.

We had a constitution and bylaws. We solicited members from those interested and have started to publicize the Association and continue to make contacts. We realize the field is specialized. We continue to get new members and have more than thirty now.

Following the principle of exchanging information, we held a one-day program for the Sports Turf Managers Association concurrently with the National Institute educational conference in Kansas City, 4 No 81.

The concurrent meetings are beneficial to both the National Institute delegates, who have athletic areas and can sit in on the Sports Turf program sessions, and the Sport Turf delegates who can sit in on any of the park, campus, general turf management sessions to pick up items of interest on budget, personnel management, etc. They also go on tour, which we did at Kansas City, and a highlight was visiting the George Toma operation at the Chiefs and Royals stadiums. George grows practice field turf in addition to vacuuming his two rugs. A large exhibit of products and equipment and some social events are also available.

Full registration was $85.00 for the four days, including lunch and tours. This was a discount of $15.00, and represents a big chunk of services deducted from your $30.00 or less annual Sports Turf dues. This first Sports Turf Managers Association program ran for one day.

Speakers were Dick Ericson on "Planning A Domed Stadium". Larry Vetter discussed, "Managing the Vikings Practice Complex" and "Renovating and Updating Sports Turf". George Toma talked about "Practice Fields for the Chiefs" and "Fertilization and Management". Jerry John discussed "Multi-Field Management and Utilization". Bill Daniel gave a mini-seminar on "Vertical Drainage Systems and Programs" and "Drainage Problems and Irrigation".

In all cases, speakers were available for discussion with delegates and plenty of specific questions were answered. The format of the conference provides ample time for this important personal contact and many opportunities for delegates to meet after sessions in the headquarters hotel and at social functions. There was a get-acquainted complimentary cocktail party early in the evening when exhibits opened. Many delegates got together in groups and attended the Shrine Circus which was an evening event included in the registration cost. Everyone came away with ideas he could use, even though few had the budget and staff which a pro team provides.

The 1982 National Institute education conference will be held October 31 through November 4 at the world's largest Holiday Inn near Chicago's O'Hare Airport. You are all invited to attend as Sports Turf delegates.

We are offering limited membership benefits at present. You get the chance to learn from interesting sessions, possibly to meet with some of the celebrities in sports turf management and talk with them. You do get to have contacts with others interested in sports turf. We hope as membership grows to become the center for exchanging information in this important field. The Association wants to tie together the professionals, the researchers, and the suppliers so that each can advance the knowledge of the others.

What's ahead? It is up to the officers and board to make the decisions and to our office to carry them out. We are the employees of the Association. One thing discussed is a newsletter with a lot of member participation. Every professional has some things he does best within his budget and situation limits. This information would be invaluable to another looking for help. If we can get an open exchange of ideas going, we would all benefit.

An enlarged conference program, running for more than one day is easily possible, again if you will share your experience, whether you are a member or not. Research projects aimed at your problems, products produced to meet your needs are possible. A united voice can help with budget and priorities.

We feel we have a bright future. To achieve it we need a lot of hard work by the directors and lots of cooperation from members. Where the Sports Turf Association goes from here is up to you.

ATHLETIC FIELD MAINTENANCE EXPERIENCES

David Heiss, Turf Services
Spring Lake, Michigan

My experiences in maintaining athletic turf areas began in the late 1950's when I started working on golf courses. My entire life has been devoted to athletic turf of one type of another, and ten years ago our firm began an athletic maintenance program for schools and colleges throughout Michigan.

Today I want to touch on the basics of athletic turf care with the hope that it will help some of us see our problems for what they really are. My experience has shown that the hardest job is to define the problem accurately. Omce the problem can be outlined a solution is easy to come by.

Athletic turf managers know what they want; a thick, weed-free turf that will sustain heavy useage. This type of field is easier to come by than most of us realize if we just pay attention to the basic concepts. Over the years this conference has repeatedly stressed drainage. Without adequate drainage you are severely handicapped in having a desirable field. The Turf Managers' Handbook lists numerous ways to improve drainage with specifications for building a porous soil and providing subsurface drainage. The information is there for reading, but I see a lot of people doing inadequate surface grading after they mix and place the soil. We utilize small road graders and set our grade stakes on 25 foot intervals. Using this method it is easy to be a half inch plus or minus of your final grade. Where soil predominates a 12 inch crown for an athletic field should extend to ten feet beyond the sidelines. This allows the surface water to run off to be behind the area that the coaches and players stand in during the game.

The next basic consideration is grass variety. If it is a practice field it is going to have minimum care and a considerable amount of traffic. Consider using a mixture of new turf type tall fescue and elite bluegrasses. This will make an excellent wear tolerant turf. With good maintenance practices, including overseeding, you can extend the life considerably. If it is a main stadium or an area that spectators will be watching, bluegrass is by far the preferred choice. Many of our newer varieties have early green up, late fall color, or lower height of growth. You know your conditions better than I. List those conditions on a sheet of paper and then match the characteristics of the grasses you will be using to your conditions.

This day and age I am amazed at how few people understand and practice good weed control practices. If you do not know the weed varieties you are dealing with I urge you to go out and buy the book, Weeds of the North Central States, to help you identify those weeds. In a few short years we may well be faced with legislation on the herbicides we can use and at what times of the year. If you know the weeds and the specific herbicides for their control, you will be much more likely to gain a permit for eradication if required. We have already had some unpleasant experiences in our office over the use of 2,4-D on college campuses.

Know your diseases and insects. A good turf is not immune to disease attack and insect damage. Mallinckrodt puts an an excellent booklet which is free from their distributors describing the most common diseases, their sypmtoms, and a list of suggested chemical controls. If you do not have an improved bluegrass you can generally expect to have an outbreak of helminthosporium. Dollar spot is rather common and brown patch is certainly not unheard of. Do not confuse disease with insect damage. Get on your hands and knees and pull the grass apart and look. Cut the end out of a coffee can and insert it into the turf and fill it with water to see which insects float to the surface. We have several good residual insecticides coming on the market. Your local turf distributor can advise you on those that are licensed for your state.

Over the years I have seen excellent athletic turf that has never been verticut or aerified. I am not discouraging these practices; I just do not like to see them substituted for good management. An athletic field needs four pounds of actual nitrogen per 1,000 square feet per season with adequate potash based on soil tests. If the field is mowed regularly so as not to remove over one-third of the leaf tissue and has a good grass variety then aerifications may not be needed. Earthworms are nature's way of aerifying. If you do have access to aerifers and verticuts be sure the other parts of your program are in order before you use them, otherwise you will be disappointed with the results.

Even the best turf suffers wear so an annual overseeding is required. Our experience shows that the seed must be incorporated with the soil to germinate and grow. Some claim success with seeding prior to a game and letting the players push the seed into the soil with their spikes. My experience has found this to be a very expensive way to introduce seed. Use of an overseeding machine is preferred. You can mix seed into topsoil and then spread the topsoil lightly on the field if an overseeder is unavailable.

The basics, good drainage, grass cultivars, correct identification of your problems, and providing adequate supplemental irrigation to reduce the stress on the turf, are steps that will guarantee you a field that is acceptable to both the players and the spectators.

THE GAMBLERS

Harry C. Gill, Superintendent
Grounds and Maintenance, Milwaukee County Stadium, Wisconsin

When Dr. Daniel called and asked me to handle a portion of this symposium, several thoughts crossed my mind. The first was that the Midwest Turf Conference was really going down the tubes if they were desperate enough to ask me to speak. My second was that the tentative title, "Upgrading Sports Turf" sounded too technical. Most of us are continuously upgrading our turf, but it is only after we have thrown the dice that we know if we have sevens or craps; thus, "The Gamblers".

I was working for Winnebago County, Illinois as a superintendent in charge of a preserve along the Rock River, comprised of an 18-hole golf course, park, campgrounds, boat ramp, school, maintenance shop and carpenter shop of approximately 438 acres when the Brewers asked me to join their poker game.

In my first interview I met with the stadium administrator who represented the County as owners of the stadium, and the vice president of operations for the Brewers, who were the prime renters of the stadium and who would be my employer.

They informed me that the Brewer grounds crew took care of the field for baseball; the County crew took care of the field for football. We all agreed that maintenance should be under one groundskeeper for all events.

On April 10, 1975, the day prior to the opening game, I decided to take a hand. My abilities at that time were as follows:

- 20 years of some form of turf experience
- 15 of those years in golf course, park, hotel and forest preserve work
- some administrative ability
- a hard head and lots of guts
- no previous major league ball park experience.

The first hand they dealt me was a bummer. My field was a disaster area consisting of a 30 percent Poa annua population, broadleaf, knotweed and clover. In December '74, our field had not been repaired after the last football game. The infield skin was classified by the players at the 1974 winter meetings as the worst in baseball.

My first opportunity for repairs came on May 5th. Sod was available, and the team was away for fourteen days. During this period we replaced 3,200 yards of Merion bluegrass. Using a golf course greensaire and five sets of spoons, we scarified the skin approximately three inches, removing some of the clay and topsoil, then added, tilled and leveled about two and one half tons of turface.

On June 8th, I was honored with the presence of the Rolling Stones rock group. This allowed 17,000 people to stand on the field for ten hours and dance on our new sod. The three amplifiers set up on the skin behind first, second and third created a very interesting traffic pattern and destroyed the grass in back of the pitchers mound in front of second base. Our new motif on the field was wall to wall garbage.

On June 22 we had another rock group called Pink Floyd. This group provided me with a little more rock education and a new set of challenges. Due to the damage to the infield from traffic patterns, nails, needles, glass and a new type of grass, I snow fenced the entire infield. When the fence went up at 4:00 a.m. the morning of the show, I must say the promoters seemed rather perturbed. This was an evening concert scheduled to start at 8 p.m. and end at 11 p.m. Due to our inexperience and the large crowds waiting to enter the stadium, fans were allowed on the field at noon for the 8:00 show. The heavy spring type storm that started about 6:00 did not seem to bother the fans, as they enjoyed splashing in the mud. Since the groups are completely electronic and the tickets read rain or shine, the heavy rains caused many delays, extending the show until almost 2:00 a.m.

The County allowed semi-trucks on the track to load and unload. The drivers removing the staging found it rather difficult to stay on the plywood as they drove out the right field gate over my right field grass.

My problems were essentially the same - garbage, cleanup and mud. The main difference was that the team had a game that night! This was the start of an eleven day 13-game homestand, and time was a major factor. Water was pumped from the truck holes in right field and the fresh dirt that replaced it was tamped and leveled for the game on the 23rd. On the 24th we received 300 yards of sod for this area. After the night game of the 24th we worked all night repairing and sodding. The sod was lightly watered and heavily rolled to prevent slippage of our right fielder during the afternoon game of the 25th. He was very happy with the repairs, but the Yankees, who lost that game,made reference in the New York Times about the Milwaukee County Frog Farmer with the swamp in right field.

One of the main facts of life I have learned in working here is that if you are on a golf course, in a school stadium,park, etc., much of your time is spent selling your product to the public. Here, due to media coverage, good or bad, our product is sold all of the time, usually more bad than good.

The eleven day homestand lasted until July 3rd, ending at 11:30 p.m. By 12:00 we had a full crew on the field.

Due to constant use of a tractor on the skin area for dragging and other maintenance, and by pulling the tarp the same way all the time, the infield between 1st and 2nd had a rise of about three and one-half inches and six feet wide, and a rise of four inches and six feet wide between 2nd and 3rd. We lifted the infield sod in these areas and lowered them four inches to the level established when the Braves were here. Our problem was the unavailability of Merion mineral sod in our area due to weather and disease. We then lifted some good sod we had from our hip areas outside the foul lines. A local sod grower we contacted told us he could provide 3500 yards of very good common Kentucky he had on mineral.

When he received the order, he gave this area a good shot of liquid nitrogen and consequently, each load he delivered was a darker shade of green than the previous one. This sod was used to replace the hips and all other repairs to the field. We lifted, replaced, rolled and watered sod where possible all night, the next day and night, and took our first break about 7:30 Saturday night, July 5th. The gang was bushed, so only watering continued on Sunday.

On Monday at 7:30 a.m., grading, rolling and patching of the sod areas was resumed and completed about 3:30 p.m. About noon, I had loaders and trucks lift the top, or turface, layer of the skin and haul it to a stockpile. The second or clay layer was rototilled, lifted and hauled to a disposal point, and the remaining area was then re-leveled. The top layer was then returned, respread, leveled and watered. This allowed us to lower the skin to conform to the new infield grade, and remove a little more of its compaction.

When this was completed, our time limit was two days to homestand and five days to the All Star Game. All the sod had been fertilized, rolled, watered and made as level as possible. We tinted all off-color rolls with Aura Green on Thursday. On Friday, July 11, we had to mow and get the field ready for the White Sox three-game series starting that night. Once again, on Monday, July 14th at 4:00 a.m., we tinted the sod that was off-color before the All Star practice and press interviews. As coverage for this type of event usually brings out 500 to 700 media people, interviews did not end until about 3:30. We then mowed, laid lines and did all routine maintenance jobs after they were through. The next morning, game day, I had the two best spray men the county employed in at 6:00 a.m. There was a walkie-talkie with each sprayer. I went to the upper deck like a great band maestro and directed them in a complete field color job. "Unit 1, not so heavy. Unit 2, a little more." etc. The resulting comments by my supervisors, the media, players and other baseball people made it all worthwhile, and my All Star ring is one of my most prized possessions.

Things then settled down to the routine baseball problesm of, "Do we or do we not pull the canvas, Mr. Weather Man; tell me please."

On August 8th, we had a small traumatic experience of a half-million dollar fire in the basement of our stadium under the lower grandstand. A week before the fire, our concession people received a shipment of about one hundred thousand dollars of paper products. The storeroom where these items were kept is directly in back of our main eletric switch control room for the stadium. We lost all power to the field lights, concession stands and sound to half of the stands. I discovered the fire about 8:30 a.m. Along with the facilities we had lost, they added fifteen trucks to my field decor. One pumper parked his rear wheels on top of my mound, just to check the height. The stadium electrician substationed in power for field

lights and some temporary stadium lights. The County obtained all the portable gas generators they could find to run as many concession stands as possible. The sound people cut the cables on each side of the fire area and strung temporary lines out in the open to the mezzanine and back down past this section. In agreement with the fire department, umpires and both clubs, we roped off the problem areas, and brought the teams down to the dugouts through the stands. Four one-inch hoses were run into the fire area from the field connections. As we played the National Anthem, the last fire truck moved around to the front of the stadium and the firemen using our hoses were ready. Four wheel vehicles removed smoldering debris out to the parking lot as the fans in the stands enjoyed the game.

On August 16, somebody called for a new deck, so they brought out the one with the football players on it. It was the Chicago Bears vs. the Packers and the Midwest Shrine Game. Seven days since the fire, 85 degrees, watering the mineral sod because it was shrinking, and I might lose a tackle in the cracks. There were 1,500 Shriners marching, riding horses, riding motorcycles and golf carts all over the field. You guessed it! The rains came in a total downpour all through the game. There was 1,000 yards lifted on Monday, relaid on Tuesday, and a game on Thursday.

On April 10, 1982, I will start my eighth year at Milwaukee County Stadium. I've played some good hands and some lousy hands. I have thought of divorce from the job several times, until I found out what community property really means. It means they get the property and you get out of the community. This is not an 8:00 to 5:00 job. My wife brings the kids down once in a while and says, "See that little fat guy on the field? That's your old man." In seven years we have had a lot of baseball, football, rock shows, jazz shows, Billy Graham, etc. Each presented a new challenge.

In baseball, I like Warren's A-34 bluegrass. It seems to stand up to our type of traffic best. I like Milorganite for quick greening and sodding and IBDU for slow release. We have tried several different infield or skin mixes for better percolation and playability. At present in 1981 I went heavier on the percentage of sand.

SKIN MIX: -No stones larger than 1/4" to 3/16"
-40% clay loam
-60% sand
-no more than 8% 12-16 mesh
-at least 80% 16-64
-no more than 4% 64-80

Right now this is working for me.

For a rock show I set up my snow fence 15 feet into the outfield grass from first to third around home.

Semi-trucks are not allowed on the field at any time and all types of fork lifts must have high flotation tires.

We have found that having the grounds crew pass out garbage bags just before the end of the show works out well, as fans will usually fill them. The promoter purchases these bags and makes an announcement from the stage as to their use.

For football, I call the priest, rabbi, or minister, face the east, and then call the weather bureau.

I learned years ago that you will suffer many defeats as you go, but just don't ever be defeated.

I have never signed a contract with anyone to succeed, but I have an agreement with God to try.

SPORTSFIELD DRAINAGE

John Souter
Souter of Stirling, Scotland

Perhaps the main lesson we have learned during the 70's is that ground availability for the construction of athletic field sites is quickly decreasing and that only the worst areas of land - the old town tips, the bogs and the stoney areas are all that economically remains for us.

Good ground, more than ever, requires to be used for food production, and with the cost having risen, problems for the planner, designer and constructor are greater. We have, therefore, to be able to "control" these situations, and our designs must be clear in that the client should have exactly the same finished surface as he would had he built the field on a perfect soil field. Now, we may require pump installations to take water out, rafts under the surface mix to "pull" water down, main outfall pipes to carry water at an acceptable rate to the main rainwater systems.

Too often an architect designs, an engineer supervises, and a contractor builds. All independent bodies. Who looks after the work on completion? Not ANY of the three mentioned, but the head groundsman. Was he consulted before the contract started? Was he allowed to be part of the construction operations? Has the future maintenance program been discussed with him?

If the answer to any of these three questions is No, then the contract should not have proceeded. There is no sense in being able to buy a Rolls Royce and not have an engineer to look after it properly.

We find that architects and engineers, unless they have a good knowledge of soil and turf, do not understand fully what we are attempting to create and certainly rarely wish to be involved with the grounds staff.

All the technical services, and there are plenty who can supply these at a fee, must be under the control of some person trained in soils, construction and maintenance, who will direct the operation from drawing board to installation and will then control it for at least the next five years in conjunction with the head groundsman.

From our experiences, surfaces in Scotland are getting better each year and the running costs are decreasing - even allowing for inflation.

Let us now examine three sites of different base/top material.

Site 1 - west of Scotland, rainfall average 80-90".
Due to planners requiring the local football stadium for an industrial site they, in their wisdom, designated the local marsh or bog to be the future field or pitch! During the level survey, with fishing waders, we sank up to our bottoms when attempting to hold the staff for readings. A problem? Yes, but the outlet point at a stream or burn some fifty yards away was fine. The scheme was therefore designed backwards from the outlet point. Growing grass on the top zone was the least of our worries. Getting all the water, from the surrounding hills, away was the main one.

We created an island, rectangular in shape, and five yards around the perimeter of the finished field size. Outlets or inspection manholes, three in number, were installed so that we could see if the water was running, and culverts also, two in number.

Once the volume water was diverted from the play area the surface settled. A layer of infill was added (some 3000 tons from the local shore and varying from one-half to three inch round stone). This created a stable base. A zone of grit material was then added for four inches over the surface and then eight inches of medium/fine sand. To this we added our dirty zone of approximately one inch of soil/sedge peat. The "soil" had been previously tested in our laboratory.

Base drainage at 12 metre invertals and grit interceptors at 4 metre intervals and 4-1/2 inches wide were installed prior to the top zone being applied. The results have been to the client's satisfaction and we are now on the five-year maintenance programme. (Year 2).

Site 2 - in the Shetland Isles.
Here the area designated for the seven fields to be installed comprised the old town refuse tip, a peat bog and a rock boulder area. Not one we would have chosen, but if that was the only area available, then we had to get on with it.

The outlet was a problem and had to be resolved by blasting - a cost of #70,000. This has done well and was similar to pulling the plug out of a bath.

We had not gravel or grit available, and therefore we required to crush whin to a size of 1/2-3/4" and wash it. Instead of the grit, a fibre barrier was used in one yard wide strips over the whin. After the base was graded to a cross fall of 1:100 the drains and interceptor slits were installed, covered with fibre.

The top zone was then added in the form of 2" sand (med/fine particle range) and 7" sand/soil mix. After fertiliser treatment of 10:15:10 @ 1-1/2 g/sq.yd. the grass seed mix of 70% Manhattan 30% Loretta ryegrasses were sown @ 1-1/2 g/sq.yd. Results were good.

Site 3 - Main Line English Football Club.
Here we had a real problem in that the club had experienced four different contractors working to advise in the ten years to 1980. Sand slitting, sand grooving had been carried out with no success at all. Take it from me, some of the directors did not want to hear the term 'sand anything' again!

However, thanks to some of our fields in Scotland, we were given the chance to survey the site, sample the soils, take profile digs to ascertain what was present, examine the existing outlet and manhole points. The outlet pipe did not appear to be able to run water, although the surface of the field held it!

It was decided to phase the program:

Year 1 - Ameliorate the top 9" of finished soil by adding approximately 700 tons of med/fine sand. Install the main drain (70 yards) and five laterals of 110 yards each. Create a new outlet manhole.

Year 2 - Put in sand slits 2" wide and approximately 10-12" deep.

Year 3 - Maintenance only (this year, 1982).

What requires to be achieved in all these circumstances is that the client, having paid his money, is entitled to some guarantees from his advisors and contractors. This we now give and it is making a big difference to the client/company relationship.

EUROPE'S FINEST STADIUMS

John Souter
Souter of Stirling, Scotland

The completion and opening date of 22 Dec. 1981 was yet another significant milestone in the history of Glasgow Rangers Football (Soccer) Club. Formed in 1973, the club has gone on to win a world record number of championships and twenty Scottish Cup wins. They won the European Cup Winners Cup in 1972.

The cost of the stadium was in excess of #20,000,000, plus the cost of the pitch,and holds around 45,000 spectators, seated. A unique part of the design was to create office space under the new stands. The area of 24,000 sq.ft. is leased to clients and enables them to park their cars, show their own customers the stadium and is within easy access of airport, rail and road transport.

During 1975 I had the pleasure of being allowed to create and install what has now become one of the most efficient turfgrass systems anywhere. The planning was thought out, and slowly but surely, the jigsaw was pieced together. Ibrox, as the stadium is known, was one of the first surfaces to be created, ie.once the soil tests were known, sand and humus in the correct proportions were added and ameliorated. Base drainage was installed. The results were exactly as we had hoped at this stage.

Significantly, we feel sure this was the first time we realised the need for a proper interceptor or grit layer and this was to play a major part once the slits and heating cables were added some years later in 1981.

However, annual maintenance is carried out by Mr. Davie Marshall, Head Groundsman, and his staff, and one of the main reasons for the progress has been due to his constant attention to detail and understanding of the situation. Like me, he is pround of his field (known as a pitch in Scotland) and we are striving to make it even better in 1982. The "finish" or top surface will be added - the last piece of the jigsaw.

Once the new stadium started to be built we realised the take off rate of surface water would require to be greater than it was the with existing soil mix. Having created a crowned pitch with 12-15" rise in the centre the slits were therefore designed to interlink into the grit/interceptor zone as previously mentioned.

The installation of the slits took place at the close of the 1980-81 season, and during the first week of May. After overseeding, the area was marked out and trenching started. The goal areas were returfed at this stage.

Once the escavations were disposed of,the trenches, 2-1/4" wide, were backfilled with grit and sand to the correct depths - previously tested in our laboratory. On completion, the surface was allowed to "grow" for only five weeks when the heating (hot water) installations commenced on 22 June. These tubes, 7/8" diameter piping, were pulled in at 10" deep and 10" wide. This was done by a four-wheel drive tractor, with vibrator, which had been fitted with a special faced bullet, made in our yard.

The operations took approximately six days to complete. Dry conditions were to favour us thereafter, the surface being dressed with the same topdressing sand as had been used in the initial mix in 1975.

In Scotland our playing season commences August and finishes April/early May. In other words, we play during the worst climatic months of the year. At Ibrox during 1980-81 approximately 75 games (or matches) were played and the surface still looked good with no real sign of major wear.

When we set out, our brief was to create a park which would:

a. have grass all the year round
b. take off water at the correct rate
c. NEVER have a game called off due to snow and frost
d. be easier to maintain, and therefore cost less to run.

We feel that by the start of the 1982 season in August we will have achieved that, thanks to the cooperation of the directors, staff and and close liaison between Davie Marshall and his crew and our own staff.

By then Europe's Finest Stadium will have: EUROPE'S FINEST PITCH!

SOIL MOISTURE SENSING - A FUTURE

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

Many tend to overwater as a natural response to irrigation management. The soil (rootzone) stores (holds) water, so it is the releasor. The turf roots absorb water so they are the remover. The best water use is a maximum utilization of both of these systems.

Continued excess wetness favors:	Alternating water supply favors:
- short roots	- longer roots
- less oxygen in soil	- more oxygen in soil
- tender plant tissue	- firmer, stronger tissue
- reduced nutrient availability	- normal nutrient availability
- more surface evaporation	- less surface evaporation
- more transpiration through plant	- less transpiration

Over the years numerous systems have evolved to measure moisture. The specific calibration requires accurate laboratory work.

During the past tyirty-three years I've worked with moisture sensing. It was a part of my PhD study at Michigan State University. After a delay of several years, and after several observations, we again worked on moisture sensing. The sophistication of the controllers for irrigation application offers more potential for including moisture sensing as the ultimate control for irrigation applications.

There are about eight companies having moisture sensors currently in research or available in the United States. One of the more famous is the Irrometer. It has a porous cup, a water reserve, and measures the tension in the soil. However, its range is very limited and it tells very little in the more moist ranges where turf is often grown.

The actual sensors in the soil have varied greatly. We have used the plaster of Paris, the nylon, and the fiberglass wraps, the Irrometer, the Demhorst - all of which use a matrix that has a pore size similar to that in the soil.

We have recently gone to bare metal probes which are spaced twenty inches apart directly in the rootzone. This gives exact sensitivity equal to that of the root itself. Along with that, the sensors give a sensitivity to moisture changes that is quite rapid.

Accompanying the resistance meter is a ten-turn potentiometer which can be adjusted at the site for any fertility or water relationships existing. This means that the user can set the machine after any irrigation, fertility treatments, watering, etc., to allow for the present condition and then let the machine operate the dry-down and re-wet cycles.

To accompany this, a dual scale chart has been developed whereby the moisture levels may be plotted from wilting to saturation. For example, when a rootzone system in the greenhouse was heavily watered and then allowed to dry down, it took twenty-four days, yet every day a comparative moisture measurement could be made to ascertain moisture availability.

For existing time clock systems, selected common ground wires can be routed through the controller. For some systems the rain outlet can easily be wired to utilize the soil's moisture. The saving in water can be significant because of less evaporation, less transpiration, improved nutrient availability and healthier turf.

Without sensing, the tendency is to overwater. With sensing, the tendency is to use less water with confidence.

The future of such systems is bright because we are concerned with moisture supplies, energy and water conservation. Such a unit is a logical best method of acutally determining the supply available to the plant and its regulation for maximum efficiency. One company, Water Sentry, of Detroit, is making an electronic sensor wigh a single point on-off control. The point selected is just at wilting in a sand culture. It may be economical and may be very useful for maintaining turf in non-wear situations where just the survival of the turf is the goal.

In closing, I feel significant progress has been made, and moisture sensing systems will be the next major development in irrigation management.

REINFORCING ROOTZONES FOR WEAR TOLERANCE

W. H. Daniel, Turf Specialist, Department of Agronomy
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The plastics industry has provided many useful items for today's society, and offers even more in the future. Surprisingly, plastics are contributing to the turf industry - plastic pipe, plastic barriers under rootzones, plastic sprinklers, etc. One of our research programs has been to test the material, Enkamat, under limited conditions. It is attractive as a nylon three-dimensional strong material. We have tested it in the greenhouse with and without topdressing, with ryegrass, with bluegrass. In pull tests we can double the strength of a natural sod by incorporating Enkamat. It does present a problem in that it forms a sieve, and soil and sand tend to go through and below it. Shaking, wind, and rain affect unconsolidated material.

In practice, the material should be placed with the points up, and the point of the player's cleat should approach the point of the Enkamat in the soil for best wear tolerance and contribution to turf stability. Enkamat has been installed in a few fields in the U. S. The material is also used some for erosion control under some conditions.

Recently we have begun to test polyester fibers. In one form they are extruded as a thin blanket. The roots will penetrate the blanket, but plant parts will not. It is therefore possible to put the Spunbond under the seed, under topdressing, and to have the roots penetrate the fiber and have a very, very strong turf matrix. Even a two-inch strip cannot be pulled apart by hand.

We have recently tested that material with holes made in it, so that it has about fifty percent opening and fifty percent fiber. This gives better soil to soil contact, and may be more suitable for traffic.

Of considerable interest is beginning research on using threads cut one to two inches long from polyester fiber such as carpet pile. The diameter of the fibers is about equal to that of very fine sand. The length of the fiber, in effect, gives a long sand grain. This readily reinforces and stabilizes the normal round sand grains. Our initial test using the cut fibers looks very promising. Moisture retention is at least equal to that of sand. The roots will proliferate into and through the fibers giving a bonding that appears to be significant. Our tests are preliminary; the results look encouraging at this time. We consider this a progress report.
