MIDWEST REGIONAL TURF CONFERENCE

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Purdue University

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1984

MIDWEST REGIONAL TURF CONFERENCE

The 32 talks included in these Proceedings are condensations from speakers before sections of the 1984 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 1984 Conference, one person of each members 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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W. H. Daniel, Executive Secretary
Midwest Regional Turf Foundation
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The Computer Revolution and its Implications for our Future

Dr. H. E. Dunsmore
Department of Computer Sciences
Purdue University
West Lafayette, Indiana 47907

Abstract

The first electronic computer was built in 1946. Computers have evolved since that time - at first getting bigger and more powerful, and lately becoming smaller (and still more powerful) due to the use of "chips" (circuits in silicon). Computers are being used both in our businesses and in our homes. Computer costs continue to decrease and speeds and capacities continue to increase. Teleprocessing (computers communicating over telephone lines) opens a realm of possibilities for home and business computer uses.

"Computing" is not a new concept. In fact, the word "compute" is derived from the Latin "computare" which means "to calculate". The first (non-human) computer was probably the Chinese abacus, which is thousands of years old. Pascal, the French mathematician, designed a mechanical calculator in 1642. But, technology was insufficient to build it until 300 years later.

In this country, Herman Hollerith of the U.S. Census Bureau realized that data from the 1890 census could not be tabulated by time to begin the 1900 census unless some tabulating device was used. He devised a system of punching holes in cards that allowed sorting by choosing those cards with holes in the same locations. His efforts led to punched-card devices that became daring products of the company we know now as IBM.

But, the computer revolution actually began in 1946 when J. Presper Eckert and John Mauchly of the University of Pennsylvania designed and built the Electronic Numerical Integrator and Calculator (ENIAC). It is

regarded as the first electronic computer. With 18,000 vacuum tubes it was very large and very slow. By today's standards it had a very small memory, generated a lot of heat, and failed often.

By 1950, both IBM and Univac (the company begun by Eckert and Mauchly) were selling computers. In the 1950's computers got larger and larger until vacuum tubes gave way to transistors. In the 1960's, transistors gave way to Integrated Circuits (IC's). The 1970's was the era of the minicomputers - smaller, yet just as powerful as their forerunners. The 1980's will probably be remembered as the age of the microcomputer - the desktop computers and personal computers, many of which are more powerful than the biggest computers of the 1950's. IC's have given way to Very Large Scale Integration (VLSI), dubbed the "micro-chip". VLSI chips are circuits in silicon. Each chip is a square with sides of about a quarter of an inch.

The computer was originally designed as a calculating machine (with information storage as a by-product). Now, the predominant use of computers are as "information retrieval" devices for storing vast amounts of information and getting back subsets of that information quickly. The business applications of computers are growing daily including handling records, personnel information, operating data, plans, and goals. We are rapidly approaching the point that most of the workforce interact with a computer on a daily basis.

Computers are also being used in our homes. The front door was opened by the calculator and the video game. Computers of the future will be more "user-friendly" almost to the point of understanding natural language. Almost 5 million home computers have been sold in this country since the beginning of the 1980's. Some think that the turn of the century will find 80 million home computers in use.

The computer (especially the small or micro-computer) was TIME magazine's "thing of the year" for 1982. Computer costs continue to decrease and speeds and capacities continue to increase. It could be said that if automobiles had evolved like computers, you could now buy a Cadillac for $2.50 and get mileage of 3 million miles per gallon. Now there are beginning to be computer networks for business (linking parts of one business or similar firms) and home (linking people with similar interests, avocations, hobbies).

A small computer system consists of a monitor (screen), keyboard, floppy disk and disk drive, and printer. Something called a "modem" can be used to transfer information along telephone lines to and from a small computer. It is becoming commonplace that the home computer is used for personal purposes: recipes, budgets, phone numbers, remembering important dates, tax record-keeping, computing taxes, investment analysis, etc. With advancements in teleprocessing (telecommunicating), it is now possible to use the home computer for electronic mail, newspapers, periodicals, and data bases (stock prices, weather, airline schedules, professional directories). An

Atlanta newspaper is now available via small computer.

In the future the home computer may be used for even more exotic home-related activities - such as controlling heating and cooling equipment, working with a telephone answering machine when you are away to select one of several messages depending on the caller, activating the video cassette recorder, controlling and monitoring burglar alarms, and administering home robots for vacuuming, mopping, grass cutting, and even snow shovelling. The home computer may help teach children mathematics, geometry, history, foreign languages, and even about computers.

Today's children are growing up using computers. They will be ready for the "electronic cottage" - a term popularized by Alvin Toffler in *The Third Wave*. This is the concept that many of us will be able to work at home via home computers and telecommunication equipment. We may need to include video cameras and cable hookups for teleconferencing because people do need to interact with others.

The computer revolution is going on right now. The personal computer is making computing and telecommunications available to the masses. The "electronic cottage" is a real possibility with home computer and telecommunications equipment used for personal and business matters. There will be a graying of the distinction between being at home and being at work. There is little doubt that computers are important in today's world and will become even more so in tomorrow's world.

Computers And Weather Prediction

W. L. Stirm
Midwest Ag. Weather Service Center, National Weather Service
Purdue University, West Lafayette, Indiana

Weather prediction is a complex operation. Reams of data are collected world wide. A major communication effort is required to collect, prepare, and release information that is widely useful. Weather services require a high use of technology and involve satellites, radar, computers, and electronic communications.

The basic Weather Service computer system makes use of two large computers located at the National Meteorological Center, Washington, DC. These computers collect, process and analyze world wide information and provide guidance products to all field stations. The second part of the system is a communication-process computer at each field office that interconnects all weather stations with the National Meteorological Center. The third part of the system is a data collection microcomputer network. These collect and transmit data automatically for aviation, hydrological, agricultural and marine purposes. The Weather Service computer system is designed to interact with military and civil defense systems for relay and backup purposes.

The first step of the weather prediction process is obtaining weather observations. Realtime weather is collected simultaneously at 500+ surface stations in the U.S. and made available to each weather office. Similarly, upper air information is collected twice daily at upper air stations using balloon ascents carrying sensing, recording, and transmission equipment. Likewise, radar collections are made at 140+ stations in the U.S. and provide composite pictures of U.S. weather every hours. Further observed weather in form of cloud cover is obtained every 15 minutes by GOES satellite visible and IR camera coverage.

The second step in weather prediction process is the analysis and intepretation of the observational data. The large National Meteorological Center computers plot and analyze the data into over 100 surface charts and around 50 upper air charts covering atmosphere from a few thousand feet to 35 to 40,000 feet. The data is also applied to atmospheric models covering the entire hemisphere. Grid point computations are made for every 1 degree of latitude and longitude over land and every 2.5 degrees over water. The information is then projected into the future in intervals of 12 hrs. out to 72 hrs., and then daily from 3 days out to 10 days. The computer also processes data for each station using model statistics relationships out to 48 hours.

The third step in the prediction process is field station interpretations and preparation-release of forecasts, weather watches, and warnings. All the analysis and guidance materials received from the National Meteorological Center are interpreted and adjustments are made at each state forecast center. State, zone, and local forecasts are then prepared and issued four times daily. Forecasts cover a 36-hour period in segments each of 12 hours. Area coverage is state-wide for state forecasts, in 10 to 15 zones (each zone is 5 to 6 counties) for most detail zone forecasts and for major local city forecasts. Additional releases are made covering weather watches, warnings, storm statements, radar summaries, and other statements on progress of weather systems.

The final phase of weather prediction is the communications to the user. The AFOS computer in each forecast office has arrangements to drive state teletype circuits to distribute weather to users. Arrangements are also set up for direct broadcasts as well as computer relay systems for both within and outside of the state.

Several kinds of special weather service centers are also involved in providing weather information. There are centers for severe storm predictions, river forecasts, marine services, fire weather, and agriculture. One of these, the Midwest Ag. Weather Service Center, is located at Purdue Unviersity. This office provides a system of collecting agriculture weather information from a network of 150 secondary observation stations. The data is processed and supplied in the form of applications relating to agriculture such as soil moisture, crop stages, crop maturity, moisture use, plant stress, pest management, and other applied forms. The office also issues twice daily per state ag advisories for a six-state area. The advisories are interpretations of past, present and future weather effects on crops, farming operations, and livestock-poultry.

Overcoming World Hunger

Lowell S. Hardin
Dept. of Agricultural Economics
Purdue University, West Lafayette, Indiana

Introduction

My purpose: to share with you some concerns about one of the most fundamental and persistent problems of our age - hunger. Fundamental because an assured food supply is essential to the stability of every sovereign nation .

Situation

Painfully slow progress is being made in reducing the numbers of hungry people in the world. As many as a billion people, almost one-fourth of the world's population, are believed to suffer some degree of undernourishment.

- About 2/3's of these are in ten countries (mainly in Asia).
- Chronic undernutrition has replaced famine as the major form of hunger.
- More than half of the hungry are in rural areas.
- About 2/3's have almost no access to land.
- Women and children are disproportionately represented among the undernourished.

Why so much persistent hunger?

- Rapid population growth is, of course, a factor. By the year 2000, the world will have to feed at least 1.5 billion more people. Most of this growth will be in the Third World. By then, an estimated 80% of the world's population will live in developing countries.

- Jobs. Opportunities to earn an income, be productive, have increased less rapidly than population has grown. Rapid additions to the labor force simply have not been able to find work.

- Therefore, people are hungry because they are poor. They lack the means to grow or to buy enough food.

- Hunger is not primarily a supply problem. Rather, it is primarily a problem of effective demand. The need is there. The ability to buy is not. In the 33 lowest income countries, per capita income averages around $260 (vs. over $11,000, or 44 times as much in the U.S.).
- Poverty's political power is demonstrated whenever poor countries seek to increase food prices, e.g., Egypt, Tunisia, Morocco.

What Are Some of the Lessons That We have Learned?

I'll focus on rural people, hence, on agriculture. Happily, several of the hungry nations are learning how to increase their food production.

a. Mostly these countries are in the tropics and sub-tropics, so temperate zone agricultural technology does not transfer.

b. One needs to know what works before one can teach or extend it. So extension cannot accomplish much in the absence of research.

c. Historically, the agricultural research that was done in the tropics focused on export crops. So research on tropical food production is a must.

   - E.g., work of U. S. universities, AID supported projects
   - E.g., international agricultural research centers
   - E.g., successes achieved - rice, wheat, sorghum

d. To sustain progress, well-trained people are essential. So are institutions in which they can work, solve problems

   - Training - absorptive, interactive capacity
   - Institution building

e. Need to get policies right, provide incentives, develop markets.

f. Greater success is being achieved on the supply side (increasing production) than in alleviating poverty. But in many respects, agricultural improvement is a key.

Implications

It is difficult to foresee a secure world society if one-fifth or more of its people are undernourished. These people are neither lazy nor lacking in ambition. They are poor and many are unhealthy. They do not want to be dependent on handouts; they prefer to be self-reliant. As we have seen, they need help, the kind of assistance that helps them help themselves.

a. In providing the right kinds of help we are in fact helping ourselves.

- Reductions in levels of expenditure for defense and armaments are related to reduction in poverty.

- Ours is now an interdependent world. Our own population, like that of advanced societies generally, is approaching a no-growth plateau.

- Our own ability to grow is therefore linked to the growth and prosperity of the developing countries. That's where 80% of the world's people will be. For example, even in their depressed state, they are our most rapidly growing market for agricultural exports.

b. Self-interest not withstanding, development assistance has a thin political constituency in the U.S. Most politicians do not feel that they can get re-elected by voting for more foreign aid. So we need to think more about where we as voters stand on this issue.

c. In my judgment, the right kind of development assistance is both self-serving and wise. Above all, it is humanitarian. The cause is not a hopeless one. Progress is being made. If we are intelligent in how we help, the pace of progress can be accelerated. And that which we help others achieve is appreciated.

Sentryworld - An Instant Tradition

William R. Roberts, Golf Course/Grounds Manager
Sentryworld, Stevens Point, Wisconsin

SentryWorld Sports Center was constructed on a 270 acre "rock farm" in north central Wisconsin. The area was basically low swampland with soil types ranging from four feet of muck overlaying bedrock to marsh sand. Native trees include white birch, white pine, ash, maple and oak. Initial construction began in 1977 but was tabled until March of 1981 when Robert Trent Jones, Jr. was re-commissioned to finalize plans, and I was given the opportunity to participate as project manager and golf course supervisor.

The Sports Center houses six indoor tennis courts, five racquetball courts, one squash court, locker rooms, golf-tennis pro shop and two restaurants. The facility can be converted and is equipped to handle up to 2,500 people for banquet service. The annual company picnic takes place in and around the Sports Center site when we accommodate upwards of 10,000 employees, family members and guests.

Additionally, we have six outdoor tennis courts, a swimming beach, a softball diamond for employee and public use, and approximately 60 acres of employee park. A fishing dock situated on our 20-acre lake is available to employees and families. The lake, in addition to serving as our main source of irrigation and being functional in draining approximately 70% of the property, has been stocked with rainbow trout, panfish, bluegills and large and smallmouth bass. Areas suitable for bass spawning were incorporated into the lake design in order to perpetuate that population.

The SentryWorld golf course is open to the public on a daily fee basis and Stevens Point Sentry employees can play at a rate reduced from the daily fee. We have incorporated four miles of cart paths and service roads into and around the property to facilitate movement and help minimize wear on our turf. The irrigation system utilizes 4,000 sprinkler heads, controlled by 850 valves in 37 zones, to water everything "inside the fence".

The golf course yardage can vary from 5,100 yards to 7,000 yards and can be played from four sets of tees. Water serves an important function in the playability of the SentryWorld golf course, presenting a challenge to golfers on 11 holes. White sand, obtained from a source 70 miles away, also adds not only to the playability and challenge, but also to the aesthetics of our facility.

One of the real challenges in construction at SentryWorld was dealing with the rock on the site, and not just the bedrock. The whole site was overlayed with field rock. In fact, there were times when it was felt we were growing rocks or spawning rocks or somehow reproducing them because they just kept coming. You can't bury them, you can't burn them, and they didn't walk when we asked them to, so we tried a couple of things.

First, rock can be utilized for lake bank stabilization. We also used rock to hold an elevated tee bank along a stream. The material can also be crushed and used as "road fill" under cart paths, service roads and parking lots. And, of course, at SentryWorld, we plant flowers in the rocks.

John Joanis, Chairman of the Board and Chief Executive Officer of Sentry Insurance, who conceived and rode herd on this entire project, has said that, "We knew we needed a theme for the entire golf course - something that would be known, that would be different, beautiful, memorable, an instant tradition if you will, and I guess my love for flowers got in the way." Further, however, people make this "instant tradition" work.

Jerry Rzentkowski is a 1975 graduate of the College of DuPage horticulture program. Jerry had six years experience in the retail greenhouse business before joining us. Jerry heads up the flower portion of the operation at SentryWorld and he and the Golf Course/Grounds Manager work closely on planning, scheduling, design and implementation of the program.

Jane Johnson, who joined us after completing four years of study for a degree in ornamental horticulture at the Unviersity of Wisconsin, Madison, Mike Kintop, another of our full-time greenhouse staff,and up to eight seasonal employees also contribute.

We got into the greenhouse business when the flower theme was determined and it became obvious that "out of house" purchasing would severely restrict ouf ability to utilize plant material on the scale envisioned. We feel the use of our own facility allows us a flexibility that would be unattainable if we bought plants outside. Cost is the prime concern, but additionally, we can control the varieties available, the size at planting time, and the quality of the material to be used.

In 1981, we purchased three greenhouses along with a back-up generator system. Included in the purchase was ten acres of land which we used to expand the existing 9,000 square feet of greenhosue space into the present 24,000 square feet. Last year we dedicated four acres of this parcel for use as a tree nursery and now have 800 trees, including white birch, river birch, blue spruce, white spruce and maple, for use on the golf course. We have also begun a program to germinate seed and propagate groundcovers from cuttings for future use on our property. We currently have 600 such plants grown up to 6-inch pot size.

Of course, as with everything any of us grows, it all starts with the soil, and in mid-January the greenhouse staff begins filling the first of 300,000 pots and flats for planting. In early February seed is placed in germination trays for about 50% of the plants we will use. The remaining 50% are placed in pots or flats as "live plants" around the middle of February. Our greenhouses are full by the third week of March, and the next seven to eight weeks are spent "growing in".

Throughout the "growing in" period, plants are pinched back or cut back as the species dictate and time allows in order to promote lateral or "bunching" type shoot growth to maximize the number of blossoms per plant. Irrigation needs are monitored and hand watering or sprinkler irrigation is done as needed. We allow blossoms to begin "showing" around the third week of May in order to have the majority of plants blooming at planting time, usually the week following Memorial Day.

This season our plant material inventory will include: geranium, ageratum, salvia, begonia, impatiens, day lily, dianthus, cosea, marigold and vinca vine. Several species of petunias will also be used.

Our planning calls for each species or variety to be used in areas for which they are adapted, particularly in terms of light intensity. For example, we don't plant impatiens on our 16th hole because of full sun. We have reduced the number of different species used in mass plantings from 19 the first year to four this year in order to simplify management in terms of fertility, irrigation and pest control. We have tried to reduce the variables of soil type and watering by using a homogenous bedding mexture and automatic irrigation.

In early May we go into the beds at SentryWorld and add our soil mix, which is composed of 70% marsh sand, 20% peat and 10% vermicullite to compensate for any material that may have settled or was lost to erosion.

The week after Memorial Day, things tend to get a little busy relative to flowers. In addition to 11 employees who are ordinarily assigned to flower maintenance, we dip into other areas of responsibility, such as the golf course and the parks staffs, and bring the planting operation strength up to about 25 employees. These employees are split into two shifts in order to minimize the impact on play which is taking place and keeping productivity up.

Since designs are finalized the previous November, our challenge at planting time is to accomplish the operation in the shortest period possible. Planting areas are marked off with a paint gun, and proper spacings are given as part of on-going work direction. A number of flats are laid out waiting for planting. Those people transporting plants must stay ahead of the people planting or we lose production time and increase the interference with play.

The transporting of flowers continues almost constantly. We use Cushman trailer set-ups, in addition to a tractor-trailer set-up to bring these materials into the field from our maintenance building which serves as the central drop-off point. We have found our two-way radio system invaluable for communicating any field changes, which plant materials to bring next, et cetera, thereby eliminating confusion which, in turn, helps minimize lost time.

At the end of five days, 90,000 annuals have been planted on #16 and we have a most unusual golf hole. Golf balls hit into the flowers are non-retrievable. According to John Joanis, who established a fairly simple Wisconsin local rule, "You don't go in after it. You just don't!"

I would offer that the best description of this hole is the one I heard from Bob Reith, our general manager and director of golf. When asked about the 16th he replied, "It's the only hazard in golf I've ever enjoyed facing."

The impact of the use of flowers on the 16th hole is dramatic but not limited. According to Robert Trent Jones, Jr., it was his intent to "create an array of color for the golfer, not only off the tee, but also from other vantage points on the property."

We don't limit ourselves to the 16th hole at SentryWorld or to annual flowers. Tulips are a welcome sight after a long Wisconsin winter, and we have incorporated about 50,000 bulbs into our planting scheme. We also feel the flower theme should be presented as early as possible to our guests, thus a mass planting along our entrance road. Further, golfers and visitors are directed to the golf course from the Sports Center by beds of red, white, pink and yellow.

We have placed additional smaller beds "out of play",but definitely not out of sight throughout the entire 7,000 yards of golf - a bit of "lipstick", according to John Joanis. We use about 210,000 plants-worth of lipstick at SentryWorld.

We seem to have a contradiction by employing such extensive uses of labor-intensive, time-consuming materials and planting processes, particularly when viewed in terms of the golf industry's dilemma with soaring maintenance costs. With the emphasis on holding the line, how can the obvious costs be justified?

John Joanis has been quoted as saying that,"You have to understand that SentryWorld is an advertising piece for the companies and if we are anything more than just another insurance company, we have to be represented by something other than just another golf course. We needed something dramatic and recognizable in a hurry, and I feel the flowers do just that."

Michael Dry, Sentry Vice-President for Public Affairs, elaborated on the advertising and other values of SentryWorld in general, and the flower program specifically. "Basically, advertising seeks to create, increase and maintain awareness. We have spent one million dollars on a one-hour television special in the past and created awareness on a hit and miss type basis. SentryWorld is something special and the flowers make it even more exceptional, so, in that context, the awareness is maintained because the golf course and the flowers are there, year in and year out.

Although we spend approximately $200,000.00 annually on the flower program, when balanced against a yearly advertising budget of 6.2 million dollars, again, according to Mike Dry, "Those are some of the most efficient dollars we can spend to reach people important to our business, to help create an identity for Sentry."

Mr. Dry also brings out a couple of other points to be considered when attempting to view this expense on balance. SentryWorld, and the flower touch, can be utilized by the companies to maintain good customer relations in addition to "messaging" potential customers - the type of customers Sentry wants.

Company meetings, training sessions and functions become more productive for sales agents and employees from outside of Stevens Point if Sentry can offer them a first-class facility to play during their stay. "You need to break up three days of training rooms and motels."

Finally, in terms of employee benefits, the golf course itself is consistent with Sentry's dedication to employee wellness. It is something extra that also can be added when trying to recruit and retain top talent for company operations in Stevens Point. Indicative of this last statement is Sentry's reputation as a low turnover employer in the insurance industry.

Once again, "Those dollars are some of the most efficient dollars we can spend."

Grasses For Athletic Fields

Dr. William A. Meyer
Turf-Seed, Inc., Hubbard, Oregon

Prior to the 1970's the improved Kentucky bluegrasses were the main species used for athletic fields in the northern part of the U.S. During the 1970's the new improved turf-type perennial ryegrasses became available and were used successfully in mixtures with bluegrass for athletic fields. In the last three to four years a new generation of tall fescues has been released that show great promise for athletic field turf.

Kentucky Bluegrasses

There are many improved varieties of Kentucky bluegrass presently available. Most of the new, low growing, dense varieties will perform well on athletic fields. There are some diseases which can be damaging to bluegrasses at times, and the resistance levels in the presently available varieties do vary greatly.

Leaf spot, caused by Helminthosporium spp., can severely damage common type varieties (characterized by narrow leaves and erect growth habit) such as Park, Kenblue and Delta when they are cut short and fertilized heavily. A-34, Adelphi, America, Bonnieblue, Bristol, Challenger, Columbia, Eclipse, Majestic, Midnight, Parade, Sydsport and Touchdown are examples of turf-type varieties with improved leaf spot resistance. The turf-type varieties Baron, Cheri, Glade, Merit, Ram I,Victa and Wabash would be considered as having intermediate resistance. All of the abovementioned turf-type varieties have improved resistance to strip smut (Ustilago striiformis) compared to Merion, which is very susceptible.

In areas with southern exposure and intense heat buildup Fusarium blight can be a devastating disease with very slow recovery. The varieties Adelphi, Columbia, Parade and Sydsport have shown better resistance to this disease. Stem rust (Puccinia graminis) can reduce turf quality during hot, dry periods which slows down the growth of bluegrass. The varieties Adelphi, Eclipse,America, Columbia, Parade and Bristol have improved resistance, while Baron, Touchdown and Merion are quite susceptible.

The varieties Midnight, Adelphi, Bristol, Glade and Ram I are dark blue-green colored. Bonnieblue, Parade, Columbia and Majestic retain better winter color and green up early in the spring compared to varieties such as Baron, Nugget and Victa.

When compared with other turfgrass species a strong case can still be made to include a good proportion of Kentucky bluegrass in turfgrass mixtures to improve cold hardiness, sod forming ability and recuperative potential to repair injuries to turf by their spreading rhizomes. A-34, Touchdown and Sydsport are varieties of bluegrass which are very vigorous turf formers and are good candidates to be used in athletic field mixtures with ryegrass.

Perennial Ryegrasses

None of the other turfgrass species can germinate and tiller as rapidly as the new ryegrasses. Since Manhattan perennial ryegrass was released in 1967 as the first real improved turf-type perennial ryegrass, there have been many other improved turf-types released. These varieties such as Birdie, Blazer, Citation, Dasher, Derby, Diplomat, Fiesta, Omega, Pennfine, Pennant, Regal and Yorktown II have displayed the excellent establishment rate and persistence of Manhattan.

At the present time, there is a new generation of turf-type varieties coming into the market that are showing improvements in density, mowing quality and overall disease resistance. Manhattan II, Palmer,Prelude, Citation II, Birdie II, Repell and Omega II can be included in this category. These varieties have also shown improved leaf spot and crown rust resistance compared to the earlier varieties. The above varieties with a II designation also have had excellent resistance to stem rust, which is a serious seed production disease.

Another interesting development in the past year has been the discovery of the presence of a fungal endophyte in certain new perennial ryegrass varieties. An endophyte is a fungus that lives within another plant. The presence of the endophyte fungus in plant tissue has not been found to cause any adverse effects and has been shown at Rutgers University and in New Zealand to provide resistance to the following insects: cutworms, sod webworms, armyworms, bluegrass billbugs, Argentine stem weevil and chinch bugs. This fungus is transmitted by seed from one generation to the next. The varieties Pennant, Citation II and Birdie II are some new varieties that contain quite high levels of endophyte, which should provide resistance to the insects listed. This fungus does not live in the roots of ryegrass plants and does not provide resistance to root feeding insects.

All of the new improved turf-type varieties have shown excellent wear tolerance in our trials located in Hubbard when compared to other species. The variety Manhattan II had the top wear tolerance rating, followed closely by the other good varieties. There is still a need to continue to improve the Fusarium nivale and red thread resistance levels in perennial ryegrass varieties.

Tall Fescues

In the last four years the release of Rebel, Falcon and Olympic has resulted in tremendous interest in new turf-type tall fescues. These new lower-growing, dense and finer textured grasses are showing real improvements in disease resistance and turf performance compared to the old, common type varieties Kentucky 31, Alta and Fawn. Some other new tall fescue varieties becoming available are Adventure, Apache, Brookston, Finelawn I, Houndog, Jaguar and Mustang.

The outstanding characteristic of the new tall fescues is their deep root system that results in their ability to stay green two to three weeks longer than other cool season turfgrass species under drought conditions. Some of the new varieties such as Adventure, Jaguar, Apache and Olympic have shown improved shade tolerance. Under moderate shade conditions, the leaf texture of these new tall fescues becomes finer and yet they maintain good density. The tall fescues have also shown better tolerance to many common insect problems than most other turfgrass species.

In our wear trials and in trials conducted in Bingley, England last year, new lower growing, denser tall fescues showed superior wear tolerance when compared to Alta, Fawn and Kentucky 31. They were not as wear tolerant as the best perennial ryegrasses in our trials, but they were better than most of the Kentucky bluegrasses and all of the fine fescues.

Athletic Field Mixtures

The combination of 60-70% turf-type Kentucky bluegrass and 30-40% turf-type perennial ryegrass is an excellent athletic field mixture. The presence of bluegrass should improve sod strength and injury repair and the ryegrass will contribute excellent wear tolerance, compaction tolerance and leaf recuperative potential.

If a field will not be budgeted to provide the irrigation and fertility needed to maintain a healthy bluegrass and ryegrass mixture, the new lower growing tall fescues are a good alternative. The only species that mixes well with tall fescue is 5% Kentucky bluegrass by weight. The varieties of bluegrass chosen for this purpose should be varieties with intermediate vigor such as Adelphi, Columbia, Parade, Wabash or Majestic.

Newer Grasses

Dr. William A. Meyer
Turf-Seed, Inc., Hubbard, Oregon

In the last 12 years there has been a tremendous increase in the release and availability of improved turfgrass varieties to turfgrass managers in the United States. This has resulted from the passage of the Plant Variety Protection Act in 1971. This Act allows both private and public plant breeders to obtain the exclusive production and marketing rights on a new unique variety. Other individuals cannot produce or market a protected variety without the permission of the owner. This Act allows the individuals or institutions that have invested money in the development of new varieties to be compensated for their efforts and investments. Many new and improved varieties of Kentucky bluegrass, perennial ryegrass, tall fescue and fine fescue are now on the market as a result of increased turfgrass breeding in the U.S. and Europe.

Kentucky Bluegrass

The 1980 National Bluegrass Test included 84 varieties. Approximately 30 of these are on the market in the U.S.

Leaf spot is a serious disease of certain Kentucky bluegrass varieties under short mowing heights and high fertility and irrigation levels. Varieties such as Park, Kenblue, Delta and Geary are examples of varieties which can be seriously damaged by leaf spot under these conditions.

The varieties Adelphi, Parade, Columbia and Sydsport have shown improved resistance to Fusarium blight and stem rust.

Fine Fescues

There has been a limited amount of breeding work in the U.S. on the three main species of fine fescue: Chewings, creeping and hard fescue. Many of the presently available varieties of fine fescues have resulted from breeding progrmas in Europe. The chewings fescue varieties Koket, Barfalla, Atlanta, Highlight, Waldorf, the creeping fescue varieties Ensylva, Moncorde, and Ruby, and the hard fescues Biljart, Waldina and Scaldis are all European varieties.

The chewings fescues Banner, Jamestown and Shadow are varieties developed in the U.S. These varieties have shown somewhat better turf performance, heat tolerance, and leaf spot resistance than the European varieties. Shadow has shown better powdery mildew resistance than most other chewings fescues. All of the chewings fescues need further improvements in red thread resistance and performance under high temperatures. The chewings fescues perform well in shade situations, especially competition with tree roots.

The creeping fescue varieties generally perform better under a higher cutting height. The U.S. variety Fortress has performed somewhat better than most European varieties. The creeping fescues are widely used in mixtures with Kentucky bluegrass and are compatible in mixtures. Boreal and common Canadian creeping fescue, which have poor turf performance are widely used because of their low price.

Flyer is a new creeping red fescue variety which has shown improved turf performance when compared with other creeping fescues.

Compared to all other fine fescues the hard fescues have shown the best overall turf performance at both high and low fertility levels. They have improved leaf spot, dollar spot, and red thread resistance, improved heat tolerance and drought tolerance. Hard fescues have a slow rate of vertical growth, but are somewhat slower to establish than other fine fescues. The varieties Waldina, Scaldis and Biljart along with the U.S. varieties, Reliant, Spartan, and Aurora are all improved varieties of hard fescue. The major improvement needed is to increase their seed producing ability to make them more price competitive. The variety Aurora is the result of a breeding project to improve seed yield and yet maintain the improved turf performance of the other good hard fescues.

Conclusion

There are many new varieties of all of the cool season turfgrass species for the turfgrass managers in the U. S. to choose from. The turfgrass manager should do an appraisal of the owner's expectation, the environmental conditions and intended management levels for a turfgrass area before he selects the varieties to be used in a turfgrass blend or mixture. As seen from the previous discussion, there is a wide range of varieties and species to choose from that differ widely in their performance and management requirements.

Intensive Sand Topdressing

Walter Ferguson, Superintendent
Forest Hills Country Club, Chesterfield, Missouri

The conditions that determine the frequency and the rate of sand topdressing application to turf grasses are:

- the budget
- the species of turfgrass being topdressed
- the height that the turfgrass is being maintained
- the rate of growth of the turfgrass
- the type and size of sand
- the amount of traffic

You could topdress 80 or 240 pounds per 1,000 square feet once a week or every three weeks, depending on the need of the turfgrass as determined by these conditions.

The budget. The budget must contain enough money to cover the additional expense of the sand, the extra manpower, and repair and maintenance caused by the abrasiveness of the sand.

The species and varieties of turfgrass. The more aggressive and thatch-prone the grass is the more intensively it can be topdressed. Topdressing can take a problem grass and use its lesser characteristics to advantage.

The height at which the turfgrass is being maintained. Basically, the taller the grass the heavier the rate of sand that can be used without causing a thinning of the turf, or smothering of the grass, or abrasive wear of the grass under traffic.

If your program is designed and implemented properly you will find that you will be managing different greens each fall than the greens you started with in the spring, and each spring you find the greens different from those you had the preceding fall.

If topdressing requires such a high level of management, why would anyone even dream of implementing such a program? This is what is has accomplished for me:

Starting with a growing media of 25% pea gravel and 75% clay it has allowed me to maintain Penncross putting greens at 7/64's to 9/64's mowing height in St. Louis the year round.

It has reduced by 75% the number of days that the golf course is closed due to wet greens.

It has aided in the development of a very tough turf that is extremely dense and provides a very smooth putting surface. Putting can be manipulated to roll as fast or as slow as the membership at Forest Hills C. C. desires at any time during the growing season.

It has eliminated the need for spring, early summer, or fall coring of the greens. I have not cored the greens in the last four years. (We average 200 round per day).

It has eliminated the need for preemergence crabgrass control. I have not used a crabgrass control for the last six years.

The rate of growth controls the frequency that the minimum rate of sand can be applied. The rate of growth is controlled by several factors. Some of these factors are under our control, and others are not. These factors are:

- The fertilization program. This we can control by determining what nutrients are applied and in what ratio, how much is applied, how often it is applied.

- The season of the year. The growth rate of grasses varies in response to fertilization during the different seasons of the year. Even if temperatures and fertilization rates are approximately the same, the growth rate and habits will vary.

- Temperature. The degree of warmth and the degree of warmth variation has an influence on the growth rate of all grasses. When the temperatures reaches ninety plus degrees, or even one hundred degrees, topdressing must go on, but the rate will need to be adjusted according to the stress on the grass.

- Type of sand. This we can control by using fine vs. medium vs. coarse.

- Traffic. The number of golfers per day per week will be the final variable that will determine the frequency and the rate of sand.

From this list of variables anyone can see that this is a management tool that can be designed and implemented quickly. The program will run by itself; just fling sand around over the green every so often and everything will be great! NO! Not quite! Sand topdressing is just another management tool but it is one that requires constant and intensive management.

It has eliminated the need for vertical mowing. Even light tickling of the grass blade will bring sand to the surface.

It has developed a firm layer of growing media that will provide surface drainage without any internal drainage other than the layer of sand. This firm layer of compacted sand will remove enough of the excess water that very little footprinting or tracking occurs around the putting cups.

In short, it has saved Forest Hills C. C. and myself the long drawn-out process of rebuilding 29 putting greens, totaling over 220,000 square feet. How long has it delayed the rebuilding of these putting greens? Barring any unforeseen problems, it could possibly continue for another 20 years or longer before the program would require major modification.

Is this program for you? Only if you have the intestinal fortitude to try and the willpower to make it work under your special set of conditions.

Winter Damage - Unwanted Experience

John P. Leeper, Superintendent
Orchard Ridge Country Club, Fort Wayne, Indiana

During the winter of 1981-82, Orchard Ridge Country Club in Fort Wayne, Indiana suffered extensive turf damage caused by one of the worst winters on record. What I would like to do is to share with you my "agony of defeat and thrill of victory".

During the winter of 1981-82, the Fort Wayne area had over 82 inches of snow, 121 days that were below the freezing mark, blizzard winds that had a wind chill factor of minus 70 degrees, and, to top it off, the worst flood in 69 years!

During the first week in March when all of the 82 inches of snow and ice began to melt, flooding began in the Fort Wayne area. Lakeside Golf Course lost most of its course from sand that was washed in from a nearby river. All of their bowling alleys and pro shop inventory were lost to high water. During the flood the people of Fort Wayne banded together to help save a good portion of the city by sandbagging flood-prone areas. Their efforts were rewarded one year later when the City of Fort Wayne was selected to receive the "All American City" award.

Before the flood, and under all that snow, ice had accumulated and maybe caused this type of winter kill. Damage was quite extensive everywhere we looked. Greens and fairways received the most damage, especially those greens that had a low wet area or some poor drainage. On the fairways which consist of approximately 60 percent bent and 40 percent Poa annua, the winter damage occurred in the low wet areas and killed most of the Poa annua. Areas that were not affected were Penncross tees and collars and bluegrass roughs.

At this point in time I felt that clear and understandable communication with the greens committee and the members was vital - whether it was verbal, written, or 'show and tell' - in order to keep bad rumors from spreading around the club. I did not beat around the bush about what had happened to their golf course. I showed the greens committee photographs of the winter damage and a U. S. WEather Service local data report on winter conditions from December through

February of 1982. I used the club newsletter to inform our members about what caused this winter damage, what type of renovation program we were using, progress reports, and playing conditions. I shared my problems with other golf course superintendents, hoping that we could learn from this 'unwanted experience'. We had many lengthy discussions of our problems. Communication with Dr. Daniel proved to be a tremendous asset to all of us suffering from winter damage. He rushed up and spent the whole day going over our problems and gave us some recommendations on renovation, estimates of how long recovery would take, and suggestions for communcations to our members. Aerial photos of local golf courses with similar damage proved to be the best communication to our members. When the greens committee and our members saw these photos of other courses it let them know we weren't the only ones who suffered winter damage. Remember the old saying,"A picture tells a thousand stories."

Communication can also be done by 'show and tell'. For example, winter damaged plugs were brought in in early March and put in a warm window sill. They were shown to the greens committee from time to time so they could watch the recovery process, if any, in our case. So beef up your communications when a problem like this occurs - verbally, in writing or by show and tell. It sure did help me!

Since this type of winter kill was my first experience of this sort in my 25 years in the golf business, I decided to educate myself on winter kill. there are all types:

- desiccation, which is caused from a dry winter usually associated with high winds and with very little snow cover
- pink and gray snow mold caused by a fungus and occurring when snow and ice begins to thaw and temperatures are between 32 and 40 degrees
- direct, low temperature kill which is the one that did most of the damage at our club.

I would like to pass on to you what I have learned about low temperature kill.

What to look for after the spring thaw:
- appears water soaked
- turning whitish brown
- progressing to a dark brown
- bad odor - smells like manure
- damage more evident in low areas of greens

Some possible causes:
- rapid decrease in soil temperature
- oxygen suffocation under ice sheets
- freezing and thawing of water in the cells of the plant.

Dr. James Beard's study at Michigan State University shows that winter kill from oxygen suffocation under ice sheets occurs rarely. I have to agree. At our club, I felt most of the winter damage was from blizzrd-like winds, or a rapid decrease in soil temperature, and from freezing and thawing of water within the cells of the plants.

We informed our members through the club's newsletter about the cause of the winter damage and the details of the renovation program. This program on the greens was to start as early as possible and to treat the greens very gently because some of the plant crowns might be healthy and could produce shoot and root growth. One way to tell if the crown of the plant is healthy is to peel the dead tissue away from the crown, and slice the crown with a razor type knife and examine it under a small magnifying lens. If the crown appears white and firm looking, chances are it will produce shoot and root growth.

Also, we kept the golfers away from newly seeded areas as long as possible to ensure the best results. We either played temporary greens or put the cup on the green in an area as far away as possible from the newly seeded areas. On temporary greens we used the large plug repair tool to make the hole so the member had a better chance of making the putt. We spiked the greens by hand and seeded the damaged areas in two different directions. We did this five or six times to ensure good coverage. The first time we spiked and seeded the greens we applied a starter type of fertilizer. We lightly syringed the greens once or twice during dry days as needed. From the time we first started our renovation program, it took approximately six weeks of good growing weather, which we had, to bring our golf course back to playing condition. And by Memorial Day the greens were healthy enough to aerify in preparation for the summer months.

What you can do to prevent direct low temperature kill:

- improve surface and subsurface drainage
- fall fertilization, high in potash
- avoid late fall mowing, higher cut
- reduce thatch
- late topdressing, buffer zone
- avoid heavy late irrigation
- artificial protection, straw, conwed cover, etc.
- soil warming by electricity

What can you do during the winter when you receive an unusually large amount of snow and ice on your greens?

Winter maintenance:
- ice and snow removal after thirty days, particularly on greens with poor drainage
- trench or remove snow in low wet areas
- dark materials, topdressing or Milorganite
- pray!

Many methods of removing snow and ice have been tried. Using a tractor and plow will cause more damage to your course because of the contour of the greens. The method I like is to use a snow blower and shovels. It may take a little longer, but it causes little damage. Or you can use a sledge hammer to break the ice sheet. We tried this without really thinking and caused a lot of hammer damager to the greens which eventually had to be topdressed.

Annual Bluegrass Management

Dr. Karl Danneberger
Department of Agronomy Ohio State University, Columbus, Ohio

Annual bluegrass is a cool season grass best adapted to the northern United States and Canada. It is native to Europe and has been found on five other continents. The ability of annual bluegrass to adapt to low mowing heights makes it an excellent turgrass species for golf course greens, tees and fairways. For example, at 1/4 inch or less, annual bluegrass provides an adequate putting surface. At 1/2 inch, annual bluegrass provides an excellent fairway turf.

Maintenance of an annual bluegrass turf is a complex and difficult undertaking. Golf course managers have to fully understand the role that environmental and biological stresses play in annual bluegrass management. The key to managing annual bluegrass is the identification of the stress periods and then implementing proper management practices that will minimize the stess effects.

Environmental stresses such as temperature, are impossible to control and difficult to predict. However, preventative management practices such as coring and/or vertical mowing will help create a turf environment more conducive for summer survival. Vertical mowing should be initiated shortly after annual bluegrass begins active growth in the spring. This will help establish more juvenile plants that will be better able to survive the summer heat stress period. Vertical mowing should be done on a bi-weekly basis until the arrival of hot weather. Coring is an important practice that is best accomplished in the spring and fall. Coring provides an excellent environment for root development, as often shown by the deeper rooting in the coring holes.

Reducing the amount of thatch present in an annual bluegrass turf is a critical management practice. By reducing thatch, one can effectively eliminate a medium that is conducive to disease and insect development. Thatch management can be accomplished by coring followed by vertical mowing, both in the spring and fall.

A cultural practice that can influence the health of annual bluegrass is fertilization. Proper fertilization can minimize the effect of certain diseases and promote desirable growth. Annual bluegrass responds well to 1 lb. nitrogen in September, 1 lb. nitrogen dormantly, and 1/2 lb. June, July and August. The total nitrogen applied should be within 3-4 lbs. actual nitrogen per 1,000 sq.ft. Phosphorus and potassium should be maintained at adequate levels.

Proper irrigation practices help minimize the effect of water stress. During the summer months, usually following seedhead formation, root production declines resulting in an active root system that may be only an inch or 2 inches in depth. Maintenance of this type of situation will require light, frequent irrigation. Light irrigation as applied here is defined as bringing the top 1 or 2 inches of the soil or whatever the rooting depth may be, to field capacity. Water applied too heavily will penetrate beyond the rootzone, thus being unavailable to the plant. When periods of high evapotranspiration are occurring, syringing will be needed in addition to regular irrigation.

Pest management by golf course managers is an integral part of annual bluegrass management. The key to proper pest management is knowing which diseases and insects are serious problems. Each grass species has associated with it certain pests. For example, the pest problems of Kentucky bluegrass are different than those of annual bluegrass. A list of the major diseases or annual bluegrasses are given in Table 1. Insects such as the Black Turfgrass Ataenius and cutworms are problems on annual bluegrass. Once the pest problems are identified, proper fungicide and insecticide programs can be initiated.

Annual bluegrass can be maintained as a desirable turfgrass species, especially as a fairway turf, in most parts of the northern United States. However, annual bluegrass requires culturally intensive management. Sophisticated irrigation control, and adequate funding for purchase of pesticides is a necessity.

Table 1. Common diseases of 4 turgrass species.

Kentucky bluegrass	Creeping bentgrass	Annual bluegrass	Perennial ryegrass
Melting out	Dollar spot	Dollar spot	Brown blight
Fusarium blight	Brown patch	Brown patch	Brown patch
Stripe smut	Pythium blight	Pythium blight	Pythium blight
Yellow patch	Leaf spot	Leaf spot	Anthracnose
Nigrospora patch	Typhula blight	Anthracnose	Red thread
Fusarium patch	Fusarium patch	Fusarium patch	Rust
		Typhula blight	Typhula blight

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Bentgrass Fairways

James M. Latham, Manager, Marketing and Agronomy
Milwaukee Metropolitan Sewerage District
Milwaukee, Wisconsin

Bentgrass fairways are receiving a great deal of attention these days because the concept of clipping removal and some new chemicals seem to have a positive effect in Poa annua suppression. They definitely improve the appearance of fairways as well as provide cleaner play for early morning golfers. In our haste to get on the bandwagon, though, we should not forget the basic characteristics of bentgrasses and the things which contribute to the success and failures of their use.

The first golf turf was bentgrass with a little fine fescue included, on the Scottish linksland from which golf evolved. These sandy, salt sprayed seaside lands supported these grasses adequately to form some sort of sod. The only fertility was provided by birds, wild life and grazing sheep.

Meadowgrasses were not used until golf moved inland and the courses were laid out across pasturelands. In fact, seed selection was not needed until courses were cut through wooded areas or heathland where grasses were not the predominant vegetation. These courses were perhaps the first to be subject to intermittent play. They could be used only in the fall, winter and during droughts, because the grass grew too lushly at other times.

The use of turf grasses in North American has followed the European pattern of bents along the shore areas and the meadowgrasses used inland. The bluegrasses have a long and illustrious history in our Midwest and still predominate as THE general-purpose turfgrass. In golf, however, their demise began after WW II in spite of the thousands of acres planted during the next three decades of booming golf course development.

This decline was triggered by fairway irrigation because golfers did not like to see the natural dormancy of bluegrass during the hot,dry summer season. By keeping the fairways a lush green color during that stress period, the grass was sufficiently weakened to allow other species to intrude. As a secondary effect, the continuously wet soil was compacted by heavy "efficient" mowing machines which further weakened the root system. Perhaps the last straw was the reduction in cutting height to please the golfers who had played on bent or bermuda fairways or had seen and heard comments on their quality by The Tour golfers.

Expert golfers, the leaders in the game, prefer the dense turf, the close lies and the consistent playability afforded by irrigated bent or bermudagrass fairways. Consider that since the mid 1950's, only one U.S. Golf Association Open Tournament has been played on bluegrass and that was at an arid, high-altitude location.

A great many of today's bentgrass fairways "just developed" from older mixed seedlings as irrigation became more prevalent. Older seed mixtures usually contained colonial bents which probably included some creeping types. All the creeper needed to become dominant was overmaintenance - just like Poa annua. Bluegrasses are no match for either when the turfed area is mowed too closely, overwatered, overfertilized and inadequately drained. In Wisconsin, bentgrass is a major weed in intensively managed bluegrass lawns.

Bentgrasses have a much greater tolerance of stress than most people realize. Much of the Poa annua problem has been created by superintendents paralleling fairway maintenance to green management. In our area of Wisconsin, bentgrass makes its greatest expansion into bluegrass during hot weather. It survives freeze-outs when Poa annua dies. It tolerates low fertility and acidic soils very well. We should also remember that the shot-holding quality of greens does not apply to fairways.

The fear of heavy thatch formation scared many of us when Penncross bent came into use on fairways. Experiences at Tuckaway Country Club in Milwaukee have shown it to be an excellent fairway grass as long as it is managed properly. The Milwaukee Open Tournament has been played there several years and few, if any, complaints have been heard about 'flying'iron shots or fluffy turf.

The best approaches to good bentgrass fairways are:

1. Keep it lean and mean to withstand the environmental stresses. This includes good management of a relatively low nitrogen fertilization program.

2. Keep the nitrogen applications on the fairways, not in the roughs. The bent encroachment can be severe with today's primary rough treatment and irrigation coverage.

3. Do everything you can to promote a high population of earthworms. They are nature's own dethatchers, so be selective in your choice of pesticides.

4. Study the lightweight mowing operations. Perhaps the recent success demonstrated by the newer techniques is because these machines disrupt root systems less than heavier units. After all, Poa annua is a problem because it survives under some stresses better than other grasses. Clipping removal may not be as important as we think, especially where perennial Poa types predominate.

5. Make sure that natural rainfall or irrigation water has some place to go. Many superintendents are finding that good drainage is the key to successful irrigation programs, especially on older golf courses.

6. Please, please do not let the current trend toward high quality bent fairways get as far out of hand as the Speed Stick fiasco did to putting green mowing. Some things should go just so far.

7. Investigate all means of relief from soil compaction. As always, this is the key to good 'working' turf. Keep the roots growing in the soil, not in the thatch zone.

8. Do not try to acidify our naturally alkaline Midwestern soils with sulfur. You will only increase thatch by reducing the population of decomposition microorganisms.

New ideas and new methods are constantly improving our chances for better golf playing conditions. Just remember that bentgrass is much tougher than most people think. It is not exactly a low maintenance grass, but it does not need the babying most people inflict upon it. Give bentgrass its measure of the things that make plants grow, then shut off the water when the barrel gets full.

New Nitrogen Sources

Clay Nelson
Bensalem, Pennsylvania

The envelope of air that surrounds the earth is composed of 80% nitrogen, which translates to roughly 35,000 tons of nitrogen gas per surface acre, and 50 times more than that can be found in the soil, rocks and organic matter. All living things contain nitrogen in the form of protein and enzymes.

Because of its importance, knowing how to utilize it efficiently becomes a prime concern.

To the turfgrass manager, nitrogen is important because it is more often found to be deficient in soils than are any of the other essential nutrients. A nitrogen deficiency in the soil can be corrected through the use of fertilizer, but the fertilizer nitrogen must be able to be converted easily to the fixed forms - NH_4 and NO_3 - for the turf plant to readily absorb it.

NH_4^+ (ammonium) - is the cation form which resists movement in the soil due to an attraction to the negative exchange sites on clay and organic matter, but because it is the most available form, saturation of the exchange sites occur and the rest is lost from the soil through volatilization (25% or more of the applied N).

NO_3^- (nitrate) - is the anion form which is not attracted to the exchange sites and moves easily with the percolating water, and once below the root zone it is lost to the turf plant. This is the form in which most nitrogen is absorbed by the plant.

As can be seen then, nitrogen deficiencies in the soil can be corrected by fertilizers which best provide nitrogen in an efficient form. External factors which exert a strong influence on the fertilizer efficiency include:

- Soil type and texture, pH, moisture, temperature, organic matter content
- Thatch accumulation, microbial activity, and turfgrass species and variety

With all of the variables that affect nitrogen efficiency, it is understandable that researchers are continuously striving to develop new nitrogen sources. Before undertaking a discussion of new nitrogen sources, presently existing nitrogen sources need to be reviewed.

Basically, fertilizers can be categorized into four groups (or types) as seen below:

Fertilizer Type	Examples	Water Solubility	N Availability
Synthetic inorganics	Ammonium Nitrate Ammonium Sulfate	Soluble	Very rapid
Natural organics	Sewage Sludge Dried Blood & Bone Meal Manure	Slightly insoluble to insoluble	Very slow
Synthetic Organics	Urea Urea-Formaldehyde Reactions IBDU	Soluble to insoluble	Very rapid to very slow
Contained organics to inorganics	Sulfur Coated Urea Polymer Coated Urea Compressed Clay Coated Synthetic Inorganics	Conditionally soluble due to environmental conditions	Slow to moderately rapid

Each of these four fertilizer types has features which makes it desirable for use on turfgrass. Ideally, the turf fertilizer should be ECONOMICAL, EFFICIENT, EASY TO HANDLE and NON-PHYTOTOXIC (non-burning). Phytotoxicity is the one thing that separates the various fertilizer types most drastically. A fertilizer's tendency to burn has been established by the relative measurement of the Salt Index Value (Table I). The degree to which a fertilizer increases the salt concentration of the soil solution - the higher the salt index, the more rapidly the fertilizer releases soluble salts and the higher the "burn potential" and the less water will be available to the turf.

The urea reaction products, because of their low(er) salt indexes, offer the turf manager a degree or margin of safety in the application of nitrogen, not found with many of the other fertilizer types. The urea reaction products can provide various degrees of water solubility which will alter or control the nitrogen release rate, in addition to many other benefits (Table II). For those turf managers who prefer to use the granular products, nitroform, Scott's products and IBDU have worked well. But for the turf manager who prefers to spray a fertilizer, several problems with the liquid urea reaction products have surfaced - stability and burn potential. (It should be noted that Nitroform Powder Blue can be suspended and sprayed easily, but it should also be noted that abrasiveness to spray equipment and a very slow nitrogen release are considerations in its use.)

The burn potential is extremely low with the urea reaction product where long polymer chains have been formed - Nitroform and FLUF - but the burn potential begins to increase as the polymer chain length decreases - Nitro 26 Plus - until the burn potential is a consideration - Formolene and GP4341.

Where the granular urea reacted products have a shelf stability longer than a year, the liquid products have a potentially very short stability. Variables such as the incomplete termination of the reaction during manufacture, alteration of the pH during storage, or the elevation of temperature during storage can allow for the continuation of the reaction or the increase in polymer chain length, to the point of product solidification.

Table I. Salt Indexes For Various Nitrogen Fertilizers

Product	Analysis	Lbs. Fertilizer /Lb. Nutrient N	Salt Index	Partial Salt Index*
Ammonium Nitrate	33-0-0	3.0	105	3.2
Sodium Nitrage	16-0-0	6.3	100	6.3
Urea	46-0-0	2.2	75	1.6
Potassium Nitrate	13-0-44	7.7	74	5.7
Ammonium Sulfate	21-0-0	4.8	69	3.3
Calcium Nitrate	17-0-0	5.9	53	3.1
Diammonium Phosphate	21-53-0	4.8	34	1.6
Nitroform	38-0-0	2.6	10	0.3
IBDU	31-0-0	3.2	5	0.2
Methylene Urea	41-0-0	2.4	4	0.1
Natural Organic	6-2-0	16.7	3	0.5

*Calculated per unit of nitrogen

Table 2. Synthetic Organics

Product	Release Mechanism	Fractions	Approximate Residuality	Advantages	Disadvantages
Nitroform	MO & W	I,II,III	6 Mos.-1 Yr.	No burn Low SI Low loss	Expensive Initial Resp.
Scott's MU	MO & W	I,II,III	10-12 wks.	Low burn Low SI Low loss Initial Resp.	Expensive
FLUF	MO & W	I,II,III	12-14 wks.	No burn Low SI Initial Resp. Low loss Sprayable	Expensive
Formolene/ GP 4341	MO	I,(II)	6-10 wks.	Rel. Inexp. Sprayable Initial Resp.	Burn Potential Stability Tank Mix Comp.
Nitro 26 P	MO	I,II(III)	6-10 wks.	Sprayable Initial Resp. Low Burn Low SI	Expensive Stability

SI = salt index, Initial Resp. = Initial Response
Tank Mix Comp = Tank mix compatibility

Recently several research oriented individuals came together to form a new company, whose charter is the development of new nitrogen sources. One of the more promising product developments is a water disperable urea reacted powder, which, when added to the spray tank,exhibits the positive aspects associated with the commercially available liquid and dry urea reacted products.

- Contains Fractions I, II & III which provides a good initial release and a variable residual release dependent upon the degree and type of reaction.
- Low salt index
- Very low to no burn potential
- Long shelf stability
- Tank mix compatible

A sidestream development to the water dispersable urea reacted powder is the ability to utilize various pesticides as an integral part of the fertilizer. This will aid in the elimination of tank mixing incompatibilities and measurement mistakes, as well as exhibit the same positive aspects as previously mentioned for the fertilizer.

One of the other areas we have directed our efforts to is in the development of products utilizing nitrification inhibitors, which is felt to be the direction of the future. Products such as N-Serve, Dwell, DCD, and Thiourea have been, or are being developed in the agricultural crop area, and Lebanon Chemical Co. has successfully incorporated DCD into their turf fertilizer technology. The nitrification inhibitors used in combination with the various nitrogen fertilizer types may offer an even greater efficiency in the plant's utilization of nitrogen.

The last area of development for us is in the area of microencapsulation, where complete fertilizer blends (N-P-K & micronutrients) are found in one discreet particle. These particles are dispersed in the tank water and sprayed. The difference is that solubles, insolubles or mixtures can be chosen as the nitrogen source, providing for a spoon feeding type of nitrogen release.

The research for new nitrogen sources has only scratched the surface. Every day hundreds of new chemicals are developed for hundreds of uses other than turf fertilization, and it is now up to those of us associated with the turf industry and the universities to locate and redirect those chemicals to the benefit of turf.

Zoysia Fairways In The Midwest

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

I. History

A. Bermudagrasses were popular in the 1960's with the success of the U-3 hybrid. Most every course in the area had a bermudagrass named for that course, but the only remaining today is from Westwood C. C., and is on about three area courses.

B. Bluegrasses can provide turf, but not tight cut fairways during the summer stress periods.

C. Ryegrasses have been helpful, but cannot match the durability and low height of cut that zoysia provides.

D. USDA research of the late 1940's provided the hybrid Meyer-Z-52 zoysia. Since then very little research work has been done except Midwest zoysia by Daniel at Purdue, and zoysia work by Portz at SIU. USGA and USDA collection trip of zoysia types in Japan and Korea in 1982 offer a lot of potential.

E. Evansville Country Club has used zoysia fairways for some twenty years.

F. Most private clubs in Kansas, Missouri and southern Illinois are either total zoysia fairways or committed to that end result.

G. Slow growth and costs have held back the move to zoysia.

II. Methods of Installation

A. Plugging zoysia

1. Manual tools
2. Mechanical methods using larger equipment - contract planting being done in St. Louis area for past two seasons: 100,000 plugs/day at approximately 7 cents per plug installed; has been very popular with many clubs.
3. Most success has been with very early season planting (March through May).

B. Planting by stolons

1. Single row planters
2. Hydro-mulcher most popular on new course construction

C. Sodding approach

1. Total coverage is costly. Mostly limited to tees and small areas because current sod costs run $4.00 per sq. yrd. delivered.
2. Strip-sodding at various widths 4" to 18" has been used, with 12" spacings between rows which will require two complete growing seasons for total coverage. Problems incurred are: purchasing narrow sod strips and the cost of installation.
3. Important for success
    a. Use quality sod, free from insect and disease problems
    b. Buy only well maintained sod that has been cut to a desirable height
    c. Keep sod moist after planting
    d. Reduce other grass or weed competition

III. Zoysia Management

A. Cutting height and frequency

1. 3/4" to 1" for first and second years after planting
2. 1/2" to 3/4" afterwards. 5/8" at Bellerive has been good
3. Grain can develop from carts and mowing patterns
4. Mowing three times per week during peak growth periods

B. Watering

1. Higher requirements than bermudagrass - more like the needs of bluegrass when cut at 1/2". Zoysiagrass can turn brown from lack of moisture and be revived to color with one week of irrigation.

C. Chemical weeding

1. Preemergence. Most provide good protection during establishment period, but will not be needed after 100% coverage is achieved.
2. Postemergence. Very tolerant to many types.

D. Fertilizer requirements

1. First and second years of planting - 5 lbs. AN/1,000 sq.ft./yr.
2. Third and fourth years after planting - 2 lbs. to 3 lbs. AN/1,000 sq.ft./yr.
3. After fourth year - 1/2 lb. to 1 lb. AN/1,000 sq.ft./yr.
    a. iron supplement in fertilizer is very helpful to color
    b. slow release nitrogen form is needed
    c. potash feeding equal to nitrogen or more - research is needed to provide more information

E. Thatch, and controlling it

1. Fertilizer not to be overdone as shown above
2. Vertical mowing and sweeping - limited results and too much time and labor required
3. Aerification during prime growing season has been most successful along with dragging cores back into turf as topdressing. July has been the best for St. Louis
    a. too early will result in crabgrass infestation
    b. too late and Poa annua will appear as if seeded
    c. aerification at this period will solve localized dry spots associated with watering problems
    d. encourage earthworms as they are very beneficial in the biological decomposition of thatch

F. Insects

1. Chinch bug - only found as a home lawn problem with poor management
2. Billbug - has not been a problem
3. Whitegrub - where a problem the use of Oftanol has given control and not damaged earthworm populations
4. Nematodes - have not been proven to be a problem

G. Diseases

1. Yellow patch or cool season brown patch? This is a new problem that sometimes causes damage
2. Springtime leafspot related disease appearing as yellow areas that are slow to green up and sparse
3. Frost occuring in late spring can cause weak turf

H. Playing Surface

More months of green grass as compared to bermudas (7 months vs. 6 months) and winter playing surface superior to bermuda because the leaf structure does not break down.

I. Winter kill problems cause by:

1. excessive wear such as par 3 tees, golf carts traffic and athletic play on dormant turf
2. poor drainage areas show up after severe cold winters

IV. Decision is yours. As a golf playing surface in the St. Louis area, there is no better. The advantages outweigh the disadvantages. If you decide to undertake a zoysia program you must manage for that grass alone. Many courses have made the change and are glad they did. This is my solution for better fairway turf. The members are happy with zoysiagrass at Bellerive Country Club.

The Bulk Pesticide Concept

Gary M. Clayton, Operations Manager, Bulkkem Corp.

Presented by:
Steve Derrick, Professional Turf Specialties
Normal, Illinois

Lawn care has inherently grown to be a highly visible industry. It has manifested this image through intense marketing, which includes equipment passing through residential areas, constantly in the public eye. Even though the portion of pesticides applied by lawn care companies is a small fraction of the sum total of all pesticides used, the lawn care industry remains the most apparent and has the greatest impact on public opinion. The lawn care industry has an obligation to educate itself to the specific pesticides applied on turf so that any potential negative attitudes may be answered. In the same respect, there becomes a second obligation to develop innovative means to operate within the safety parameters of handling, storing, and disposing of pesticides and its by-products. With the tremendous growth lawn care companies have enjoyed during the past several years, these parameters have become a great concern to the industry at large.

One method that has been employed to satisfy these operational concerns is the bulk system. The scope of this article is to introduce and present information relative to the current trend for bulk handling of pesticides in the lawn care industry.

A bulk system consists of a pesticide station comprised of one storage unit per product and a dispensing method. The system is economical, eases daily operation, and offers many other benefits. When compared to smaller containers, the greatest benefits derived from the bulk system are cost, time, and safety. The highlighted cost and time savings includes the elimination of triple rinsing, the expense of properly disposing of drums, the facilitation of inventory control, and the reduction of warehouse space. The safety factor is of direct concern. With the bulk system, there are not containers to (1) lift and handle, (2) upset and spill, and (3) pour from, thus reducing exposure.

The United States Environmental Protection Agency issued a policy applicable to the Bulk Concept since, "It has come to our (EPA) attention that an increasing practice among manufacturer and distributors of pesticides involve the transport and transfer of pesticides in large quantities, i.e. 'bulk'. For the purpose of the policy the EPA has termed 'bulk' as any volume of pesticide greater than 55 gallons liquid or 100 pounds dry material held in an individual container".

This policy, issued in 1977, cites the EPA reasons for preference to handle pesticides in bulk rather than in small individual containers. The reasons are basically the same as the aforementioned reasons, but the policy goes on to state, "In the interest of energy and resource conservation and of improved safety measures in pesticide handling, it is incumbent upon the agency to encourage and endorse these purposes insofar as they are consistent with the broad purposes of FIFRA (The Federal Insecticide, Fungicide and Rodenticides Act.)"

An enforcement policy is defined in regards to bulk shipment and transfer practices. It is the philosophy of Bulkkem, and should be that of the end user, to institute these practices in accordance with regulations. Among the pertinent is included FIFRA Section 3 (A) U.S.C. 136A (A) . It states that no person may distribute, sell, offer for sale, or hold for sale, to any person, any pesticide which is not registered with the Administrator. The purpose of the registration is to provide a vehicle for review, tracing, identifying, and assuring that a labeled product is accountable.

The lawn care company, as an end user, requires no special registration (i.e. establishment of product registration) for the storage and use of bulk pesticides. Yet, regulations that are applicable to the general usage of pesticides should be enacted. If a bulk purchaser, however, transfers the product he purchased in bulk into smaller containers for resale, the registrant could not be held accountable for the product, nor would the transferred product be considered registered. The lawn care company could be subject to enforcement under Sections 12 (A) (1) (A) and 12 (A) (1) (E) for selling and distributing unregistered and mislabeled pesticides.

A lawn care company should exercise caution if the movement of pesticide is required for either relocation or to supplement the needs of another branch. The Department of Transportation requires placard identification markings depending on the product and quantity which is transported.

Planning A Pesticide Storage Area

The strategy around planning a pesticide storage area should emphasize both safety and day to day operations. Recommendations and regulations generally focus on the proper storage of pesticides, regardless of whether the pesticide is in a small container or a bulk tank. Whether a single bulk tank or a complex pesticide station is employed, many considerations should enter into the planning of a bulk facility. Some such considerations to take into account are accessibility, growth, proper selection of bulk system materials, and precautions. Bulk tank placement and set-up require a conceived plan since its design is for easement of daily operations. Plumbing should be selected to serve the particular need required. A metering system should match the quality of work it will have to perform. Many lawn care companies utilize a meter system with a totalizer to allow a quick reading of materials used.

The storage area should have the essential equipment that is near any chemical storage. This equipment includes protective handling gear, eye wash, a sink or shower, first aid kit, and assortive material. An emergency procedure with phone numbers should be posted. The National Fire Protection Agency publication 43D publishes a code for storage of pesticides in portable containers which is an excellent reference for guidelines. These guidelines include building location, separation of pesticides, posted signs, storage arrangement, and other storage area requirements.

Spills from leaks are unlikely, yet should a spill occur, dikes prevent a loss and a potential pesticide issue. Walls should be high enough to contain the volume stored in the tanks. Spray tanks from which the material is applied to lawns may also serve as another source of containmment if needed. Even though dikes are generally not required by law, a local ordinance could force diking around storage areas whether it is a large liquid fertilizer tank or small containers of pesticides. Pesticides of particular note are Xylene based compounds which are classified as combustible liquids (i.e. Bensulide). The National Fire Protection Agency publication NFPA30 -- Flammable and Combustible Liquids Code, provides these as a Class II liquid. This code defines the standards of storing these liquids with, for example, storage arrangement for protected palletized or solid pile storage of liquids in containers and portable tanks, preventative fire requirements and so forth. Lawn care companies storing these liquids should refer to this code. This code does address the control of spillage of Class II liquids on preventing accidental discharge from endangering important facilities, adjoining property, or reaching waterways by remote impounding or by diking.

Most of the regulations regarding storage of pesticides are well designed and well serve their intended purpose of promoting safety to humans and the environment. The regulations subject to interpretation, or those being generated on a local level will, to a certain degree, reflect the industry's future. The Bulk Concept offers you an alternative to the way you store, handle, and dispose of pesticides and their by-products.

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The Tall Fescues

Dr. William A. Meyer
Turf-Seed, Inc., Hubbard, Oregon

The new generation of tall fescues released in the past few years is useful for home lawns, athletic fields, parks and golf course roughs. The presently available varieties can not be maintained for long peridos of time at the short cutting heights required on golf course fairways or tees.

Kentucky 31 and Alta tall fescue were developed as pasture grasses, but have been used for turf, especially in the transition zone since the 1940's. Their usage has been primarily for turf at 2-3" cutting heights. Rebel, Falcon and Olympic were the first of a new generation of tall fescues that have a lower growth habit, fine leaves, greater density and the ability to persist at cutting heights of 1" or more. Some other varieties released more recently are Jaguar, Mustang , Adventure, Houndog, Brookston, Finelawn I and Apache.

Growth Habit. The presently available tall fescues are bunch type grasses with no extensive rhizome system like Kentucky bluegrass. As a result, severe disruption of turf by athletic play must be repaired by overseeding worn areas. With Kentucky bluegrass new tillers can develop in scarred areas from underground rhizomes. The application of seed is needed to maintain dense turf in high wear areas and prevent the invasion of turf by undesirable weedy species. Seed should be spread every two or three weeks when the field is being used intensively.

Establishment Characteristics. Tall fescues have a good germination and establishment rate (tillering ability) compared to Kentucky bluegrass, but are slower than perennial ryegrasses. Beard at Texas A&M University has found that tall fescues have a ten degree F. higher base temperature requirement for germination than perennial ryegrasses. Our experience in establishing the new tall fescues in seed production fields during the late summer and fall has confirmed the need for a higher soil temperature for good establishment. The new tall fescues also tiller from the new seedlings more slowly than perennial ryegrass. Because of this, tall fescues should be seeded at rates thirty percent higher than those normally used on perennial ryegrasses.

Wear Tolerance. In our wear trials and in trials conducted in Bingley, England last year, the new lower growing, denser tall fescues showed far superior wear tolerance when compared to Alta, Fawn and Kentucky 31. They were not as wear tolerant as the best perennial ryegrasses in our trials, but they were better than most of the Kentucky bluegrasses and all of the fine fescues.

Disease Resistance. The new tall fescues have generally had better leaf spot resistance than Kentucky 31, Alta or Fawn. The varieties Falcon, Jaguar, Olympic, Apache, Adventure and Mustang also have shown improved crown rust resistance. Rebel and the above varieties have shown moderately good brown patch resistance. The use of 5% Kentucky bluegrass with these tall fescues can also help to reduce brown patch.

Cold Injury Tolerance. Both tall fescues and perennial ryegrasses have been found to suffer from cold injury especially in poorly drained soils where ice sheeting is prevelent. Our trials on the high desert of Eastern Oregon have shown that the new tall fescues have better cold tolerance than any of the perennial ryegrasses.

Short Mowing Tolerance. Tall fescues do not perform well in competition with Poa annua at cutting heights below 1". A cutting height of 1-1/2-2-1/2" is desireable for good lower maintenance tall fescue turf.

Fertility and Irrigation. Tall fescues have a real advantage over perennial ryegrasses by requiring less fertility and irrigation. Our observation would indicate that the improved perennial ryegrasses require approximately 30-40% more nitrogen fertility than tall fescues to maintain good density and growth. Under drought conditions the deeper rooted tall fescues have been found to continue to grow two weeks longer than perennial ryegrasses and four weeks longer than Kentucky bluegrass.

Summary. These new tall fescues have created much interest in the turfgrass industry. Many breeding programs are presently in progress to continue the improvements of this species. Varieties with even fine leaf texture, dwarfer growth habits and extensive rhizomes should someday be available.

Editor's Note: In fall of 1983 at Purdue we planted replicated plots as part of the National Tall Fescue Test.

Johnstone	TF 813	NK 81425
Rebel	Olympic	NK 82508
Clemfine	Jaguar	Tempo
Williamette	5GL	Barcel
Mer Fa 83-1	Apache	Festorina
ISI. CJ	5L4	Unknown
Houndog	Finelawn I	Rebel 33%,Galway 33%,Falcon 33%
Brookston	Kenhy	Rebel 60%,Manhattan II 40%
Falcon	Syn-Ga-1	Rebel 60%, Manhattan II 30%, Wabash 10%
Maverick	KS-78-4	Falcon 90%, Wabash 10%
Mustang	Arid	Wabash 100%
Adventure	Ky-31	Galway 100%

What Is New In Turfgrass Pathology?

Henry Thomas Wilkinson, Asst. Professor of Plant Pathology
University of Illinois, Urbana, Illinois

There have been a number of new and exciting development in turggrass pathology that directly affect the turf industry in the north central United States.

A potentially significant finding concerning the etiology of Fusarium blight syndrome has been reported by Dr. R. W. Smiley of Cornell University. Dr. Smiley has reported the identification of two fungi (Leptosphaeria korrae and Phialophera praminicola) that he suggests produce the same symptoms as Fusarium blight syndrome. Recall that Dr. Smiley differentiates Fusarium blight, a disease of crown and root tissue caused by Fusarium fungi,from Fusarium blight syndrome, a disease primarily of Poa pratensis, the causal agent of which is not definitively known. The two fungi that have been identified are pathogens of P. pratensis and will produce disease symptoms in turf that resemble the symptoms of Fusarium blight syndrome. The work by Smiley is preliminary in that considerable research is still required to understand if the identified organisms act alone or in consort with other microorganisms such as Fusarium fungi that also inhabit the turfgrass ecosystem. The difficulty in identifying the causal fungi, the complexity of environmental factors surrounding the development of this disease, and the insensitivity of the pathogens to cultural treatments should temper any optimism that a control of Fusarium blight syndrome will be available in the near future. Dr. Smiley has indicated that in preliminary research chemical activity against the identified pathogens has been observed. The identification of fungi that appear to play a role in the development of Fusarium blight syndrome does afford researchers a distinct advantage in developing a control for this disease that researchers during the previous thirty years did not have.

Yellow ring disease has been observed in the midwest area during the past few years. I briefly reported on it at this conference in 1983. This disease of P. pratensis is caused by the fungus Trechispora alnicola. This is the second species of Trechispora that has been reported to attack turfgrass. The other species of Trechispora that attacks only Agrostis palustris is T. confinis. Trechispora alnicola (yellow ring) has been observed in Indiana, Illinois, Iowa, Wisconsin, Pennsylvania and in New Jersey. It is primarily observed on bluegrass that has considerable thatch (greater than 2 cm), and sufficient water and nutrients to remain green and lush during the entire growing season. No yellow ring has been observed on turfgrass younger than two years. Trechispora alnicola is primaily a saprophyte, capable of breaking down thatch and therefore has both a useful ecological niche and a deletreious esthetic effect. Research is being conducted to determine why a saprophytic fungus will, under certain conditions, parasitize P. pratensis roots. In addition, preliminary research at the University of Illinois has demonstrated a reduction in both pathogen activity and the development of the yellow ring symptoms in turf when treated with the chemical pentochloronitrobenzene.

A disease of zoysiagrass that I will temporarily call Zoysia patch has been observed in the Mississippi Valley area bordered by Illinois and Missouri. This important disease is being researched in my program at the University of Illinois. The name Zoysia patch is a temporary name chosen for convenience in communicating about the disease, however, should the disease turn out to be a disease already reported on zoysiagrass, the early name will be permanently adopted. Zoysia patch is characterized by large, 4-5 meter diameter patches of dead grass that usually appear in the spring as the zoysiagrass starts breaking dormancy and later in the fall as cooler temperatures start to slow down the growth of zoysiagrass. The cause of the disease is unknown and resembles no other disease on zoysiagrass or other southern grass species. Zoysia patch has been observed on sod farms and on golf course fairways. Current research efforts are attempting to identify the cause of the disease and develop an effective control program.

Finally, two potentially major problems for turf this spring will be winter dessication and damage due to snow mold causing fungi. The high winds and cool dry air caused considerable turfgrass to be desiccated this winter. It is likely that considerable turfgrass will recover from the foliar desiccation. The only good aspect of desiccated turfgrass is that it did not contract snow mold. Considerable snow covered or moistened turfgrass showed severe symptoms of snow mold damage during the warm period of February. This damage can be expected to increase if more snow covers the turfgrass or we experience a cool, wet spring. Treatment for snow mold is best done in the fall, but should the opportunity to apply preventative chemicals present itself during the winter, additional protection can be gained.

Diseases of Zoysiagrass

Henry Thomas Wilkinson, Asst. Professor of Plant Pathology
University of Illinois, Urbana, Illinois

Zoysiagrass is an introduced turfgrass that is distinctly different from species of Poa, Festuca, Lolium, and Agrostis, all of which are more closely related to one another than to Zoysia. Indigenous to Asia, zoysiagrass was introduced into the United States about the turn of the century. The 85 years zoysiagrass has been cultivated in the United States represents a very short time period for adaptation. The cultivation of a plant species in a new foreign environment predisposes it to a myriad of problems and its cultivation can threaten natural vegetation. Compounding the difficulty of zoysiagrass in the U.S.A. is the effort by man to extend its cultivation in areas of the U.S.A that have relatively harsh environments for zoysiagrass. Zoysia species from Asia are well adapted to warm climates and a wide range of soils. During the 1950's considerable breeding research in the U.S.A. resulted in the selection of several cultivars of Zoysia species of heritage that are suited for cultivation in the southeast and Mid-Atlantic states. These cultivars were not selected for use in the northeast or north central states,yet during the past decade they have been transplanted into these temperate areas.

The upshot of this rapid dissemination and short cultivation period of Zoysia species in the United States is a deficiency in our knowledge of the pathogens that attack zoysiagrass and how to manage them. For the remainder of this text, I will emphasize reported pathogens and potential pathogens of zoysiagrass in the north central states. Time will not permit a lengthy discussion of the effects cultivation and climate have on predisposing zoysiagrass to pathogen attack, but be advised that these factors will undoubtedly play a major role in predisposing zoysiagrass to disease.

Zoysiagrass species appear to have an unusually high level of natural resistance to pathogen attack based on the small number of virulant pathogens reported to attack zoysiagrass in Asia, Australia, and the United States. An explanation in part could be that zoysiagrass is very tolerant to drought, low fertility, shade, cold, and salinity - the very same stresses that predispose Poa and Agrostis species to attack by numerous pathogens. In addition, the Zoysia plants produce an extensive system of roots, rhizomes, and stolons, all of which act as survival structures and appear resistant to attack by microorganisms. In the north central states, the growing season for Zoysia is markedly shortened compared to that in the southeastern states, thereby reducing the production of tissue upon which the plant depends for survival. This could increase the number of organisms capable of attacking zoysiagrass.

There are four major groups of pathogens that have been reported to attack zoysiagrass: fungi, nematodes, viruses, and mycoplasma. There are twenty diseases caused by more than 25 fungi, (Table 1), seven pathogenic nematodes (Table 2), one pathogenic mycoplasma and two viral pathogens (Table 3). Of the 37 pathogens reported to attack zoysiagrass, only 12 have been observed in the United States and only four of those have been observed in the Midwest. There are no reports of mycoplasma or viruses attacking zoysiagrass in the United States. The scarcity of reports describing diseases of zoysiagrass in the United States, particularly in the Midwest, probably results from a short history of cultivation, the small area of cultivated zoysiagrass, and the scarcity of research in zoysiagrass pathology. It is ill-advised to believe zoysiagrass will have only a few disease problems in the Midwest.

In the United States today there are five severe diseases of zoysiagrass and two, rust and Zoysia patch,are known to occur in the Midwest. (Table 4). There is very little information or research concerning rust diseases in the Midwest although they have been reported. Based on information describing rust diseases of turfgrasses in the Midwest, Zoysia that was growing slowly under stressful conditions would be most susceptible to the rust disease. The severity and frequency of Zoysia rust disease in the Midwest is unknown. It is also uncertain whether the rust fungi would successfully overwinter in the Midwest or originate from the southern states and be disseminated by wind. More research is needed to determine the severity and distribution of Zoysia rust in the Midwest.

Zoysia patch is a "new" disease which was first observed ten years ago in the Mississippi Valley area bordered by Illinois and Missouri. The name Zoysia patch is only a temporary name and may be changed after continuing research identifies the causal agent. Zoysia patch is a perennial, killing disease that develops in the spring and occasionally in the fall. Patches of blighted grass can be as large a 5 meters in diameter and grow radially each season at a rate of 1/2 meter. Presently, research is attempting to identify both the causal agent and a control procedure for Zoysia patch.

The remaining three severe diseases in the United States, dollar spot, nematode damage, and fairy rings have caused severe problems in the southeast United States, but no such reports exist for the north central states.

In Table 5 I have listed four diseases that potentially could become severely damaging to zoysiagrass in the Midwest. Spring dead spot occurs in cool spring weather and the organisms, if present in the Midwest, could be favored by the cool springs and falls common to the Midwest. Rhizoctonia solani causes a severe disease in Asia, large brown patch, and has been reported in the southeastern United States. This same pathogen is present in the Midwest and causes brown patch on A. palustris (bentgrasses). That the pathogen is indigenous to the Midwest and pathogenic to zoysiagrass would suggest that it could be a potentially severe problem if climatic conditions are appropriate for disease development. The fungi causing "Helminthosporium" leaf blight and Fusarium blight are pathogenic to zoysiagrass cultivars and they are common inhabitants in the Midwest. They too represent potential disease problems for zoysiagrass in the Midwest.

In summary, our knowledge concerning the disease of zoysiagrass is very limited as is our knowledge of where Zoysia will grow successfully in the United States. As the interest in and practice of Zoysia cultivation increases, pathological research will slowly follow.

TABLE 1

FUNGAL PATHOGENS OF ZOYSIA

	DISEASE	PATHOGEN	GEOGRAPHIC AREA
1.	Copper spot	Gleocercospera sp.	Asia
2.	Dollar spot	Lanzia sp.	S.E. USA
		Mollerodiscus sp.	S.E. USA
3.	Phyllosticta leaf blight	Phyllosticta sp.	Asia
4.	Red thread	Laetisaria fuciformis	S.E. USA
5.	Pink patch	Limonomyces roseipellis	S.E. USA
6.	Rust	Puccinia zoysia	Asia, S.E. USA C. USA
7.	Snow mold	Typhula sp.	Asia
8.	Pink snow mold	Gerlachia sp.	Asia, S.W. USA
		Micronectoriella navils	
9.	Rhizoctonia large patch	Rhizoctonia solani	Asia, S.E. USA
10.	?	Rhizoctonia cerealis	S.E. USA
11.	Southern blight	Sclerotinia sp.	Asia
		Corticium sp.	Asia
12.	Spring dead spot	?	Asia
13.	Leaf blights	Biopolaris sp.	Asia
		Exserohilum sp.	Asia
		Drechslera sp.	Asia
14.	Curvularia blight	Pseudocochliobolus geniculatus	S.E. USA
15.	Pythium blight	Pythium sp.	Asia
16.	Fairy rings	Lycoperdon perlatum	Asia, S.E. USA
		Lepista sordida	C. USA
17.	Ergot	Claviceps yanagawaensis	Asia
18.	Fusarium rot	Fusarium sp.	Asia
19.	Fusarium blight syndrome	?	C. USA
20.	Slime mold	Mucilago sponiosa	Asia
		Physarum cinereum	Asia

TABLE 2

NEMATODE PATHOGENS OF ZOYSIA

DISEASE	PATHOGEN	GEOGRAPHIC AREA
1. Stem nematode	Ditylenchus dipsaci	Asia
2. Root lesion nematode	Pratylenchus zeae	Asia
3. Root knot nematode	Meloidogyne incognita	Asia
4. ?	Helicotylenchus dihystera	Asia
5. ?	Helicotylenchus platyurus	Asia
6. ?	Hemicriconemoides sp.	Asia
7. ?	Paratrichodorus mirzoi	Asia

TABLE 3

VIRUS AND MYCOPLASM PATHOGENS OF ZOYSIA

DISEASE	PATHOGEN	GEOGRAPHIC AREA
1. Zoysia dwarf virus	ZDV	Asia
2. Zoysia mosaic virus	ZMV	Asia
3. Yellow	Mycoplasma	Asia

TABLE 4

SEVERE DISEASES OF ZOYSIA IN THE UNITED STATES

DISEASE	PATHOGEN	UNITED STATES	
		CENTRAL	OTHER
1. Rust	Puccinia zoysiae	Yes	Yes
2. Dollar spot	Lanzia sp.	?	Yes
	Mollerodiscus sp		
3. Nematodes	Nematodes	No	Yes
4. Fairy rings	Complex of fungi	No	Yes
5. Zoysia Patch	Unknown	Yes	?

TABLE 5

POTENTIALLY SEVERE PATHOGENS OF ZOYSIA FOUND IN THE UNITED STATES

DISEASE	PATHOGEN	UNITED STATES	
		CENTRAL	OTHER
1. Spring dead spot	Complex	?	?
2. Rhizoctonia large spot	Rhizoctonia solani	Yes	Yes
3. Leaf blights	Drechslera sp.	?	Yes
	Bipolaris sp.	?	Yes
	Exserohilum sp.	?	Yes
4. Fusarium blight	Fusarium sp.	?	Yes

Providing Materials For Athletic Field Improvements

Frank D. Smith
Frank D. Smith & Associates, Palatine, Illinois

Those of us who were here for the Turf Conference about fifteen years ago were told by Dr. Daniel that many of the products in use at that time would become obsolete or unavailable within the following ten years. He stressed the importance of keeping informed of new products and ideas so that we would not fall behind or become somewhat obsolete ourselves within that time.

Since then, we have seen many radical changes and improvements in turf equipment, chemicals, fertilizers and turfgrass varieties. With regard to grasses for athletic fields, very few people today continue to use annual ryegrass, common perennial ryegrass or Merion bluegrass. We depended heavily on them fifteen years ago, but they can't compete against grasses available for athletic fields today, and yet we can be sure that many of our present favorites will lose out competing with new varieties in the future.

Good turfgrass management requires that we know and practice the basics but we should also recognize that our maintenance programs are not carved in granite. They can and should be changed whenever we can be certain of ways to improve them.

The first question that most customers have for a supplier is usually, "What's new today?" Suppliers know the importance of having good answers to that question. That is why you see so many of them at Purdue today and at other conferences throughout the year. However, in discussing ideas and products with a customer who has not had many years of experience, a salesman may forget that what was new years ago would still be new to someone hearing of it for the first time.

Many baseball diamonds throughout the country have been greatly improved by an idea and a material that was used in building an experimental golf green here at Purdue in 1959. We were here for the fall Field Day and Dr. Daniel told us, as we stood around the green, that it had been built with a soil mixture that contained a material new at that time, "Turface", a calcined montmorillonite clay. To demonstrate the ability of the soil mixture to absorb water, Ray Freeborg used a hose attached to a nearby fire hydrant to flood the green unitl it was covered by a sheet of water. When finally Dr. Daniel asked Mr. Freeborg to stop watering, we were all surprised to see the remaining surface water disappear into the green within a few seconds.

When we were asked to walk onto the green we found that the flooding had not affected the firmness of the soil mixture and that the green was in excellent playing condition. Dr. Daniel told us that he had saturated a sample of Turface and then had subjected it to a series of twenty or more freeze-thaw cycles. At the end of that test there was no evidence of changes in the size or shape of the remaining particles and, therefore, we could expect this material to remain effective for a very long period of time. After twenty-five years the Turface is still performing as well as it did in 1959.

Gene Bossard, Field Superintendent at Whitesox Park, decided to try Turface on the skinned area of his infield early in 1960. With his recommendation and, since retirement, his son Roger's encouragement, many have found that it is not difficult to build or renovate a diamond with Turface and, thereafter, have far fewer rain-outs of scheduled games.

Calcined clay absorbants are used in many agricultural products as a carrier for a variety of pesticides. However,they do not require the same ability to resist the weathering effects of our winters and, if they are offered as a substitute, remember the freeze-thaw test. A sample of a few ounces in a plastic bag, with enough water to wet it thoroughly, can be placed in the freezer compartment of a refrigerator, removed when it has frozen and, after thawing, freezing again and repeating this through at least twenty cycles. Following this test, if you find that the particles can easily be crushed between your fingers, you will know that the material is not suitable for your requirements.

One of the newer developments that has not received much publicity is a 12-volt motor driven rotary spray nozzle that can increase the area covered by a boom sprayer from an average of 2-1/2 acres to 18 acres per 100 gallons of broadleaf weed tank mixtures. This results from "controlled droplet application" and there is no misting to cause problems with drift. The discharge rate is only 5-1/2 to 6 gallons per acre, compared to the usual 40 gallons per acre, or seven times more acres sprayed per tank filling. Moreover, the application rate for the herbicide can be reduced 10% because less material is lost due to the elimination of drift.

Long Term Arsenic Use

James R. Brandt, CGCS
Danville Country Club, Danville, Illinois

My first experience in working with the arsenicals was for the control of crabgrass in unwatered bluegrass fairways. When I came to the Danville Country Club in 1953, I inherited greens and fairways that were free of Poa annua. Each year that we had adequate moisture crabgrass was the major problem on the fairways.

After reviewing all available data and having been exposed to the early work of Dr. Bill Daniel, it was decided to initiate some trial plots on our fairways using tri-calcium arsenate as the material to control crabgrass. These plots were treated in March 1958 with 10 pounds per 1,000 square feet. 1958 proved to be a banner year for the production of crabgrass.

The test plots were absolutely free of crabgrass. When the crabgrass had reached its most obnoxious state, small signs were placed on each plot giving the source and cost of material. The membership then demanded that we initiate the program. Our fairways then received the following treatments:

March 1959 450 lbs. of tri-calcium arsenate per acre

March 1961 85 lbs. of tri-calcium arsenate per acre

March 1964 100 lbs. of Chi-Cal granular 48% material per acre

Per recommendations of Dr. Daniel, we went into a fairway fertilizaiton program using approximately 3 lbs. of nitrogen and 2 lbs. of potash per 1,000 square feet per year. This program gave us fairways that were free of Poa annua and crabgrass for 15 years.

In 1984 we started to experience the loss of bluegrass in our fairways due to Fusarium roseum. Each succeeding year the loss became greater, the replacement grass was Poa annua. In the 1970's the manufacture of arsenicals was banned by OSHA. We tried all existing materials to try to halt the invasion of Poa annua but met with little or no success. In 1979 and 1980 we went into an extensive renovation program using Roundup to kill out all fairway vegetation. We reseeded to a mixture of superior bluegrasses, but to this date Poa annua is still our major problem in our attempts to produce superior fairways.

In 1980 Dr. Bill Daniel approached me to inquire if we had an interest in trying a new formulation of tri-calcium arsenate that might be made available through the work of Mr. John Alden of the Woolfolk Chemical Works. This was of great interest to me as we had been continuing the use of arsenate of lead on our putting greens to enable us to maintain greens that were absolutely Poa annua free.

As a result of Purdue's trial plots on our 9th fairway, it was decided to cooperate by treating one-half of three fairways in the fall of 1981. The material was applied at the rate of 3.36 quarts of the Turf-Cal per 1,000 sq. ft. These same plots received 1.3 quarts per 100 sq.ft. in November of 1982, and 1 quart in May of 1983. As a result of the arsenic treatments, we now have over 95 percent cover of bluegrass in treated areas while non-treated areas remain at 40 to 50 percent improved blugrass.

We expanded the tests to include one-half of our 5th and 10th fairways. These fairways received 3.9 quarts per 1,000 sq.ft. in November of 1982 and 1 quart again in May of 1983. We have noticed a dramatic increase in the amount of bluegrass in the treated plots. The remaining one-half of the fairways received Balan in August of 1981 and Betasan in 1982 for control of germinating Poa annua. They also received a treatment of Betasan in April of 1983.

Our plans call for the continued use of Turf-Cal on all fairways. As an added bonus, grubs and crabgrass cease to be a problem on turf that has adequate arsenic residuals. Overseeding into existing turf may be accomplished at any time. With the reduction of Poa annua. we can foresee a great reduction in the cost of fairway fungicide treatments. We believe this type program to be cost effective.

Our Poa annua control, on the putting greens, using arsenate of lead has been as follows:

1962 3.5 pounds arsenate of lead during season - cutworm control

1962 10 lbs/m in November - Poa annua control

1963 2.0 lbs/m during season - cutworm control

1963 10 lbs/m October - Poa annua control

Since 1963, we have used from 1 to 2 pounds per 1,000 sq.ft. during the summer for cutworm control. These rates have been entirely effective in controlling Poa annua in our putting greens. We do have sufficient arsenate of lead to continue the practice of using from one to three pounds per 1,000 sq.ft. on our putting greens for the next several years.

While there are newer materials on the market that are quite satisfactory in the control of crabgrass, it has been my experience that there is no material on today's market that can compare favorably with the arsenic compounds for the control of Poa annua. I would encourage you to experiment comparing Turf-Cal to other materials available for Poa annua control - then select your winner!

Turf-Cal Product Development

Dr. Jim Fickle, Research Agronomist
Mallinckrodt, Inc., St. Louis, Missouri

Tri-calcium arsenate (TCA) was widely used for control of Poa annua, other annual grasses, and as an insecticide prior to 1977. Revised OSHA regulations in the middle 70's were not attainable by the then current manufacturers, and TCA became unavailable. Turf-Cal is now back in the market because of our ability to meet OSHA standards via the new flowable fomulation and the efforts of turf researchers. Turf-Cal's introduction represents a unique situation in that strong demand for the product preceded its development.

The use of TCA is predicated on a programmed approach for gradual replacement of Poa annua by desirable overseeded turfgrass. Although TCA has some post-emergent foliar activity, its soil and preemergent activity is more important and is maximized by timely application. TCA is selective for the warm and cool season turfgrasses presented, although not equally so between all species. TCA's selectivity is partly positional due to predominantly shallow rooting of annual weeds but is also largely a function of differential uptake. The modes of action within the plant include uncoupling oxidative phosphorylation, effects on enzyme activation and alternation of membrane integrity.

Data presented from previous investigations have shown TCA to be the most effective chemical control available for Poa annua. Safety to desirable turfgrasses has also been demonstrated when the conditions required for TCA use have been met. The next speaker will address in detail a ten-point program to ensure effective use of Turf-Cal.

Calcium Arsenate Application, 1982

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

During the summer of 1982 our course was selected by Dr. Bill Daniel to participate in evaluation of the newly formulated flowable calcium arsenate. This product was produced by the Woolfolk Chemical Works, Inc. of Ft. Valley, Georgia. To my knowledge this was the first time since 1977 that calcium arsenate was available for use in the control of Poa annua and other weed plants.

In 1960 I was involved with tri calcium arsenate for the same purpose on the course where I was formerly employed. I recall vivid memories of the results, some of which were not anticipated. At that time I was working with heavy clay soil. The leaching factor of that material was slight and the effects lingered many years after the initial application. We had obtained, however, the results we were looking for, which was the elimination of crabgrass in bluegrass fairways. It also controlled Poa annua, which was an added feature. I can also remember the low, poorly drained areas which were totally killed out when water was allowed to stand there. Time passed and the fairways eventually filled in with a decent stand of Kentucky bluegrass.

With these memories in mind, and knowing that Morris Park C. C. where I am now employed has well drained sandy soil, I was eager to try the new material and see if the results would be acceptable. In the fall of 1981 the fairways at Morris Park C. C. had been recontoured and treated with Roundup. New Penncross bentgrass had been planted on these fairways, and by the summer of 1982 a good stand of Penncross and Poa annua had reestablished itself on our fairways. This provided an excellent opportunity to determine if the calcium arsenate would be effective in eliminating the Poa annua from the new bentgrass fairways. I would estimate that by midsummer we had an approximate cover of 50% Penncross and 50% Poa annua. The turf cover was light enough that thatch was not a concern. The fairways were filling in to a good playable turf cover of the two grasses. The Penncross was evenly dispersed over the entire area, leaving it the opportunity to fill in any void areas we were to create. Up to this time our plan was to stress the Poa annua through controlled watering and low fertility rates.

We received 200 gallons of Turf-Cal flowable on September 28. We were able to start the application of the material on Tuesday, October 12. It was decided that our test application would first be applied to one-half of our #3 fairway. It is an open area, fairly flat, and we had recently installed open trench pea rock drainage in this fairway. We felt that the problem of drainage would not be a concern here. In addition, it had a good sunny exposure. For our first application, Dr. Daniel was on hand to offer his assistance and support. The sprayer, mounted on a Cushman truckster, was a John Bean Turfkeeper with a 110 gallon tank and Model 1010 pump. We mounted a 20' boom with flow jet nozzles which were capable of discharging 1.9 gallons per minute at a pressure of 25 psi. At 4 MPH the sprayer delivered about 45 GPA.

The concentrated calcium arsenate material was delivered as 2 gallons in a 2.5 gallon container. The lid was removed, a quart of water added, then the container was closed and hand shaken to better loosen the material. It was then poured into the running sprayer. The containers had to be triple rinsed to be sure we were using all of the material. We used 28 gallons to 82 gallons of water in the 110 gallon tank. This was a 1 to 3 dilution. This made quite a thick slurry which our operator described as being about like mayonnaise. It wasn't really that heavy, but it was by far the thickest material I had ever been involved with.

The fairway varied in width from 90' to 110'. We had decided to spray a 60' section for 1,050', most of the length of the fairway. This would give a good comparison from side to side. The area treated was to 63,000 sq.ft. and when we had finished we had used 64 gallons of the calcium arsenate material. This had come out about as close to our calibration as we could expect to be. Our concentration was such that we had to cover an area twice to apply the required one gallon of material per 1,000 sq.ft. The entire operation on #3 fairway took about two hours to complete and this included the time required to mix and fill the sprayer. When completed, the fairway was watered to wash the calcium arsenate into the soil. It took several days for the residual material that had dried to be washed off the leaf.

The following day we treated the entire #15 and #16 fairways. This was the extent of the test applications for 1982.

The results started to show somewhat over a week later when we could notice a slight discoloration of the Poa annua. It set in slowly and advanced to a more distinct yellowing of the Poa annua in the turf. No adverse effects were noted in the bentgrass.

Winter weather set in late that year. We even had several rounds of golf played on Christmas Day. The winter was a moderate one without excess snowfall. The turf came through the winter with no apparent difference in the treated fairways from the untreated fairways except for the discoloraiton of the Poa annua. In the spring of 1983 a distinct line of the application cutoff could be observed. The treated area of the fairway showed distinct signs of Poa annua stress as soon as growth started.

We are on a triplex mowing program on our fairways so we were able to notice a definite difference in the amount of clippings that were removed from the treated fairways. There was a marked difference in the aggressiveness of growth also. The discoloration continued into the summer months. It was not enough to be objectionable, however it was apparent to the trained eye. The Penncross did not suffer any lack of growth or loss of color from this chemical. I do feel that an earlier application date in the fall would have resulted in an increased decline of the Poa annua that first season, and we would have had the same results in the spring.

The #3 fairway had several areas where, by the fall of 1983, our drainage trenches were not able to remove all of the rainfall quickly enough and water stood for over six hours in those two areas. There was not any severe damage to those areas the several times this happened, but the high water line was apparent on the grass and it showed signs of starting to discolor. These areas will be watched closely in the spring to detect any damage from standing water. I am anxious to watch the continuing development of these wet areas. During this past winter of 1983-84 we have had over two months of continuous snow cover. The ground just started to show through this past two weeks and is again covered with snow. Before this last snow cover we were able to check the areas which were treated with calcium arsenate and did not find any snow mold damage to those areas any different from the untreated areas.

By the spring of 1984 this material will have been down for one year and six months. This should be ample time to note any effects or differences. At this point, I have not noticed any specific reduction in the Poa annua which I can attribute directly to the calcium arsenate. Both the treated and untreated fairways made gains in the bentgrass population which, overall, I have had to attribute to the dry hot summer and the suppression of irrigation on all fairways. I believe there were some additional gains made in the bentgrass population due to the triplex mowing program. I purposely avoided a follow-up application this fall to await an appraisal of the first treatment. With several spots starting to show signs of the limited drainage I do not want to establish a position of being a full strength with the calcium arsenate while having areas where water stands. We plan to retrench these areas of poor drainage next spring if necessary.

In summary, may I say we have had some results, with the yellowing of the Poa annua and the light growth response in the spring. We know the material works and to just about what degree if affects the grass. The rates are correct so now we must decide if the results are worth the cost, effort and risk involved.

Assuming Distribution and Sales Of Turf-Cal

Cecil F. Kerr, Mallinckrodt, Inc.
Kalamazoo, Michigan

Approximately three and one half years ago Dr. Woolson, from USDA, Beltsville, Maryland, called me asking how much tri-calcium arsenate I could sell if a flowable was available.

I wasn't sure at that point if we could sell a gallon of material. Ten years ago at least a thousand programs were terminated when OSHA banned Chip-Cal because of the dust from its manufacturing process. The product was well known and the need evident.

Dr. Woolson, John Alden of Woolfolk Chemical, and I surveyed the present need for this product. Our surveys showed interest in using tri-calcium arsenate flowable in Massachusetts, Pennsylvania, Maryland, Indiana and Ohio. Our research department and I visited Purdue University plots and fairway demonstrations at several golf courses, including Lafayette Elks and Danville Country Club in Illinois.

As a result of our survey we prepared a five year sales projection. Costs were much higher than superintendents had paid for the program in the past. Yet a mower is four times higher than it was twelve years ago.

We were pleased with the results of the programs conducted by several superintendents. The quality of the flowable was improved!

The cost of the program is high; however the benefits are worth the price. Turf-Cal controls crabgrass, goosegrass, chickweed, Poa annua, and soil insects. After control is once achieved in a two to three year period the maintenance dosage is less than the cost of insect control with existing insecticides.

This program is not for everyone. It is only adapted to competent superintendents who are willing to follow a total ten point program. Some golf courses that cannot be properly drained should never use the program.

We decided to market tri-calcium arsenate flowable (Turf-Cal) in the beginning to superintendents who have had previous experience with arsenicals. We also decided to limit our distribution to distributors with arsenical sales experience at the beginning of the program. We conducted initial educational programs organized by Mel Lucas in Long Island, New York and Kermit Delk in Springfield, Ohio. Distributors meetings were held with Terrie Co. in New Jersey, and also in Georgia and the Carolinas. We also held superintendent meetings with Cornell Chemical in Baltimore and with Turf Specialties in Indianapolis, Fort Wayne and South Bend.

We discussed the importance of following our prescribed ten point program for removal and prevention of Poa annua in cool season grasses.

1. Drain low, wet areas. Use excavated soil to fill low spots. Slit trenches 3-6" deep, filled with sand may also be used to rid area of excess moisture. Aerify and topdress wet areas with sand. Good grass requires good surface and subsurface drainage.

2. Correct soil acidity. Turf-Cal is most effective in soil with a pH range of 6.0-7.7. If lime application is necessary, allow four weeks before applying Turf-Cal.

3. Eliminate Phosphorus in fertilizer programs. Use no phosphorus or as little as possible. The higher the phosphorus supply the more Turf-Cal is required to achieve Poa annua control.

4. Remove thatch and reduce compaction. Aerify intensely before Turf-Cal application to reduce heavy thatch. Verticut to make room for new growth. Bring the soil to the surface to favor new seedlings. Avoid overseeding in heavy thatch. Aerify yearly as necessary to keep thatch from accumulating.

5. Overseed as needed. Repeat introduction of seed of the desired cultivars until uniform stand is produced. Slit-seed 5-20 pounds per acre when conditions are suitable. Repair worn areas and resod critical areas. Use caution in treating newly seeded areas. Use lower recommended rates of Turf-Cal on new seedlings and keep rootzone moist.

6. Apply Turf-Cal in late summer or early fall. Use Turf-Cal before Sept. 15th when possible because days become shorter and light intensity diminshes. This encourages cool season grasses and new seedlings to fill in during fall, winter and spring. Apply uniformly. Avoid skips and overlaps.

7. Maintain effective soil arsenic levels. Continue program by applying supplemental Turf-Cal at maintenance rates annually in the fall.

8. Emergency phosphorus supplement. If unusual conditions indicate emergency correction is needed, weakened Poa annua can be improved by the application of 1/8 to 1/4 pound per 1,000 sq.ft. of soluble phosphorus as a liquid fertilizer. Do not use more than needed. Avoid this procedure if possible.

9. Eliminate all plant material. Turf areas composed of high percentage of Poa annua may be killed with Roundup. Cultivate and reseed to desired cultivars. The new stand of grass may be protected by use of Turf-Cal.

10. Special note on greens. Use lower rates on greens where sand predominates in the rootzone. The base exchange capacity is low on sand greens.

Equipment should be carefully calibrated. Turf managers should understand the limitations, the requirements, and the need for continuity to successfully get rid of Poa annua and establish desirable grasses.

The elimination of weedy grasses and the establishment of fine turf requires a knowledgable, dedicated superintendent who communicates effectively with his membership.

Keeping Key Personnel

Randal C. Bellinger, Bellinger's Professional Grounds Maintenance
Lafayette, Indiana

Why is it important to keep key personnel through the winter months when business income comes to a halt? This is a question that many business owners and managers have asked themselves and weigh out the pros and cons. Let's ask ourselves that question and answer it from two different viewpoints.

First we should see it from the eyes of labor type employees - the people who are in the field every day and who have the true hands-on experience in the everyday routine. Are they so important to the success of the business that it pays to keep them on in the winter months? Are there jobs in the shop that they can handle? Are they mechanically inclined? Are they self-motivators or do they need someone by their sides constantly telling them what to do and how to do it? The answer to the question, are they worth keeping through the winter is: maybe and maybe not. There are still some questions that need to be answered before that decision can be made.

Let's talk about the managerial type people and look at what may or may not qualify them for wintertime employment. What type of salary are you paying them or are you paying them by the hour? What are their limitations? Is your management type personnel capable of doing the labor type work as well as their own?

As you can see, there are a lot of questions that need to be answered, and those answers must be justified. Perhaps we should go a few steps further and define what the qualifications are for becoming a key person.

One must look at his company and operation from several aspects to rationalize the possibility of holding on to people during the winter. Some questions you may want to ask yourself are:

- How valuable is the person for next spring?
- What type of leadership does the person display?
- What type of loyalty does he show to the company?
- Does he enjoy the work or is it just a job?
- What positive work skills can the person supply in the winter?

As you may notice, the questions so far have been directed mainly towards the people themselves and what they can do for the company. We'll get to the company questions later. Let's talk about these first questions in more detail.

How valuable is the person for next spring? If your company is anything like ours,a lot of time and money is spent in training involving company procedures, the do's and don'ts in presenting yourself to the clients, equipment operation and maintenance, and professional attitude and performance on the job. This training is very valuable and must be considered in figuring operating costs.

What type of leadership does this person display? Is he a take-charge type of person or does he need constant instruction and guidance? After all, if you have to be with him every hour of the day you may as well do the job yourself and save some money.

The next two questions go hand-in-hand. Is their loyalty to the company and industry, and do they enjoy the career they have chosen? Too many people feel a job is just a job and they could just as easily be in another type business. Hopefully, you identify these people at the time of employment. I'm not saying that everyone hired should be as dedicated as you, but it does make for nicer working conditions. It's not possible to have that type person all of the time, and the "job is a job" type person will probably leave you anyway before the winter employment question presents itself.

What work skills can the person supply in the winter? We certainly know that one must display some mechanical skills in this industry. The winter is a great time for equipment maintenance and rejuvenation. Management skills can be used in increasing sales and perhaps restructuring production procedures to increase field and office productivity.

I mentioned that all of these questions have been directed at the personnel level. We can't forget to investigate the questions directed at the business.

- How many people can the business support?
- Can the business support these people with no alternate income?
- Will the company be exhausting its cash flow by spending money on payroll?
- What alternate incomes are available and feasible for us to establish?

We have found that it is certainly necessary to keep key personnel employed. After all, we are trying to present a professional service to the customer, and I find this very hard to accomplish with continuous employee turnover. Greater profits during the peak season where productivity is high will offset the payroll burdens encountered during the winter months.

We need to talk about alternate winter incomes. Our company policy has been to never depend on wintertime work to finance the business. Wintertime income is too unpredictable. We have two services with which we have the potential to create income in the off-season - snow removal and firewood sales. We cannot depend upon Mother Nature to always provide us with the amount of snowfall we need to pay our bills. However, if you budget your seasonal money to carry you through the winter, the money generated by snow removal becomes gravy. Snow removal keeps your trucks productive in the wintertime, but also generates additional costs. Insurance rates soar because of the high risk factor. Vehicle maintenance can increase due to the type of work being performed. Inceased fuel usage can also eat at your pocketbook. All of the facts must be explored and researched before making the decision to take on such a service. Also one very important question is not to be overlooked - Do I really want to get out of bed on a bitter cold, windy night?

The sale of firewood does generate income for the winter, and it is a lot like snow removal in that the more severe the winter the greater the demand. However, firewood sales do not provide profits to the company, and in most cases the operation barely supports itself. By the time you figure the cost of the wooded land, the chain saws and accessories, a chain grinding machine, a log splitter, a truck to haul the wood, and the labor of two people, you've got a sizable investment just to get started. We estimate two cords of wood must be cut and split per day to break even on expenses.

The whole idea of creating wintertime income is not for generating profits but rather for keeping on key employees. The income generated from wintertime work is sufficient if you just break even on payroll. In effect you have accomplished what you set out to do - provide job security for those who show promise in building your company's future.

Chimney Services As An Additional Income Source for Lawn Care Businesses

Todd Williams, Chimney Masters
Kalamazoo, Michigan

Chimney services offer an unlimited opportunity for profit and growth. It's the perfect combination of a growing market, your established market position, and a very modest entry cost. It's an opportunity that only you, as a lawn care specialist, can capitalize on.

Wood burning is the fastest growing segment of the home service market in the United States today. Each year, over one and one-half million woodstoves and fireplaces are being installed. A great percentage of them are being installed in the north-central states where wood is available and traditional fuels, oil and gas, are expensive.

Each of these new wood burning appliances creates a need for regular maintenance and repair. Add this to the millions of fireplaces built into established homes, which are now being used regularly for the first time, and you can appreciate the size of the market.

The need for maintenance and repair is critical. Over fifty thousand chimney related fires are reported each year. Thousands more do only minor damage and go unreported. These fires kill thousands of people. They destroy millions of dollars worth of property. All of these fires are the direct result of improperly installed and maintained wood burning appliances.

Properly trained and equipped, you can correct and maintain these installations - profitably! You start with your present work force, keeping your summer crew year round. You utilize your present location and office personnel and a truck or van which you probably already own.

Sweeping, of course, is easily learned. But it's the training and marketing program that lets you sell accessories and helps proper chimney service pay more. For example, most chimney sweeps collect forty to fifty dollars per job. That's the national average. But the average Chimney Masters sweep is billed at one hundred dollars.

Offering a free inspection paves the way for the initial contact. The customer welcomes your service when there is no obligation. Knowing what to look for and explaning the need in terms of the customer's own self-interest and safety makes the sale. Equally important, you must provide the finest chimney service and accessories available. It's good business and safety is involved.

To give you an understanding of the operating side, let's go sweeping. Arriving at the scheduled inspection, the chimney sweep is in full uniform. The homeowner knows who he is and can see that he is ready to work properly. The sweep conducts the inspection quickly and safely, examining the chimney from the bottom. He is looking for signs of accumulated creosote, which can be sticky and tar-like, or flaky.

The sweep shows the homeowner the grey fly ash of a clean burn and the creosote caused by incomplete combustion. He looks for physical damage in the fireplace or wood-burning appliance. He also looks for proper connection of the smoke pipe and adequate insulation between the stove or fireplace and any combustible material.

The sweep explains what he has found and how much the sweep will cost. Before he begins, the homeowner signs the work order which was generated by the original phone call. Paper work is greatly simplified for accurate, easy-to-maintain work records.

With the work order signed, the sweep begins as tools and equipment are taken from the well organized truck. Step one is to spread the drop cloth and close the damper to prevent any soot from entering the home. Then it's onto the roof. Sweeps can also be done from the bottom. When to do which is part of the Chimney Masters training program.

Sweeping down with the flexible fiberglass poles, the sweep listens for broken or cracked flue tiles. (A trained ear becomes a valuable tool for the chimney sweep.) The fitted wire brushes, which are supplied in several sizes, cut through most creosote materials.

Going inside the home, the damper is removed, carefully, to avoid spilling soot or creosote loosened in the sweep. Cleaning the smoke chamber is perhaps the hardest part of the job. Being a contortionist helps. Cleaning the smoke shelf is followed by a thorough sweep of the firebox walls.

After the sweep is done the homeowner is informed of any minor repairs which may be needed. Caulking the cement crown of the chimney, silicone-spray waterproofing to protect brickwork, tuck-pointing, are all part of the added, and profitable, services you can offer. A raincap, if the customer doesn't have one, is easy and profitable to sell. It keeps out rain, birds and animals, and is easy to install and won't rust or blow away. Raincaps raise your profit on the sweep about fifty percent, and they are easy to sell on the basis of readily understood customer benefits.

Finished with the work, the sweep is generally paid at this point and he is ready to go on to the next job. Doing between four and six sweeps a day can generate between $350 and $600 in sales, per man, per day!

You are ideally suited to add this profitable business to your established activities. You have the work force. You have the market position, and your people can be trained easily. You already have the vehicles you need. You have an established customer base from which to work. Your lawn customers have fireplaces and stoves with soot and creosote problems that really need attention for safety and operating efficiency.

As a lawn care specialist you are in a unique position to build extra profit on the base you have already created.

Herbicides For The Future

R. P. Freeborg, Agronomist
Department of Agronomy, Purdue University

Before I get into the discussion about the newer herbicides with potential to serve the turf industry, I want to develop a concept that, I think, is going to develop in the turf industry as it has in other crops. It is one where you expect your desirable perennial grasses to have some moderate degree of phytotoxicity. This may be a small superficial leaf burn, something that would be removed in one or two mowings; for example, to control tall fescue or quackgrass in a perennial bluegrass turf where the bluegrass may have some leaf phytotoxicity but will survive, whereas the other grass weed would die. There would be an initial concern when you see the turf that something has gone wrong, but when you consider the eventual resulting weedy perennial grass control, the phyto may be acceptable. If we can work with this concept then we can use some of the newer selective grass controls in a bluegrass or perennial turf.

Another approach to weed control is with selective inhibition. Many of you may have already had some experience with Rubigan. It is primarily a good fungicide. We are looking at it because of its potential to selectively inhibit Poa annua growth in a Poa-bentgrass stand. With good bentgrass management and reduced vigor of the Poa annua caused by the Rubigan application, it is possible to encourage the bent and gradually effect a transition from Poa to predominantly bent. This cannot be done in a short time. A lengthy transition period is required. It may take most of the summer, but it can be effective.

Another approach to selective control of Poa annua is with the growth regulator Cutless, in combination with mefluidide or Embark. On your left is an untreated control. This is primarily a Poa annua population. In our tests the untreated control had abundant seedhead development. However, when treated with the Cutless (flurprimidol) at 1/4 lb. active ingredient/A plus Embark at 1/8 lb. per acre, 95-98% of the seedheads were eliminated. In addition to seedhead control the vigor of the Poa annua is reduced. The bent growth is not inhibited as much as the Poa annua and so with good bentgrass management, a transition from predominantly Poa annua to a bentgrass population can be effected. When the Poa annua is either eliminated or reduced to a small percentage of the total population, then the use of a good preemergent annual grass control can begin.

The growth regulator chlorflurenol has been around for some time. It was used in combination with maleic hydrazide as a seedhead inhibitor of Poa annua. It also had some potential to control broadleaf weeds or to enhance broadleaf weed control when combined with other herbicides. In combination with either 2,4-D or 2,4-TP plus dicamba, the chlorflurenols tend to be somewhat complimentary or syndergistic. There is a continued interest in combinations of chlorfluernols with various broadleaf weed control herbicides. The problem is that chlorflurenol is difficult to formulate in an available form. It is also expensive. Currently, there is a new formulation that is more soluble, has more stability, is as active and possibly available at a lower cost.

The organic arsenates have been widely used for control of crabgrass. Disodium methyl arsenate, one of the first, was very effective in selectively taking crabgrass out of bluegrass stands. There is also the Daconate (monosodium methyl arsenate) for postemergent control. One of the limitations is that it requires two applications at five to seven day intervals to be effective. There are now two other products that have given good crabgrass control with one application, and may replace it to some extent. One is identified as Acclaim. It is an American Hoechst product. It is a good selective postemergent crabgrass control especially in the early stages of growth. Maybe its greatest advantage is that it appears to be an extremely good selective goosegrass contol, as long as the goosegrass is a young plant. To date, we don't have another product that will do that. They are going to have an experimental use permit on it in '84, intending to have it on the market in '85.

Another product you may have heard a little about is Dowco 356, agriculturally sold as Tandem. The name will change when it comes to the turf market. We have had one year of testing and it looks quite interesting. It is a good selective annual grass control. We have worked with it on crabgrass. We don't know yet what its performance will be on goosegrass or Poa annua, but there is potential for post selective control of weed grasses. There is also some evidence of postemergent activity as well. It is possible that a commercial lawn care company could use this in their program as a preemergent, starting early. If, however, crabgrass has emerged it would then serve as a postemergent and thus keep weeds out all year. We are not yet sure to what extent the preemergent activity will hold up, but it certainly looks promising.

Some of you may already have had experience with Garlon (triclopyr). This is another new herbicide currently on the agricultural crop market. It is complimentary to the phenoxys, such as 2,4-D. By itself, it is not a totally effective weed control. There are some broadleaf weeds it controls, some it doesn't, but together with 2,4-D or other phenoxys it has been a good broad spectrum weed control. There has been some evidence of fairly good Oxalis or yellow wood sorrel control. Some of the weeds not killed readily with the Trimec or Trexsan formulation may be controlled more readily with this formulation.

Another new group of herbicides of similar chemistry from DuPont have potential as selective broadleaf weed controls, as plant growth regulators and/or as a synergist with other herbicides. These herbicides are very active. The rate on one herbicide, 'Glean', is one-half ounce active ingredient per acre. You might, for example, need to apply one to two pounds of other formulation. In combinaiton with the phenoxys or with growth regulators there have been some encouraging results. The plant reacts very rapidly to it. In about two hours after application there is evidence of inhibition of cell division. This activity is enhanced when Telar (Glean) is used in combination with other herbicides.

The Indiana State Highway Department is going to use Telar with Embark and 2,4-D at 2 lbs. ai/acre with 0.25% surfactant, DuPont WK, as a result of work done at Purdue this year by Dr. Morre. On highway roadsides for regulation of tall fescue, inhibition of tall fescue seedheads, as well as control of broadleaf weeds, they will use Telar at 1/4 oz. ai, Embark at 1/8 lbs. ai, and 2,4-D at 2 lbs. ai/acre with 0.25% surfactant, DuPont WK. Embark (mefluidide) used at a quarter of a pound per acre costs $8.75 per acre. Estimated cost for materials and application is $20.00/A. The roadsite site to be treated is I-70 from Indianapolis to Terre Haute. Telar also controls wild carrot, a weed that has been difficult to control.

There are other new herbicides that are commercially available for use in other crops that have had some potential for use in turf. One of these is Goal. It is commonly used in soybeans. Its primary advantage is that it has preemergent activity on broadleaf weeds. As we look at some of these new herbicides, I feel, quite strongly, that in the future we are going to begin to see herbicides that will give us preemergent broadleaf weed control just as we have preemergent annual grass control. It's only a matter of time.

Another broadleaf weed control that has come in from Europe and is a Dow Co. herbicide that has potential as a replacement for some of the phenoxys is Lontrel. It has the potential to control some of those phenoxy acetic and proprionic herbicides such as 2,4-D and 2,4-DP. Possible Lontrel in combination with the phenoxys or other herbicides may give broader spectrum control.

Some of the grass controls, Fusilade, for example, are good annual and perennial grass controls. At the rates used in soybeans it would damage bluegrass, but with a reduced rate there is evidence of good control with only moderate toxicity to the desired perennial grass species. This is a systemic herbicide much as Roundup is. It translocates throughout the plant and so has a potential to control grasses that we have had some difficulty in controlling.

Another one of the grass herbicides much like Fusilade is Poast, and another is Haelon. One of the new DuPont products is called Assure. It has some potential for control of annual and perennial grasses. It is still classed as an experimental herbicide. Quackgrass, large crabgrass, barnyardgrass, goosegrass are some of the weeds that are controlled.. Use of light rates at the right time of year and possibly repeat applications may provide selective control of these weedy grasses.

Another new herbicide from Shell with potential for turf use is Cinch. It has potential for surpressing many of the broadleaf weeds as well as being a broad spectrum grass control.

I want to develop another concept as we talk about herbicide efficacy. For example, of the total amount of the herbicide applied to foliage only 5 to 20 percent of that herbicide is actually effective. Therefore one way of increasing herbicide activity is to get it into the plant more rapidly so it gets to the active site more efficiently.

The answer may be found in the use of the newer surfactants. Surfactants are used for various reasons - better leaf surface coverage, better spreading of the droplet, better sticking ability. There is evidence that they do something else for us and that is to alter or weaken the surface wax layer on a leaf. Thus they permit more rapid movement of the pesticide into the cell where it needs to be in order to work effectively. Some surfactants are more effective than others. DuPont WK and X-77 are examples of those that tend to deteriorate the wax layer more than others. With the use of these surfactants a larger area of leaf is covered and the wax layer penetrated more effectively and, as a result, the herbicide is more actual and lower rates can be used.

Bentgrass Fairways In '83

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

The varieties of bents in the first six fairways at Meridian Hills Country Club are somewhat of a mixed bag because of earlier bent overseedings in the fifties. Since we started our conversion program, we have used Penncross, Emerald and some Penneagle.

This past summer's weather was testy and we were most fortunate in having a successful season, and made good advances in our bentgrass fairway program. Our most limiting factor was in our irrigation system where there were isolated areas that presented problems because of distribution and coverage. We are in the process of correcting these deficiencies. There were a number of procedures we used this past season that differed from other years, and I would like to tell you about some of those changes in our program and thinking.

Basically, we changed our approach in early season watering practices, fungicides, aerification and mowing equipment and techniques.

We did not begin to water fairways until the first part of June. The only time we used the irrigation system was to wash chemical off the grass leaves. The combination of aerification and frugal early irrigation helped to establish an excellent rooting system.

You must really be prepared and anticipate the first early periods of heat stress and droughty conditions in late May and June. If your bent-Poa turf is stressed too severely during this first period, it is difficult to snap back and survive ensuing hot weather that can occur during the rest of the summer. This is of particualr importance when Poa percentages are high. Moisture levels, weather forecasts, close monitoring and intuitive "greenskeeping skills" should be employed most judiciously as well as communication with other superintendents.

This past year was the first time we used Bayleton for the control of anthracnose in our Poa on fairways. Some turf disease people felt it was too hot this past summer for dollar spot and the flaw in some fungicide programs allowed an expression of brown patch. Brown patch presented somewhat of a problem in our program. PMAS and Thiram provided curative and preventative protection.

As bent-Poa fairways develop, higher percentages of bent-thatch will become an increasing problem. Our program will be one of intensifying aerification and development of a verticutting, thatching or thincutting program. We plan to use one of several different machines to achieve this goal. (Ryan Grounds Groomer, Aero Thatch and GM III Verticut.)

We intensified our aerification program this past season. Our goal at the onset was to aerify all 36 acres of fairways using Ryan greens aerifiers (5/8" tines) within a calendar year - starting in September of '82 and finishing in the fall of '83. Our back nine soils are tighter, so in the fall of '82 we chose the most troublesome two fairways for starters. The response from aerifying coupled

with different mowing techniques was super. These normally troublesome fairways were more managable and turf quality was dramatically improved. Because of play, weather, and learning better techniques, we did not finish the back nine fairway greensaire aerification until the spring of '83. We started the front nine aerification in September of '83 and finished in late October.

We have two Ryangreens aerifiers and in addition, contracted a new service in our area, and leased two machines and operators for the fall period. We learned one hard lesson! Never aerify and produce more soil cores than can be processed, cleaned up and worked that day. We had portions of two fairways that were partially cleaned up after aerification when rain caught up with us for six consecutive days. That was a mess!

Generally, we could start with four machines on a 2-2-1/4 acre fairway in the morning and finish aerification by 1:30 to 2:00 p.m. We found by aerifying across the fairway instead of lengthways, we could complete sections and start cleanup much sooner. The cleaning up and core processing is the most limiting factor in this program.

Our basic procedure was to:

1. aerify
2. break up plugs using a Fuerst drag mat
3. verticut with a Toro GM III with every other blade removed
4. chop the remaining plugs with a Mott hammer knife mower set in the reverse or leaf mulching mode
5. drag again
6. sweep with Toro vacuum or blow off debris
7. mow with a gang pull mower

Greensaire aerifying produces a tremendous amount of soil and subsequent handling. This does require extra machinery, time, patience, but it is well worth the effort.

Our mowing program varied drastically over that of the past. We have been using greens mowers to mow collars and approaches and Par 3 fairways for several years. The results have been favorable, so we elected to get involved in fairway close mowing equipment.

There are many reaons for the success of triplex mowing equipment. Some are well understood, others are more elusive in explanation. Well known aspects are:

1. Lighter equipment reduces wilt stress and compaction.

2. Clipping removal not only reduces Poa seedheads from being returned to the turf, but decreases any silage effect during hot humid summers and reduces disease incidence.

3. Mowing patterns are aesthetically pleasing to the player. Cross mowing helps to stand the grass more erect and affords a better lie.

4. By increasing the clipping frequency, the amount of mowing can be decreased.

5. Lighter equipment can mow when soil conditions would be too wet for conventional pull type units.

The more elusively explained aspects of triplex mowing are:

1. Bent seems to be more competitive when mowed at heights of 5/16" to 1/2" and grows at the expense of Poa.

2. When bent is mowed higher than 1/2", the plants become lazy and have a tendency to lay down and mat.

3. At closer mowing heights, fluffiness and puffiness are reduced. Fluffy bent develops a lazy root system and is subject to scalping. Closer mowed bent develops a deeper root system, and does not wilt as quickly as fluffy patches.

The disadvantages are:

1. Equipment cost is high.

2. Labor cost is high.

3. Clipping handling is expensive.

4. Dew and heat of day can cause delays.

In the spring of '83 we purchased a Toro II bladed 7 gang and a HF-5-5 gang. Since we have 36 acres of fairway, our plan was to mow all fairways at least once per week and pick clippings and use the Toro II bladed 7 gang alternatively. We also decided to exclusively mow two troublesome fairways all season with either the HF-5 or GM III's and pick up clippings. This worked very well, but when it really started to get hot and stayed hot, we used three to four Toro GM III's and the HF-5 to do all the mowing and removed clippings. We did not use a conventional tractor and pull unit on the fairways from early June into September. In September, when we lost our school help, we tried a new wrinkle. To keep extra weight off the fairways, we used the 11 bladed Toro's in a 5 gang configuration and pulled the unit with a three-wheeled Cushman. This was our salvation, for we could not possibly have accomplished the mowing of 36 acres with our labor force. We are looking at alternative equipment to pull or push the 5 gang and the possibility of baskets for catching clippings. Regardless of any choice of hydraulic mowers, back-up 10 bladed Jacobsen or 11 bladed Toro's are a necessity.

This past year has been a learning experience and we have been able to gain better insight and confidence because of adversity.

Increasing Emhpasis On Grooming Turf

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

As a traveling agronomist for the US Golf Association's Green Section, I routinely visit and spend half days touring almost 200 different golf courses with their superintendents and usually club officials. Seeing this many courses each year is a tremendous educational experience. In years like 1983, this agronomist had the opportunity of seeing clubs from Long Island, through the Midwest out to and including California. This was a tremendous cross-section of golf courses, general growing conditions, and problems in an area.

Beyond these yearly visits to the clubs, just being involved with the USGA gives us access to the general thinking and trends going on in the golf community. Thus, as agronomists for the USGA we sometimes are in a position to see and appreciate trends in the industry as they begin and later develop into programs and procedures that golf course superintendents perform on their golf courses. It is this trend towards an increasing emphasis on grooming for playability that is my presentation to you.

In my opinion, this industry moves in cycles. Some people refer to it as the "pendulum theory". That is, the pendulum swings over to one extreme and ultimately swings to the other. It may take years to accomplish this, but in looking at the past history of the turfgrass management industry, there are noticeable "swings" in the philosophy of how golf turf should be managed as well as what golfers want from a golf course and what type of turf conditions are rated excellent, good or indifferent.

The most noticeable pendulum swing occurred during the mid to late 60's when the "best" golf courses were those that were green and lush. The greener, lusher the grass, the better the golfers liked it and the more they patted the superintendents on the back for giving them the conditions. It was quite commonplace for golf courses to apply 10 to 12 pounds of actual nitrogen per 1,000 sq.ft. per year on greens. Now, 2 to 4 pounds per 1,000 sq.ft. per year is the normal range.

In all candor, I do not know whyor how this perception began that a good golf course must be green, soft, wet and lush any more than anyone can understand why there has been such a swing of the pendulum to the more natural golf courses which look more like Scottish links than anything else. Perhaps as a group there just is a feeling of getting back to the "roots" of the game, and these obviously are the conditions which did and still do exist in the British Isles - that of a natural and almost penal type of golf course that rewards good shots and oftentimes severely penalizes a poorly played one.

In between these two extremes golf course superintendents during the 1970's went through a period of mechanization. In the 60's most of the important grooming work on the golf course was accomplished by fairly inexpensive and abundant hand labor. Greens were all cut by hand, sand bunkers were all raked by hand, a tremendous amount of hand rotary mowing was done, most of the larger turf areas

were cut with 5-gang pull frames or sometimes, at most, 7-gangs. Heck, sometimes they still used sickles and grass shears and clippers for trimming!

In the 1970's there was a move towards reducing the cost of labor which, due to inflation, increased dramatically. No longer could many golf courses afford large maintenance crews. Inflation and the high price of petroleum products and energy meant that everything from fertilizer to pesticides (most all petroleum based) also dramatically increased in cost. The courses were caught between the price/wage and, with labor being the greatest single expense on the golf course, labor costs were cut whenever and wherever possible because there simply wasn't any substitute for fertilizers or pesticides. You had to buy materials and the only real area of savings was in labor.

Hand mowers were mothballed and triplex putting green mowers were purchased. Gone was hand raking of sand bunkers; this was performed by mechanical sand rakes. Five-to seven-gang mowers were replaced by hydraulic seven and even nine-gang mowers which could cut tremendous acreages of grass in only a few hours. Efficiency was the emphasis then. If golf course superintendents could show that a particular piece of equipment could save labor it was readily purchased. This was the thinking at that time, and this now is also beginning to change. Perhaps we have two pendulums at work, one involving the philosophy of what a gold golf course should be and the other in how to manage and maintain the golf course?

Today there is a definite trend towards playability on the golf course. We see this in the use of the sand topdressing programs on greens. Golf course superintendents know or at least suspect that, eventually, as the sand begins to build up and accumulate we will have a different set of management problems with which to deal. However, this type of topdressing program is expedient in providing the firm, fast and true putting surfaces demanded by the vast majority of today's golfers.

Besides such things as sand topdressing, reduced applications of water and fertilizer we are now beginning to see more and more golf courses hand mowing the greens. This is especially true during the summer when labor is more available. During the spring and fall months the triplex machines are used so that, in reality, we are seeing more and more of these integrated hand mower/triplex mower programs being instituted on golf courses. Why is this?

Any time you go for maximum efficiency you sometimes give up quality for this efficiency. The triplex putting green mowers are great labor saving tools which do a good job of cutting the grass. However, where ultimate quality on putting greens is desired, the triplex mowers just do not do the job as well as the hand mowers, in my opinion.

The same is true for sand bunkers. The triplex machines do a great job but, increasingly, these machines are fitted with hand rakes so that the operator can rake the majority of the bunkers but then finish it off with hand raking as the edges. Again, this is integrating hand raking and mechanical raking of a bunker.

By far the biggest change in the management of golf courses in the past three or four years has been the ever-increasing usage of light weight 3- and 5-gang mowers to cut fairways. Only a few years ago it would seem ludicrous for any golf course superintendent in his right mind to cut his fairways on a continuing basis with these small machines and to pick up the clippings. However, the use of this type of equipment on fairways is dramatically increasing as the golfers see the results and as golf course superintendents realize that, in the final analysis, if the membership is willing to pay for it, why not?

To some extent anyway lower cut fairways were the result of the desire by many for firm, fast greens. You see, from the golfing standpoint it is extremely difficult to "hold a firm green" when hitting a fairway shot from long grass. A flier results, which is universally despised by golfers. Common sense would indicate that there is much more to holding a green with a golf shot than just the length of grass on the fairways, but it is an important consideration. Thus, one program to some extent begot the other. The other reasons for lightweight machines involves overall improvements in fairway quality, an increase of permanent grasses like the bentgrasses at the expense of the Poa annua and the simple fact that these lightweight machines help fairways develop into some of the finest and most maintainable and reliable fairway turf obtainable today through the talents and expertise of the golf course superintendent.

All of this, going to more hand mowing of greens, hand raking of sand bunkers, lightweight triplex or 5-gang mowing of fairways, all have their roots in the desire by golfers for more playable turf and golf courses. This is a definite trend that exists throughout the industry.

Fortunately, the vast majority of golf courses which we see are, for the first time in many years, not balking at spending money for golf course maintenance. For many years it seemed that the vast majority of capital expense on the golf course ultimately was spent in the clubhouse, swimming pool, for a tennis facility, etc., and the golf course got the absolute minimum of what it took to do the job. Now I see this is changing also. Golfers realize that if they want the greens to be hand mowed then the superintendent must have the equipment and manpower to do it. The same is true on fairways . If golfers want the fairways triplex cut then fine, the budget must be increased accordingly to accommodate these new programs. It is truly amazing to me how few golf courses are balking at these new programs. For the first time in years money is being spent back out on the golf course where it should be spent!

Perhaps this is the first sign of another trend - that being to get away from the "Country Club" and get back to the "Golf Club". The success of such golf courses such as Crooked Stick Golf Club in Carmel, Indiana, is just one close example that more and more golf courses are being developed as golf courses. Whether this is a true trend or not or whether it will ultimately continue is hard to say, but it will be interesting to keep this thought in the back of our minds as time goes by.

In summary, golf courses are spending more money for golf course maintenance. They are grooming the golf course better but grooming the golf course so the facility looks and plays better. After all, isn't this the whole idea of the game of golf and the turfgrass management industry - to provide golf courses for the playing enjoyment of the people who use the facility? There are no great secrets in accomplishing the extra level of management that seems to be desired. It just takes the approprite amount of time, materials and manpower. If superintendents have the tools, I am certain they can do the job.

Tall Fescue Replaces Bluegrass

Jeff Lefton, Regional Agronomist
ChemLawn Corporation, Indianapolis, Indiana

In areas where drought and heat stress continually thin bluegrass one might consider using the new fine leaf fescues on the market.

Varieties available. Research has brought about several new tall fescue varieties that provide excellent turf. These varieties include Houndog, Rebel and Falcon. Tall fescue is normally a bunchgrass. Yet when properly seeded it can produce a dense uniform lawn. Check with your local supplier for additional varieties on the market.

Major qualities. The newer tall fescue varieties adapt well to full sun or medium shade and perform well in heavy clay or sandy soils. Other positive characteristics include no serious insect problems, no thatch build-up and quicker establishment than Kentucky bluegrass.

Seeding rate. Six to eight pounds per 1,000 sq.ft. is the ideal rate. Seeding at a rate higher than this can lead to problems with drought tolerance and increase susceptibility to the disease Brown Patch. The newer fine leaf tall fescues tiller twice as much as the old pasture type tall fescues (K-31). Therefore, you don't need the higher seeding rate. Mixtures with other species such as Kentucky bluegrasses are not recommended.

Seeding procedures.

- Kill existing vegetation using a material containing glyphosate (Roundup) as directed on the lable. Tall fescue should not be overseeded into an existing bluegrass lawn without killing the bluegrass stand.

- Use a power dethatcher set to penetrate 1/4 inch into the soil. Criss-cross the lawn in two or three directions.

- Pull the excess debris off the lawn and discard it.

- Seed the lawn at the 6 to 8 pound per 1,000 sq.ft. rate.

- Drag the seeded area with a piece of chain link fence or door mat for better contact with the soil.

- Consider operating dethatcher over the area after seeding and remove only loosened thatch when dry.

- Water the seeded area two to four times daily. It is important to keep the seedbed moist. Reduce the watering frequency as the seed germinates.

- After it has been mowed twice it will require a light fertilization to help further vigor.

Management. Mowing at about 2 inches is recommended. It may require more mowing than bluegrass. Little if any supplemental irrigation is required during the summer.

Topdressing - My Program

Jim Conroy, Superintendent
Hurstbourne Country Club, Louisville, Kentucky

In 1965, Hurstbourne Country club was designed and built, using technology available in 1923. The front nine greens were modified to an adobe - pea gravel was used as a coarse amendment. Several materials such as gravel, turface, peat, sand and clay were used in completing Hurstbourne's 27 holes.

Certainly the variability of playing conditions was encouraged when some greens were sodded while others were seeded. All sod used was grown on mineral soil and thickness of the soil layer varied greatly. A sand topdressing program began in 1978 while I was assistant. The program involved two aerifications with three heavy topdressings of sand. This program was continued in 1979, with one aerification and three heavy topdressings.

In 1980 I was employed as superintendent and our current program began that spring. This program involves balancing growth and topdressing amounts with minimal aerifications. A typical year would involve:

1. No spring or fall aerification. Aerification in mid-June on a green-by-green observation.

2. Light sand topdressing the 1st of March, April, May and June 15th or July. Then September 1st, October and November 1st, if growth warrants it.

3. Minimal fertilization, 2-3 pounds of nitrogen with equal or greater potash, 3-4 pounds.

4. Water sparingly in March, April, May, and as needed in July, August and September.

5. Normal prevent pesticide program is used.

This topdressing method works well at Hurstbourne C. C. with less variance in greens playability. This program has also reduced our maintenance costs in the process.

Upgrading Athletic Facilities

David Heiss, Turf Services
Spring Lake, Michigan

Before you begin, decide if the facility will be needed in the future. Don't spend a lot of time or money on a practice football field if you need a new soccer facility. Get input from the coaching staff, band director and anyone else who will use the site. Team effort pays off big. In my travels, I see too many schools at war with themselves, and while you may win the battle you will most likely lose the war.

The soil is the basis of any sports turf facility. Today most soil fertility problems can be corrected with good management and a fertilizer program. Your local golf course superintendent is one source,in addition to the county extenison agent and independent consultants, for soil fertility correction.

Any sports turf area must drain well, otherwise it will be very difficult to have good root development and a dense turf. For new construction, consider the PAT System. For upgrading an existing side, consider the Cambridge sand injection system. Both systems are patented and both work. Don't fall in the trap of thinking all you need to do is mix in a little sand to a heavy soil and make it drain better. There are numerous fields that are worse off after doing this. You can always mix some proposed samples in a pail with water, then allow the mixture to dry in the sun. Many of these dry so hard you could never break them, nor grow grass in the mixture.

When rebuilding is done, use grade stakes no more than 40' apart. Specify deviation from grade to be no more than + or - 1/2 inch. You never see a paved parking lot full of low spots. Why accept that on a playing field? A uniform surface drainage will help any sports turf area. Football crown of 12" to 15" extending 10' beyond the sidelines is adequate as is a similar grade on a baseball field. This 1% grade is acceptable for player use in most all sports.

After precise grading, to prepare a seedbed we prefer a rototerra rather than a rototiller which disturbs the grade. Set depth at about 4 inches. Following this, install irrigation. Consider the new heads on the market that can be installed below grade and have only a 2-5/8" top, which reduces potential for player injury. When doing a new seeding use a Brillion-type seeder, run at least two directions. The newer turf-type tall fescue hybrids should be considered. They have better color retention, lower water requirements, and the best wear tolerance of any sports turf. Look at data for your area and select varieties that green up early in the spring for soccer and baseball and varieties that hold color late in the year for football use. Use a slit seeder, set no more than 1/2" into the soil, to establish new varieties in a thin or existing turf. Spreading seed and working it in during a game by use of player activity has proven only marginally acceptable in our experience. Seed can be mixed with topsoil and spread if desired. The key is to have the seed make contact with the soil.

When placing stone dust on baseball infields, depth should be a minimum of 4" deep, compacted. Too many architects specify 2", which is hard to place uniformly and harder to maintain in future years. Use of aqua-grow granular on the stone dust area helps drain the area and hold moisture, making the stone dust easier to play on and to work.

When new seed comes up wait for at least two mowings before applying weed control mateials. Early application of herbicides results in seedling injury. Finally, when mowing begins, use a sharp mower set at 1-1/2" minimum.

The above steps are in outline form only, but it is hoped they will give you guidelines to work in while improving athletic turf areas.

Insects Today and Tomorrow

Roscoe Randell, Extension Entomologist
University of Illinois, Urbana, Illinois

Introduction. Sometimes a "new" insect pest of turfgrass is reported. Years ago this insect was a problem, then it disappeared, and then returned to be a serious pest of high quality turf. An aphid pest of grain developed a biotype with an appetite for Kentucky bluegrass. This insect called greenbug is not new, but is relatively new as a lawn insect pest.

Grubs. The annual white grub or Southern masked chafer will remain a major pest of home lawns and golf courses. Late summer damage by the C-shaped larvae is a common occurrence in Illinois, Indiana and other midwestern states.

Japanese beetle grubs also will continue to increase in populations on the fringe areas of its present locations. Metallic green and copper colored adults will also cause damage to trees and shrubs.

The true white grub, larval stage of the May beetle, is sometimes a pest of turfgrass. This group consists of more than one species; up to 40 species are found in the soil feeding on roots of various crops, mostly on grass roots. Less than five species are a problem on well managed turf. These species will remain in localized areas and not be as abundant in a community as the annual white grub. Most of the species in this group require three years to complete their life cycle, spending over two years as a grub in the soil.

Black turfgrass atenius grubs returned in 1973 to be a pest of bentgrass and annual bluegrass sod. Two generations per year by this insect have caused serious damage to golf course fairways, greens and tees. Life cycles and effective treatment periods have been determined for this potential pest.

Sod Webworms. Two or three species of this group of foliage feeding caterpillars will continue to fluctuate in populations from damaging levels to almost disappearing from an area. Highly maintained turf areas will remain as the favorite host of webworms.

Chinch Bug. The Southern chinch bug is a pest of zoysiagrass in the mid-western states. Hairy chinch bug is commonly found on bluegrass in Ohio and surrounding states. This insect is increasing in both population in established areas and in new areas of infestation.

Bluegrass Billbug. Billbug damage is reported each year from Ohio to Nebraska with scattered infestations in the states in between them. These small areas will enlarge into neighboring communities. Adults appear in the spring to lay eggs in bluegrass lawns. Eggs hatch and larval damage to stems appears in June and root feeding damage follows in July.

Greenbug. This aphid, a pest of bluegrass in the midwest since 1970, migrates into the area in mid-summer from the southwestern states to suck plant juices from bluegrass foliage. This feeding activity leaves a toxin in the leaves causing them to turn a rust color. Greenbug feeding is mostly found inside the dripline of trees on the lawn area. This insect will continue to appear in some growing seasons and not in others.

Cutworms and Armyworms. Turf armyworms and some cutworm species migrate into the midwestern states each spring to feed on agriculture crops. Sometimes these caterpillars infest a lawn in great numbers. This situation will continue in the future.

The black cutworm species is a common pest of bentgrass greens and tees on golf courses. It migrates into the area in late March, April and May to feed and produce succeeding generations.

Mites. Clover mites and two-spotted spider mites can be found at times in grass areas without exhibiting any damage symptoms. A new pest, winter grass mite, is slowly showing its presence. This mite has a dark body with eight red legs. Damage, if present, will appear in the early spring.

Other Insects. Many insects are attracted to the "oasis" effect of an irrigated and fertilized fairway, green or home lawn. Flea beetles were numerous in green grass areas in drought stress regions in 1983. Leafhoppers migrate to healthy grass to feed on plant sap. Predator and parasitic insects feeding on turfgrass insects will always be hearby to infestations of aphids and caterpillars. These beneficial insects commonly include aphid lions, ladybird beetles and parasitic wasps.

Nitrification Inhibitors

Dean K. Mosdell, Department of Agronomy
Purdue University, West Lafayette, Indiana

Turfgrasses take up nitrogen in the inorganic form, either as NO_3-N (nitrate) or NH_4+N (ammonium). There usually is very little NH_4-N in the soil solution since it is rapidly converted to NO_3-N by soil microorganisms in a process called 'nitrification'. This process is a two-step conversion with NO_2-N (nitrate) as an intermediate.

$$NH_4^+ \xrightarrow[+\ \text{Oxygen}]{\text{Nitrosomonas}} \qquad NO_2^- \xrightarrow[+\ \text{Oxygen}]{\text{Nitrobactor}}$$

All forms of nitrogen fertilizers must be converted to these inorganic forms for uptake. Most of the slow-release turf fertilizers are polymers of urea or are coated ureas. Once they are broken down into the urea monomer, hydrolysis of the urea produces NH_4^+.

The NO_3-N form of nitrogen is subject to losses through leaching with percolating water and gaseous losses mainly through nitrificaiton. The NO_3-N form is an anion and as such is not held on the exchange sites in the soil. In solution it may flow to the roots of plants with water, or move downward in the soil profile if rainfall or irrigation exceeds the water-holding capacity of the soil. The greater continuity of soil pores (high percolation rate) of coarse textured soils are conducive to higher NO_3-N leaching losses.

When the oxygen content in the soil becomes limiting, as occurs when water fills the pore spaces in poorly drained soils, microbes who normally use oxygen start to use the combined oxygen in NO_3-N. Thus, the NO_3-N is converted to gaseous forms of nitrogen and escapes to the atmosphere.

The amount of N lost through nitrification has never been observed in turf situations, but in general agriculture more than 50% of the applied N has been lost as gaseous N. Most of the denitrification occurs during warm-wet springs following N applications.

The amount of N lost as NO_3-N leaching varies with soil texture, amount of N applied, N source, and rate of rainfall or irrigation. Generally, coarse texture, high N rate, soluble N sources and high rate of irrigation or rainfall increase NO_3-N leaching losses. Amounts of NO_3-N leaching losses reported from turf situations range from 2% to as high as 25%.

To prevent losses of applied N, nitrification inhibitors have been used to maintain inorganic N in the NH_4+N form. The inhibitors disrupt the ability of the nitrosomonas to convert NH_4-N to NO_2-N. Dicyandiamide (DCD or DIDIN), ridomil (Subdue), Turayole (Dwell) and N-Serve are chemicals classified as nitrification inhibitors. In general agriculture, crop responses to applications of nitrification inhibitors have occurred when the chemicals are concentrated in a band with the fertilizer at a rate of 0.25-0.5 lb/acre. In turf situations, the inhibitors must be broadcast over the surface. There are disadvantages in broadcast applications. The chemical may be adsorbed to organic matter as it passes through the thatch. Volatilization and photodegredation of the chemicals increase with surface applications. The N and inhibitor applied together may move into the soil at different rates. If the N moves faster than the inhibitor, losses of N could occur before the inhibitor disrupts nitrification. Also, broadcast applications interact with a much greater volume of soil than banded applications. Consequently, application rates must be increased, which makes the use of nitrification inhibitors less cost effective.

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The results of our work with nitrification inhibitors have varied from one year to the next. This can be expected as weather conditions play an important role in determining the amount of N lost through leaching or denitrification. Warm-wet spring and fall seasons are conducive to NO_3-N loss, consequently, response to applications of a nitrification inhibitor would occur under these conditions. However, they have not performed as well as slow-release N sources in our tests.

An important point to remember is that the application of nitrification inhibitors with urea or other soluble N sources does not change the characteristics of the fertilizer. The release of N from the N source is just as rapid so turf response and phytotoxicity are comparable to equal amounts of soluble N source without an inhibitor. Their effect is to maintain inorganic N in the rootzone for plant uptake by reducing losses of NO_3-N. As the price of N fertilizers continues to rise, the economic importance of improved utilization of the applied N increases.
