1971

TURF CONFERENCE PROCEEDINGS

Sponsored by the

MIDWEST REGIONAL TURF FOUNDATION

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PROCEEDINGS OF THE
1971
MIDWEST REGIONAL TURF CONFERENCE

The 56 talks included in these Proceedings are condensations of talks by speakers before sections and divisions of the 1971 M.R.T.F. Conference. We appreciated the willingness of the speakers to participate and prepare material for your reading. Proceedings of each annual Conference since 1948 have been prepared. A limited number of 1962, 1963, 1964, 1965 and 1966 Proceedings are available at $ 1.00 per copy. Copies of 1969, 1970 and 1971 are $ 2.00 each.

A copy of these Proceedings were mailed to:
The 725 attending the 1971 Midwest Turf Conference
One person of each member organization within the Midwest Regional Turf Foundation not represented at the Conference.
List of those in educational activities.

Additional copies are available at $ 2.00 each from:
W. H. Daniel, Executive Secretary, Midwest Regional Turf Foundation, Department of Agronomy, Purdue University, Lafayette, Ind. 47907

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For Lawns - first see articles starting on pages -

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For Sod Production - first see pages -

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EXECUTIVE SECRETARY'S REPORT

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

It is appropriate to pause today and recognize the late Carl Bretzlaff, who served as Founder, as a Director for nine years, and President for three years. In paying tribute to him we also recall other former Presidents of M.R.T.F., Taylor Boyd, Frank Dunlap, Ward Cornwell, Al Brandon and others, who have contributed so much to turf here and elsewhere.

We reach an anniversary of twenty-five years completed as Midwest Regional Turf Foundation. Chartered in 1945, with first dues in 1946, 118 members pushed off. At a peak 384 belonged in 1962, and last year over 360 belonged. Since 1950 about $ 10,000.00 per year has been made available to promote turf improvement.

The basic values, research support and education push has been the continuing aim. Your pay-off has been 12 Ph.D.'s, 10 M.S.A.'s, and some 60 B.S.A.'s. And, there are more to come - our undergrad group is the largest yet. About four graduate students are a normal load. Freeborg is doing a great job on arsenic residual, John Thorne is booming on growth regulators, and James McAfee is working on seed and bluegrass.

Lastly, twenty-one years of my working with you must become very personal. Your concerns have been my life. You wanted Poa annua controls. (Half of you are using them). You wanted water control. (We have porous rootzones, including PURR-WICK). You want educational programs. Welcome again to another M.R.T.F. Conference. There have been over 600 here each year since 1960.

Also, an average of 60 trips a year are taken which involve about 100 days and 40 nights each year. In all of this Your Foundation has been a focus; yet a way to promote turf at all levels.

Thus, after 25 years of M.R.T.F. you and I face renewed opportunity! Let's resolve that the depth of concern and understanding will be matched by a devotion to excellence. Then, some of you here will examine the 50 year mark. Meanwhile, again to those whose early work initiated what exists today goes our heartfelt thanks. We would dedicate this program and proceeding to the late Carl Bretzlaff.

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THE SELECTION OF GOOD TEACHERS

J. B. Peterson, Head, Dept. of Agronomy
Purdue University

It has been my good fortune in the twenty-three years at Purdue, before retiring in 1971, to have hired approximately 100 staff people. In most universities like Purdue, usually young Ph. D.'s with limited experience must be hired. Universities seldom give department heads adequate funds to inveigle a top, renowned undergraduate teacher from some other university to change positions, However, this is frequently done by some institutions in seeking research men. This

means the beginning undergraduate assistant professor must be pre-judged. Things to look for are:

a. Previous teaching experience
b. Intelligence and scholarship
c. Balanced personality, free of rancor, prejudice, temperament, capriciousness, sarcasm, and deceit
d. Warm-heartedness, sympathy, understanding, commitment
e. Poise, articulateness, pleasant appearance, sense of humor, tolerance, resilience
f. Evidence of liking to work with young people as demonstrated by voluntary help in such activities as Boy Scouts, 4-H, Future Farmers, Little League, Sunday School classes, church youth organizations, etc.

Securing Recognition for Undergraduate teachers comparable to that for Research Scientists

The potentially good undergraduate teacher will be reluctant to elect a teaching career unless it is apparent that he will have equal opportunity with other types of staff members for salary increases and advancement in academic rank.

To gain respectable rewards, it will be necessary for the teacher to be a good one. It will help if he can establish capacity for scholarship outside as well as inside the classroom by writing scholarly papers, textbooks, etc., and/or by doing and reporting good, basic research work.

Currently there seems to be a growing desire among universities to seek out and reward the good undergraduate teacher with appropriate rank and salary. This tendency has been quite noticeable at Purdue during the last few years. The first twenty years following World War II was a period in which research growth and achievement were great, and where research received a justly deserved acclaim from the academic community and from the public. Unfortunately, country-wide during the same period, there was not always a paralleling growth in respect for undergraduate teaching. In the future, there are excellent prospects that good teachers will receive adequate support in rank and in salary.

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MAN AND HIS ENVIRONMENT - CRISES OR CHALLENGE

Earl L. Butz, Vice President Special Projects
Purdue University

Individual citizens will have to decide "how much we are willing to pay for a better quality of life beyond that which is truly necessary" in dealing with problems of pollution and environmental control. When we quit thinking of these problems as the concern of others and face the fact that they are ours - this nation can move forward with greater effectiveness toward the achievement of a better quality of life for all.

It is completely unacceptable to believe there is no way out of the problems we have created. There are risks involved, but none so great as the risk

that we may quit risking, try vainly to set the clock back, abjectly surrender the goal of a better world in the mistaken belief that this one is as good as can be. Caution must be exercised that we don't go overboard in our hysteria to clean up the environment and make everything absolutely safe.

We constantly offset risk against benefit. We must decide if we want to completely eliminate risk in using chemicals, pesticides and antibiotics in food production, or whether we want to have an adequate, nutritious and economical food supply.

Moden agriculture cannot continue to produce adequate amounts of safe and wholesome food without chemicals or antibiotics. If we were seriously to curtail their use on farms and in the food industry, we would immediately experience a decline in the quantity and overall quality of our food supply. Consumers would quickly experience a rapid rise in food prices, and consequently would have much less to spend for all the other things that go into the fabulous American standard of living.

We farmed organic agriculture seventy-five years ago. Before we move in that direction, someone must decide which 50 millions of our people will starve. We simply cannot feed, even at subsistence levels, our 205 million Americans without a large production input of chemicals and antibiotics. We are a mono-culture of people. And, we have intense mono-culture of orchards, crops - even turf - which need protection for maximum production.

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MODERNIZING THE TURF INDUSTRY

Gene C. Nutter, Editor, Publisher
Turf-Grass Times & Southern Golf Course Operations
Jacksonville Beach, Florida

During the 70's the turfgrass industry should see its greatest era of expansion, professional advancement and modernization. The challenge of leisure time, the emphasis on a healthy and beautious environment, the rising standard of living, and the role of recreation in physical and mental therapy - all of these, as well as other factors, will lead to fantastic opportunities in our industry in the decade ahead.

New facilities of all types (golf courses, schools, parks, highways, sod farms, cemeteries, lawns of all types, resorts and vast real estate recreational complexes) will spring up all across the nation. While these new facilities will command much attention, the greatest challenge will be in modernizing the existing facilities which are rapidly becoming obsolete and inefficient. In addition to being inadequate from the use standpoint, many of the older facilities are becoming costly to operate because the out-dated design does not accommodate modern methods. Since all turf managers will not be operating new facilities, many will be faced with the more demanding job of modernizing existing facilities - and in many cases modernizing their philosophy of management.

Greater Demand on Facilities

In considering the modernization of turf facilities, let's face th basic

facts:

1. Increasing usage
2. Higher grooming standards
3. Greater demands for operating efficiency.

These three fundamentals will apply to all turfgrass facilities over the next decade because no matter how many new facilities are developed, we cannot expect to catch up with the demand.

We quickly see that these three factors are in conflict. How can we expect to provide higher grooming standards while increasing usage brings greater wear and tear on the turf, and still operate more efficiently? You bet we will - because this will be the demand of ownership. However, in many cases these objectives cannot be met on the existing obsolete facilities. Here is where MODERNIZATION becomes a necessity.

Modernize for Greater Usage

Greater usage means more activity per day, and less down time (loss of facility -use due to seasonal or weather limitations). To a great extent these limitations can be met by improving soil structures, drainage and contours.

Particularly for intensive wear, wear areas such as golf greens and gridirons, poor soil structure already has limited optimum use of many facilities for years. With the expected increase in play, these facilities will reach the point of no return. Complete renovation or rebuilding is the only answer. Applying modern soil technology, modified soil profiles can result in structures which will allow greater wear tolerance by providing more adequate aeration, drainage and a healthy medium for growing high quality turf.

Surface drainage is another limiting factor to full use of facilities. How many times have you seen golf courses closed to golf carts because of poor drainage? Ditching, trenching, resurfacing and filling are techniques to correct surface drainage. While soil modification may be impractical on large scale areas, underground tile lines are proven aids.

Tough, better adapted grasses may also be the key to better wear tolerance, hence greater usage of facilities. Fortunately, the turfgrass industry can look onward to an increasing number of improved grasses.

Modernizing for Better Grooming

Higher grooming standards will result from improvement in design, installation of modern equipment, better soil structure and improved grasses. By improvement in design we refer to reshaping to allow use of larger more modern equipment. Better grooming results from increasing the frequency of an operation such as mowing, raking of traps, or pickup of trash. With labor and budget limitations, we can increase frequency only by increasing the size of equipment, or by greater mechanization.

Take the case of the new triplex greensmowers. These efficient, new machines are bringing about revolutionary changes in grooming of greens and tees. However, many old greens are not designed to effectively accommodate their use. Or, consider the new nine-gang hydraulic mowers which can greatly increase the acreage mowed per day on extensive areas - if the facilities can accommodate

their size and mobility. And, how about redesigning sand traps so that merchanical equipment can speed up the grooming of these costly features? Redesign should also consider trees, landscaping, service roads, and other features which both increase maintenance costs and thereby limit grooming quality.

By installing of modern equipment we can quickly refer to irrigation systems. Automatic systems are the answer to better grooming and greater efficiency. This is one of the most important things to consider in modernization, and should be phased into any plans for redesigning facilities.

Golf cart paths are another example of installation for grooming improvement. The size of cart fleets has increased at an amazing pace over the last decade, and will grow even faster through the 70's. As fleets approach the 100 car size, serious wear will require continuous cart paths and directed traffic control. In many cases this will call for some redesigning of facilities.

Modernize for Greater Efficiency

Most of the above mentioned improvements will increase efficiency in facility operation. However, much more will be required. Total administration must be reviewed and streamlined. The Table of Organization must be scrutinized and updated to fit modern operations. How about job descriptions and the operations manual? When were they updated?

Labor is the predominant factor in turf operations, and both labor availability and labor requirements are changing rapidly. Everything possible must be done to develop an effective labor force. This means hiring, training and supervising practises must be studied and changed as necessary. Greater mechanization means less hand-labor, hence a high quality of labor and higher wages. Recruiting and training practises must reflect these changes.

Another major modernization need in many existing turf facilities is an improved operation center. We no longer use horses, so the old barn must be replaced by a facility with adequate size and provisions to serve as the base of a modern operation. In Jerry Cheesman's SHOP OPERATIONS COLUMN in TURF-GRASS TIMES we have introduced the Zonal Concept in designing a functional center. Every facet of the operation must be carefully considered, and proper space, tools and equipment provided for each. This certainly includes modern office and crew quarters.

In the future more and more of the manager's time will be spent in administration as a requirement for improving operation efficiency. Hence, his office should have every necessary convenience, and all equipment needed to carry out efficiency in adminstration, as well as throughout the rest of his operation. He may need to plan space for a secretary.

Yes, Moderinization has many aspects. The application of all new technology is included. Yet, to effectively utilize the new developments, old facilities must be carefully studied and modernized for increased usage, higher grooming standards, and greater efficiency of operation. This for the turf managers, will be their challenge of the 70's.

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MODERNIZING GOLF COURSE METHODS

Richard Trevarthan, Supt., Prestwick C. C.,
Frankfort, Illinois

Golf courses in the Chicago area are constantly in search of new maintenance procedures, new personnel training techniques, new equipment, and new budget management control.

In 1971, in some private clubs, superintendents have been asked to cut their budgets due to an expected drop in membership; while other clubs have increased their budgets not only for capital improvements, but just to meet the rising costs. In either case modernizing is needed.

Most courses have succeeded in cutting costs in every area but labor. The addition of new machines, such as the tri-plex greensmower and the power riding sand trap rake, has saved many man hours. However, many superintendents have not cut the extra men created by these machines, but now these men are free to be used for other jobs. We have the capability of getting more work done in a shorter period of time. In my case I have cut two to three seasonal employees; however, I have added one additional full-time employee.

Some examples of modernizing are as follows:

One club has changed its quick-coupling fairway valves to automatic hydraulic ones. This is not only a labor saving, but has given quantity control of moisture, which has produced beautiful Poa annua fairways on very poorly drained soil. Automatic irrigation as a whole is still not used on a large scale in the Chicago area.

Most golf courses use commercial tree men that are equipped with large towers for trimming at a rate of $ 35.00/hr. They save the superintendent and his crew many cold days. In the past the job was not only unsafe, but never done correctly, and in some cases not at all.

Closed circuit television is being used, whereas cameras are placed in Martin houses for course surveillance. The micro-filming of machine parts and overhaul procedures are being taped by the same golf course superintendent. He is also developing an automatic irrigation system with moisture sensing devices that are recorded on tapes.

In the last couple of years the Chicago District Association has started conducting seminars on various subjects, whereby both greens chairman and superintendent have participated. This, no doubt, has given better public relations with the whole club structure.

The superintendents are interested in keeping up. Over 80% of superintendents attended the 1971 national convention. The local wrote a letter requesting immediate attention to the GCSAA over the banning of chemicals. The large support of the GCSAA Certification program will bring a complete review of study. Examples illustrated included:

Bulk storage of fertilizer can allow 1 ton spreaders to back under them and load in a matter of minutes.

Tree removal equipment to place trees from out of the way areas to desirable areas on the course.

Sweeper on the front of a small tractor to sweep up clay pidgeons at a gun club.
A chemical to kill grass around trees, saving many hours of rotary work.

Preparing to load helicopter for application of 60 lbs./acre of potash. Takes an average of 35 seconds/fairway at a cost of $ 165.00/hr. minimum amount.

Application of a fungicide to a golf green, and insecticide to elms by helicopter.
Stolonizing a green by hydro-mulching proved fast and efficient.

Modern shop built for maximum efficiency has several doors for equipment movement at the beginning of a work day.

A large office for conducting your many office duties, with a large window offering plenty of light.

A shop offering 8,400 sq.ft. of efficient working space.
Overseeding of fairways by use of combination slicing, and placing seed at the same time in the slits.

A large tent was used by a local dealer for field days.

Incinerator at La Grange C. C. has two chambers - one chamber burns refuse, the second the smoke at 2000°. All garbage from the premises is burned. The initial cost was $ 8,000.00 - a must in the future due to many new pollution laws.

All tee quipment was placed in one neat area for fast maintenance, also serving as a focal point.

The manufacturers, the dealers, the universities, the local serminars, and all those people who work with turf have helped the superintendent to become very modern with the times.

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MODERNIZING IN THE SOD INDUSTRY

Ray Johnson, Shamrock Turf Nurseries
Hanna, Indiana

Modernizing is constantly going on in the turf industry, and especially on sod farms due to two reasons:

1. It is inherent for man to improve the situation in which he finds himself. Regardless of the progress made by our forefathers, we find it always necessary to drive on so that we may contribute something to our chosen field and to society in general. Few people are content to rely on what someone else has achieved, and those who do are not usually the leaders in any field.

2. Being practical, the most important reason for modernizing in the sod industry would be from the economic standpoint. We find ourselves constantly trying to find ways to improve an operation in order to reduce cost, and yet improve the product at the same time.

In the sod nursery business, just as in many other fields, competition stimulates this need to modernize in order to keep pace. Each grower is always alert to something that will give him an edge on his competitor, and always keeping in mind a better product at a greater profit.

One of the major factors relating to modernization in the turf industry in the past few years has been the labor situation. The rise in the cost of labor, and new and proposed regulations regarding labor camps are forcing growers to look to modernization as the only hope.

Examples at Sod Farms

Modern equipment which will do the job faster, more accurate,and better than ever before has made this one of the largest growing industries in the past several decades. For example, the sod cutter is now used on virtually every sod nursery. Sod, for many years, was all rolled by hand, but now most nurseries use some form of a sod roller.

One of the more recent forms of modernization which has been a great help to the grower is the fork lift and pallet. This is also an added service to the customer.

For the past several years, we and other growers have begun to use cardboard, disposable pallets, which is a reduction in expense, and is still another service to the customer. Now, mechanical harvestors are appearing on the market, and many sod growers are working these into their operations to combat rising labor cost, and to be able to deliver a better, fresher product to the market.

Irrigation has been greatly improved in the past few years. It was not uncommon to see a large labor force do nothing but move irrigation pipe, or if the labor was not available, some areas just did not get irrigated. We now have a large variety of irrigation systems on the market that will fit any size operation, and more important - save money and virtually guarantee a better product.

Other more specialized equipment is constantly being developed for and by sod growers - fertilizing equipment and spraying equipment such as aerial application, and fertilizing through the irrigation system. I believe one area that is just beginning to be explored is a profitable by-product from grass clippings, and we will be seeing more of this in the future.

In addition to the mechanical revolution, much progress has been made in the field of chemicals. The problem of weeds is now one of our lesser problems - thanks to chemicals. Many foreign and unwanted grasses can now be controlled by chemicals. New fungicides and fumigants are appearing on the market constantly.

Last, but certainly not least, I believe sod growers are trying to modernize by developing better grasses. This is being done by cooperation with turfgrass research stations, and also at the local sod nursery. We will never have the perfect grass, but as long as interested people are continually working at it we are going to see giant strides made in the turf industry towards that "perfect grass."

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CHANGES IN PUBLIC GOLF IN THE 1960's

Robert J. Strauss, Public Recreation Commission
Cincinnati, Ohio

Golf, once the exclusive game of the very rich, in the 60's became enjoyed by the masses. According to the National Golf Foundation, semi-public courses increased by 85% in that decade, municipal courses 42%, and private courses 38%. New course openings averaged 354 per year. Golf is unquestionably the fastest growing competitive outdoor sport.

How has this affected the superintendent? What changes have occurred? Competition is keen for the greens fee dollar. The public links golfers are demanding better courses. He migrates from course to course; his locker room is the trunk of his car. He knows what a first class course looks like because he sees them close up every weekend on television. If your course isn't in shape, if it's hilly, too rough, if your tees are hard and full of crabgrass, if your greens are sub-standard, he and his golfing buddies will drive to another.

Golf management must "care" about the golfer, the fellow who is paying the bill, by measuring up to the demands of the times, present and future. Management problems on public courses have increased tremendously. Public courses are crowded seven days a week from sun up to sun down. It is a real problem when the superintendent can get his work done. Perhaps this means some of the maintenance will have to be done under lights?

The public and private links golfers are increasingly demanding year-round golf. Are we willing to admit that winter golf does not permanently hurt our courses? That damage can be corrected when grasses start to grow again? During the month of January, 1971, Cincinnati's municipal golf receipts were over $ 13,000.00 at a time when our maintenance costs were practically nil.

Electric golf carts have arrived on the public courses, and the problems connected with them must be managed by the superintendent, and with the co-operation of the clubhouse personnel. The golfer wants the carts, especially the senior citizens, and the profits are important to the club. Rising costs, with increases jumping 10% a year or more, require an efficient operation. The superintendent must constantly be finding better and less costly ways of doing more and more sophisticated management. It is truly a real challenge for you in the profession.

The superintendent has to constantly initiate in-service training for himself and his workers. Indicative of this incentive is the tremendous interest here at Purdue.

In the past ten years, the superintendent has developed into a highly skilled individual. He has drawn on the knowledge of many of the experts in the field -- the manufacturers' representatives, university personnel, and other better trained superintendents. To be abreast of the many improvements that are taking place, he must draw on the ability and knowledge of others, and he must apply the techniques learned, training his personnel on the courses.

The design of new publicly operated courses, the successful ones, have certain definite characteristics. Some of the important factors are:

1. Easy walking terrain
2. Large greens and tees, so markers and cups can be moved more frequently
3. Wide open fairway and minimum rough for low cost maintenance and fast play
4. Few, if any, sand traps
5. Watered fairways if free city water or natural water is available.

The future of golf, we all realize, is tremendous. Men and women, including seniors and people from all walks of life, are demanding more courses and better facilities. The problem of financing is a major one. Many cities and counties are using the self-liquidating revenue bond because the golfer is willing to pay his own way.

Tremendous opportunities for new well-trained golf personnel, with attractive salaries, should be the order of the day. This will surely happen for the superintendent who possesses enthusiasm, a love for his work, and the capacity and willingness to constantly learn a better way of serving the public or private links player.

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IDEAS THAT PROMOTE GOLF

Jerry Claussen, National Golf Foundation
Lakewood, Colorado

Does golf need promotion? All public courses in populated areas are crowded. Publicity given Eisenhower's interest and Alan Shepard's shot on the moon helps. TV of major tournaments and filmed pro matches expose many people.

Leisure time and affluence of American middle class permits play.
Image of clean, outdoor, family activity, no big investment near home attracts.
Industrial-company leagues and tournaments develop new interest.

Junior programs in schools and colleges produce new golfers.
NGF consulting for feasibility, and promoting public facilities in cities springs ideas into action.
Management ideas to promote existing facility:

Invite company leagues and one-day tournaments
Help promote golf events for charity benefits
Work closely with local press-radio-TV on golf news
Encourage formation and tournaments for men's and women's associations.
Have junior group lesson programs and club for tournaments
Work with high schools and colleges for team use and practice
Place scorecard and fact sheet in nearby motels
Have annual clinic with well-known professional
Advertise in local newspaper
Give weekday promotional rates for seniors, juniors, women
The pro-manager must be public relations conscious.

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IDEAS FOR YOUR GOLF COURSE

Jerry Claussen

A famous author of the 19th century wrote: "He is the greatest artist who has embodied, in the sum of his works, the greatest number of the greatest ideas." That might also be said of golf course superintendents, architects, and builders, because a great golf course is a work of art, the sum of nature's raw material and men's creative ideas.

A golf course is never finished. The increasing demand for perfect playing conditions, plus beauty, is a constant challenge to the best of superintendents. But, it is this challenge, I believe, that makes the golf business so attractive.

A real professional never stops looking for ideas. A superintendent who cares, who has imagination, good judgment and an open mind, will find ideas everywhere. Every day he will find new ideas, sort out those he can use and adapt them to his course.

It is impossible to attend a Conference like this and not go home with at least one new, usable idea. We find new ideas from speakers, from talking with other superintendents, from visiting other golf courses, from visits by salesmen, from reading books and magazines, and research reports. I think most superintendents find they have more ideas than they have time or budget to use.

We of the National Golf Foundation are in the ideas business. We don't originate many, but we do try to find the best information on golf course planning and operating, and tell others about it. So, we hope you will never stop looking for ideas to make your golf course better. A supintendent is an executive. An executive is paid to find ideas and use them with good judgment.

The credit for ideas belongs to thinking superintendents at many golf courses. In his own way, each is an artist who has created something special. We hope each of you takes as much pride in your own facility. A series of 100 slides was shown.

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TAXES AND SERVING GOLFERS - A PANEL DISCUSSION

Wm. E. Lyons, Lyons Den Golf
Canal Fulton, Ohio

In the morning mail came a story that Paul Truckenbrod, Sunnybrook Golf, Kent, Ohio, took from the Miami, Florida Tribune, Mike Fowler, writer. It may be a real lesson for us. It is his story of a mockingbird in a holly tree, and how she alone defended her domain. "Just one mockingbird," wrote Mike, "thousands of robins, and she drove them off."

Where favoritism is shown by politicians it is usually in favor of the "most votes." Owners of golf courses and private clubs do not have the most

votes, nor do we have enough money to hire a lobby to persuade legislators. So, what can we do?

In Ohio the constitution reads that all real property shall be taxed in its true value in money. What is the true value of your golf course? Is is the market value? The tax sale value? Is it the construction cost? Or, is it the hypothetical value under the all encompassing phrase, "Highest and Best Use?"

The Ohio taxing laws, as in many other states, were written by our wise Puritan forefathers when a work day was 10 to 12 hours, and recreation was looked upon as a cardinal sin. I was told in Pennsylvania last week that they (the Puritans) sinned but did not know how to enjoy it. Nowhere in the Ohio tax code is the word recreation mentioned.

On the USE basis all property (real) is bracketed in:

Residential
Agriculture
Commercial
Industrial

As a result taxing authorities wised up. Since they have the last word, they chose to put all golf courses in the COMMERCIAL bracket. Finally, after five years of effort, one mockingbird has gotten the owners of courses and clubs to see the need of having RECREATION spelled out in the taxing regulations. It is still years away from accomplishment. We hope for enough mockingbirds to win this fight.

Another avenue is "OPEN SPACE" legislation. There have already been five bills put into the legislative hopper in Columbus as a result of the popular ecological and environmental boom now emotionally sweeping the country. Our efforts now point to getting the authors of those five bills to meet and consolidate all of the good points into one good bill and everyone back it. If the Good Lord lets me I will return next year and report the progress of our legislative efforts in Ohio.

There is not one of us here who is so selfish that we want to shift our tax burden to our neighbor. Here is a chart made up from county records, and may I suggest you go home and do this for your property, to be able to compare the values assessed:

Golf Course	$ 1730.00 per acre
Farm A (South)	334.00 " "
Farm B (West)	240.00 " "
Farm C (North)	352.00 " "

From these comparisons one cannot help but wonder why an acre of bluegrass as a golf course should carry such a high value as compared to a farm. The auditor's answer was "USE."

We have had to operate in Ohio with a board of Tax Appeals. Sounds good, but the joker is that the same people who assessed the tax values are the judge and jury. Does an appeal have a chance? Not very often!

Farmers in Ohio are being relieved of the personal property tax on their equipment. But, because we golf course owners are not in the FARMER classification we are not eligible. Discrimination?

In Pennsylvania there is a law that a township can get permission from the state legislature to levy a 10% amusement tax. It can be charged on greens fees and bowling, but the theatre owners battled and won, and do not have to charge it. Discrimination?

In Ohio some wealthy landowners are using the $40.00 per acre FORESTRY regulations to hold land speculatively that has a market value of many thousands.

We also have a farm pond or lake law. To qualify for this the Soil Conservation Service has to certify the pond or lake. The owner is given much lower valuation for the acres covered with water. On the other hand, in Geauga county, Ohio the tax assessor put a higher valuation on the water covered acres than on the land. All ponds or lakes were assessed at $ 1,000 per acre value.

In the same county all golf courses from the best to the cow pasture type were assessed a flat $ 8,000 per hole, plus land values. In other counties the values were set at $ 4,000 per green, plus acreage. Size, building costs, etc., were not considered. In our case, the tax values assessed are many times higher than our costs. Our buildings now are assessed at more than their costs.

To summarize, the tax situation is becoming a jungle through which golf course owners need a guide. To hire a trained tax lawyer we will have to organize strong state wide associations to guard the interest of "OPEN SPACE" for all the people.

In your state you may already have District Golf Club organizations. We have four in the metropolitan areas of Ohio, plus the Ohio Outdoor Recreation Association, which includes membership to the fee course owners. We could not get these organizations together until after the "horse was stolen." Now they are trying to lock the door. Membership in the Ohio Outdoor Recreation Association is less than 10% of those who could benefit - yet progress is being made.

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GOLF COURSE TAXES

Thomas M. Tuttle, Manager, South Shore Golf Course
Syracuse, Indiana

The South Shore Golf Course is located in Turkey Creek Township, Kosciusko Country, Syracuse, Indiana. It is a semi-private 18 holes on 125 acres. Few improvements were made over the years.

It was built in the early 1930's, the club house was remodeled in 1945, and an underground watering system was added in 1966. (Approxmite cost watering system - $ 15,000.00). Property taxes went up 150% in 1969. The same is true for other two (125 acre and 18 holes) golf courses in the Syracuse area. It is disturbing that the township assessor stated that the fact that a golf course is a seasonal business is not taken into consideration -

1. 80% of income derived in a 16-week period
2. However, seasonal operations are treated the same as year-round operations.

The township assessor stated that the State of Indiana wanted a $ 2,000 to $ 6,000 per acre assessment (depending on location, etc.) Therefore, a larger course is penalized unfairly.

Example: 18 holes on 80 acres
18 holes on 150 acres

Both courses generate same amount of gross sales, i.e.,

80 acres - $ 3,000 per acre assessment - $ 240,000.00 in tax base
150 " - 3,000 do - 450,000.00 do

Proposal: Fairer Tax System

A. Taxes should be tied to gross sales
1. Currently owners file S.T. 103 sales tax return each month
2. I propose that an additional form be composed to enable owner to pay taxes based on monthly sales
3. This form would be filed each month accompanied by payment of property taxes for that month

B. Change name from property tax to "land use tax."

C. Advantages -
1. To state -
a. Can establish a cash flow system by receiving money monthly
b. Can benefit immediately from capital expenditures on part of owner.

2. To owner:
a. Smaller payments
b. Payments made in month when owner has cash flow.

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TAXES AND SERVING GOLFERS

J. Henry Amt, Owner, Old Orchard Golf Course
Elkhart, Indiana

Real estate taxation of golf courses is interesting for two reasons: my unpleasant experiences with the tax assessor, and the increasing extent of the problem.

You have probably read most of these same articles. A paragraph from the March issue of Golf Digest points up a threat to all of us - "Property taxes are skyrocketing in many areas, and clubs in other parts of the country are afraid the trend may be contagious. Instead of being taxed on the basis of 'recreational use,' many clubs are being taxed on the basis of 'best land use.' For a club located in or near the city, this practice can prove disastrous. The land may be assessed at the same rate as nearby high-rise apartments.

For example, in one midwestern area some clubs have recently been assessed at five times what they once were. The assessment on a club near Cincinnati jumped last year from $ 58,000.00 to $ 304,000.00. In Minnesota recently, the

assessed valuation of one course rose from $ 3,200 an acre to $ 16,200, with the total tax payment jumping from $ 26,000 to $ 112,000. The ecology-conscious Minnesota State Legislature evidently saw that there was a danger of driving country clubs out of business, and passed a green-belt law to protect open spaces. Some states are not as understanding. On the north shore of Long Island a club hit by a tax increase of $ 93,000.00 shut its doors and sold out."

My own personal problems are not yet quite so serious. In fact, I presently have a tax rate that I would be happy to live with, but unfortunately someone goofed on the last assessment and the township assessor knows it. And, my relationship with the assessor has not been a bed of roses.

Several years ago I completed my first nine, and subsequently received a notice of the reassessment on the portion of the land that was now golf course. I thought that the amount was unreasonable and checked with the assessor to find out how he had arrived at that figure. I found that he had overstated the amount of acreage that went into the course by 25%. He said he would have it checked, and if confirmed would make an adjustment. In the meantime I was to pay my spring installment, and the correction would be made on the fall installment. It took much needling to get his depty out to the course, but he finally got there just a couple of days before the fall installment was due. He confirmed the error, but I didn't pay the fall installment.

In the meantime, I had built another nine holes. Also in the meantime, the entire state was undergoing a reassessment by an outside agency, and they treated me very well. By spring of the following year I had still not received the adjustment on the prior year's taxes, but I went ahead and paid the current year's taxes. Having been promised an adjustment on the prior year, I was determined that I was not going to pay the delinquent installment until it was made right.

To conclude a long story, in August of last year I called the township assessor and asked him when he was going to get things straightened out so that I could get current on my taxes. He said they were working on it, and by the way, someone made a mistake on the taxation on the new nine which was in my favor, and he would like for me to come in and see him. This sounded like trouble, so I went right to the treasurer's office and not only paid the back taxes with interest, but I also prepaid the fall installment before any changes could be made on that. I'm not looking forward to the new assessment notice which I expect to receive any day now.

Why should I have to be so concerned about real estate taxes? Why should you? As far as I know there is no standardized basis for assessing golf courses in Indiana. For example, in one county four courses within ten miles of each other are assessed at the rates of $ 1,500, $ 1,500, $1,200 and $ 1,000/acre. One of these was at $ 2,500 and then reduced to $ 1,500 on appeal.

We are providing a recreational facility which in some cases is doing a job that the municipality would otherwise have to furnish, or we are facing competition from a municipality which does not pay taxes, and yet we have to provide all of the same services. So the tax advocates say, "But you are a business man in this thing to make a profit." O.K. The farmer is also a business man. We are both doing something that benefits the public but with a profit motive.

Before I built the golf course the farm land paid less than $ 500 per year in real estate taxes on the land. He rented the land to an operator who was paid over $ 900.00 by the federal government to not raise crops. The net effect to the taxpayers was a deficit of over $ 400.00 in tax money. On this same land I developed

16 lots, each of which now has a $ 25- to $30,000.00 house, plus I built a club house and storage building, all of which add considerably to the tax take; yet I am personally worried that I may be taxed out of business.

Why is now the time to do something? Two reasons - our State Legislature is looking for more tax resources, and the current emphasis on ecology makes our existance more important.

What is being done in Indiana to protect ourselves from taxation oblivion? At one of our Michiana Superintendents meetings last year, John Raber and I made a list of golf course owners in the state. Prior to that John had talked to the Lt. Governor about our concern, and was told that if we would like to bring a group to Indianapolis to discuss the matter we would be given an audience. John and I sent out about 50 questionaires to sample the interest of other golf course owners. We received answers from fifteen people saying that they were interested and would like to participate. They also gave us the names of some additional owners to contact. We need others. We will set up a meeting. If any of you from other states have any suggestions we would appreciate all the help that we can get.

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GUIDELINES AND TRAINING FOR THE INEXPERIENCED

Ariel C. Hunt, Assistant Supt. of Parks
Evansville, Indiana

My purpose is to bring together some of the guidlines and training methods needed to develop an efficient work force, whose purpose it is to maintain the landscape in a knowledgeable and effective manner.

W. L. Marsh in LANDSCAPE VOCABULARY defines landscape as - "That portion of the earth's surface which is visible from any point on or above the land surface." Proper maintenance has long been neglected due to the passive attitude of educational institutions, business, industry, governments, and the people in general. This same complacency has led man to the brink of his own environmental demise, and polluted him into a corner.

Whatever ecological microcosm we are working in we need knowledgeable people to do the work. Good help is hard to "come by," and by "good help" I mean people who will apply themselves to the task of learning and initiating proper programs of maintenance. It is our duty then to supply a program, pertinent subject matter, and practical experience for our employees.

I'm reminded of one educator who said, "My greatest student (or employee, if you like) is one who, under my teaching, learns to surpass me." More often than not we destroy our constituents by the omission of guidelines and training, and as a result destroy ourselves in the process. This, then, places us in the original position of looking for help again, and when we find him, we begin the cycle of employes and self-destruction all over again. Putting it simple - let's help people take care of the landscape in such a way that they can take care of it by themselves. Let's share, through an organized program of training, our experiences and knowledge so that the employe will feel a sense of pride in being an important part of our maintenance program. How then do we do this?

Most people, by nature, want to know "why" they are performing a certain task, as well as "how," "Where" and "when." But quite often to know how, where and when to perform a job becomes meaningless unless he knows "why." Knowing "why" will cultivate his interest, and provide in many cases a stimulus to broaden this knowledge and efficiency. We, in other words, must mold and form our employees to our program - we cannot afford to pick up people from the street, let them flounder, and expect them to be "good employes."

During the past six weeks we, in Evansville, have been holding landscape maintenance classes every Thursday evening from 7 to 9. These classes meet in the 4-H demonstration room of the County Extension Agent's office. We have had good attendance from the grounds maintenance departments of the universities, the Civic Complex, industry, garden clubs, and the general public. These classes were organized originally to instruct park personnel in all the areas of grounds maintenance. Since we were going to spend considerable effort in bringing this information to our people, we felt other groups, including the homeowner, would benefit.

Each person in the class is encouraged to make a booklet containing his own plan of maintenance for his particular area. This booklet also contains a description of his area, identity of trees, shrubs, ground covers, turf and other miscellaneous landscape structures (i.e., parking lots, roads, walkways, etc.) Mineos and bulletins from Purdue are supplied, and he is introduced to other publications from extension services of other universities. He is exposed to magazines such as - Grounds Maintenance; Weeds, Trees and Turf; Park Maintenance; The Golf Superintendent, etc. These classes then serve as a medium for employee training, as well as for civic groups and the general public. The employee and superintendent's relationship, of course, is a much closer one, and it is our duty to help the employee apply facts and theories in the field.

Encourage and stimulate each employee to expand his worth to the limits of his ability, and provide him with training and guidelines that are meaningful. If we cannot communicate our knowledge and experiences, including what we learn at this Conference, we are in trouble.

The guidelines and training aids illustrated are only a few - there are many others. Their purpose, of course, is to simplify maintenance procedures so the inexperienced person can, with your supervision, know what his job is all about.

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PLANS FOR EXTENSIVE TRAINING IN TURF

W. H. Daniel

Let's agree that increased regulations, additional materials, new personnel, and intensive management face you as turf managers. What about special training and credit programs? How many of you wish a special, intense, concentrated training session or schooling?

Herbicides, insecticides and fungicides are plant protectors. So, do you wish to intensely study them? The general plan suggested is:

Monday	Arrive by 2:00 P.M.	Class:	2:30 - 5:00	7:00 - 9:00 P.M.
Tuesday	Test: 9:00 - 12:00	"	2:30 - 5:00	7:00 - 9:00
Wednesday	Test: 9:00 - 12:00	"	2:30 - 5:00	7:00 - 9:00
Thursday	" 9:00 - 12:00	"	2:30 - 5:00	Dinner & hash session
Friday	" 9:00 - 12:00	Close - go home		

Now, that is intense - lots of contact time. Likely there would be one section for golf course superintendents only; then another section for salesmen, general turf, or younger persons.

Plans for Intensive Training

It will require - much lecture time
much reference papers, etc.
much study
considerable test preparation
definite grading and standards

Only those passing will receive certificate.
Those not passing would have references and learning obtained.

Assume this was $25/day, plus personal expense, and it is four days of hard study and concentration, with no easy lessons.

We'll appreciate your comments. We can work with the GCSA in their Certification and will join anyone in the mutual goals.

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INJURIES AND ATHLETICS TODAY

W. E. (Pinkey) Newell, Athletic Department
Purdue University

Sports, by their very nature, invite injury. The all-out effort required, the speed of movement, throwing and striking of missiles, and the rapid change of direction are among the hazards inherent in sports activites. These are the hazards that are responsible for the various injuries suffered by the athletes.

There is no comprehensive estimate of the number of athletes injured annually in athletic competition. Insurance companies, however, report that tens-of-thousands of athletes suffer fractures, sprains, strains, abrasions and contusions annually. Statistics also indicate that the annual number of injuries resulting from athletic competition, especially, football have been increasing steadily.

The blame for this increasing number of athletic injuries does not, however, rest with the nature of the activities alone. The increase is also due to the increased participation of youth in the sports programs of today. An example of this involvement is the estimate that more than 810,000 young men in over 14,000 high schools alone participate in football each year.

If the risk in sports competition, such as football, is to be justified, every sports program is morally obligated to do everything within its power to

prevent injury whenever possible, minimize the severity of the injury, and treat each injury promptly and properly with total rehabilitation as the goal. In order to fulfill this obligation, each community must develop an athletic training program with appropriate personnel to carry out such a program.

Editor's note. It was reported there are 30 athletic fields with either Tartan, Astro, or Poly turf now in use. Basically the player runs, stops, turns, pushes, and falls. Basically the ball bounces and rolls. For running, the artificial tracks have been very successful. For bouncing, some of the basketball floor coverings have proven quite uniform. For economy and speed in running, the artificial turfs were made with limited cushion. Their shock absorbency has real limits.

The report of more upper body injuries reflect the inherent firmness used in artificial turf. The extreme traction provided when the shoe firms onto Astro stops the shoe, but does not stop the body movement. This phenomena has led to numerous injuries including toes and tendons. When a body falls it might strike the surface, transfer the shock to the hip, or the elbow might strike the surface and transfer the shock to the shoulder, thus hip points and shoulder separations are produced.

Vertical drainage has always been needed to allow for scheduled athletics. The dilemma of trying to remove all water across the surface has made the traction during wetness very variable on artificial turf. (In natural turf this problem must be solved also).

Heat accumulation and reflection in artificial turf presents additional problems. A study at Penn State reported surface turf temperature to 140°, while the turf adjacent was 90°. On a partly cloudy day the temperature was 132°, while the grass temperature was 95°, and air temperature was 86°. Due to this, foot temperatures were raised within five minutes after being on artificial turf. Because of blood circulation the foot temperature remained below the pain threshold of 113°F.

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MAINTENANCE OF ATHLETIC FIELDS

Melvin J. Robey, Supt. of Athletic Facilities
William H. Daniel, Dept. of Agronomy
Purdue University

A dense, wear resistant turf is important in reducing injuries, providing sure footing, and presenting a pleasing appearance. A program which recognizes the importance of good maintenance practices should be a part of every school's budget. A properly maintained field will have a deep rooted, tightly knitted stand of grass, which is resistant to wear, and firm to a player's footing. The surface will be smooth, and have resiliency to cushion falls and minimize injuries.

A maintenance program must use many known agronomic principles, combined with common sense and good judgment. The person placed in charge of the athletic field needs to be trained and have some experience in Turf Management. However, a person with limited knowledge of turf care can do a good job if he is interested in the field's condition, and has the ability to grasp new ideas. Information from state experiment stations, Extension offices, golf course superintend-

ents associations, turf suppliers, private consulting firms, text books, and turf magazines are of value as guides in athletic field maintenance programs. An understanding of what needs to be done and the principles involved will greatly enhance any program.

Maintenance Procedures for Athletic Fields

The four basic procedures considered minimum maintenance for any athletic field include: selection of adapted grasses, fertilization, watering and mowing. Seven manicuring procedures, which can be used in conjunction include: aerification, topdressing, pesticide application, overseeding, drainage improvement, plugging and rolling.

Selection of Grass

In order to select the best grass many factors must be taken into consideration. For example, what kind of wear is it going to be subject to? What extremes in climatic conditions and soil conditions may occur? And, what kind of maintenance procedures are going to be used?

There are many different varieties and species of grasses that can be used on a football field. They may be rhizomous, stoloniferous, or bunch in growth habits. They can vary in disease and insect resistance. Some require warm climates, while others do best in cool regions.

In northern, cool, humid regions varieties of Kentucky bluegrass have been most used. Occasionally ryegrasses for quick starting, red fescue for drouth tolerance, or Zoysia for wear resistance are added to bluegrass. A single variety, or a blend (mixture) may be considered when selecting a grass. Some of the bluegrasses on the market include: Park, Delta, Newport, Merion, Windsor, Sodco, Fylking, Pennstar and A-20. An example of a blend would be Delta, Park, Newport, and Merion in equal proportions. One advantage of a mixture is the insurance it provides. If a disease weakens one or two of the varieties, those which are less susceptible may fill in. Ample, strong rhizomes seem to be the essence of good results with bluegrasses, which also means good wear and recovery.

Bermudagrasses are seldom blended together. Instead a single variety will be grown. Overseeding ryegrass, Kentucky bluegrass, fescue and annual bluegrass into dormant Bermudagrass is a common practice. This is done to extend the greenness. Some of the Bermuda varieties available are: Tiflawn, Tifway, Sunturf, U-3, and Tiffine.

Fertilization

A football field should be fertilized at least twice a year at a minimum, and more often if it is possible. The first application should be in the early spring to cause the grass to come out of dormancy faster. An early fall application is important to carry the growth of the grass through the end of football season, and allow some carryover into the following spring. A third application should be applied just prior to fall football practice sessions. The fields should be amply watered after each application as fertilizer may burn turf leaves.

Regardless of the number of applications used, the overall goal is to apply 3 to 6 lbs. of actual nitrogen per 1,000 sq. ft. per year. One high in introgen, low in phosphorus, and medium in potassium is usually best for turfgrasses. Some fertilizer analyses available include: 16-4-12, 12-4-8, 18-5-9, 10-3-7, 22-5-8, and 30-3-10.

Terms which describe the rate of release from different sources of nitrogen should be understood prior to selecting a fertilizer. Quickly available, soluble forms include ammonia, nitrate and urea. Thus, ammonia nitrate, potassium nitrate and urea sources are used alone, or in mixtures, when a quick greenup is desired; when cold temperatures limit response; or lots of fresh decomposing organic matter have been added to the field. Also, these sources are economical to use. The soil solution and exchange complex in soil may store and hold soluble portions for 3-6 weeks unless excess rains or irrigations leaches them. Thus, 4 or more applications - early spring, early summer, early fall and early winter (March 15, June 15, Aug. 15, Oct. 15) - are suggested. Pelletizing and coatings have minimized foliage burn.

Medium available nitrogen sources, which release nitrogen by deterioration, include organics and cold water soluble fractions of ureaforms. Hot temperatures and ample moisture favor faster release, whereas cold soils minimize availability.

Slow release nitrogen sources include hot water soluble and hot water insoluble portions of ureaforms (Uramite, Nitroform and others), and IBDU (Isobutyldiene diurea). The larger molecules of ureaform break down slowly by bacterial action. With IBDU the slow dissolving by hydrolysis (water solution) can be controlled by increasing particle size. Thus, larger particles (1-3 mm) will last longer.

The best turf fertilizers manufactured with a complete analysis contain about 50% slow release nitrogen sources. This means that when this type of fertilizer is applied half of the nitrogen is ready for immediate use, while the other half is released gradually, and is available over a longer period of time.

Watering

One of the biggest problems in maintenance of football fields is the tendency to overwater. Too much watering is just as bad as too little, probably even worse during football season. With pop-up, padded sprinklers, automatic irrigation can minimize labor needs. If hoses are still used, use turf or lawn type traveling sprinklers with automatic shut-offs. If non-traveling sprinklers must be used, repeatedly set them so there is a 50% overlap in coverage for more uniform water distribution.

Check the soil when the watering has been completed. There should be moist soil at least 6 inches deep. Do not water the field again until this 6" reservoir of water has been utilized. This should take 1 - 2 weeks, depending on weather conditions. Test the soil moisture content by using a soil probe. If the soil is friable (crumbly) then it is about time to water again. However, in the summer wait until the grass starts to show signs of wilting. Check the field during the afternoon. If the grass blades have started to roll up and turn a bluish color it is time to water again. Infrequent watering will favor deeper roots. If a field is overwatered, the grass roots will grow only where there is adequate oxygen, causing shallow-rooted plants which can be easily torn out. It is better to underwater than to overwater.

During a game it is better to have the field a little on the dry side, which allows for some rain, makes a faster surface, and also will reduce the tearing up of the turf. Too heavy of watering before a game, followed by rain before or during the game, can create a mud hole. Close consulting with the local weather station can help coordinate the watering schedule with predicted precipitation.

Mowing

The grass should be mowed often enough so that clippings are shorter than mowing height. This will leave sufficient leaf area to carry on photosynthesis for normal growth. If too much of the grass blade is removed it is a shock to the plant, and the overall performance of the grass will be reduced temporarily.

If used, tall fescue should be cut at 2½ inches. For those bluegrasses which don't show dwarfness, such as Delta and Park, the best mowing height is 2 inches. Bermudagrasses are cut near 1/2 to 3/4 inch. The height of cut must leave enough leaf surface to carry on photosynthesis, and a dense enough playing surface to support heavy use.

A reel type mower, which makes a clean cut across leaf blade, is the best type to use on a field. Rotary mowers tend to leave a frayed leaf tip which turns white due to dead cells. If rotary is used, sharpen blade tips monthly or oftener.

Aerification

Beyond the four basic maintenance procedures, aerification is the next most important procedure. It reduces soil compaction, improved infiltration helps to level the field, protects the crowns (growing points) of the grass, and creates a safer playing surface.

Aerification once in mid-summer, when the weather and soil conditions permit, and again in the fall immediately after football season is suggested. The entire field should be passed over twice, or more, with the aerifier from different directions.

If the field is severely compacted then a more intensive program needs to be developed. Some fields have been aerified ten times in one day. If necessary the field can be aerified once a month starting in the spring, and continuing through to football season. Aerification should be avoided during the three weeks prior to the start, or during the football season as the loosened turf would be torn out more readily.

Aerifiers have hollow tines which remove a core of soil from the ground, thus forming an air pocket with a minimum of soil compaction. After aerifying the fields, let the soil cores lay on the ground until partially dry. Next drag the field with a chainlink fence drag, or steel mat. This will break up the soil cores, help fill in the low spots in the field, and bury the crowns. Greens-aires with core shredders attachments permit 2 x 2" holes, and immediate shredding of cores also.

Within two weeks after aerifying, the young white grass roots can be found growing in a mass in the aeration holes. This helps to create a tough, wear-resistant turf which is capable of withstanding heavy use. It should be noted that there is a difference between spiking and aerification. Spiking is a process in which a solid metal finger punches a hole through the turf and into the soil. Although it does create an air pocket in the soil, it also compacts the soil around the hole. If only spiking machines are available then they should be used.

Topdressing

If any type of organic topdressing is to be used (peat, manure, crushed corncobs, treated barks, cotton seed hulls, etc.), it should be spread evenly over the entire field prior to aerification. This allows the soil to be brought up on top of

the topdressing material, and allows the two to be easily mixed in the dragging operation, thus speeding up the breakdown of the organic matter. It should be remembered that with the addition of large quantities of organic matter, extra nitrogen will also be required.

Eight reasons for applying topdressing material are:

1. Protects crowns of grass from being damaged by football cleats.
2. Levels the surface of the playing field.
3. Increases resiliency of playing surface, thus minimizing player injuries.
4. Improves soil structure.
5. Increases water-holding capacity of the soil.
6. Increases water infiltration and percolation rates.
7. Builds up the nutrient level of the soil.
8. Increases cation exchange capacity of the soil.

Pesticide application

Pesticide application should be done only when there is an adequate understanding of how the chemical works and what it controls. Most failures or problems can be traced back to a label that was not read, and directions that were not followed. A mistaken idea of the novice is that if a little is good, a lot will really do the job! Numerous new and old laws and regulations must be adhered to.

There are three groups of pesticides commonly used on athletic fields:

1. Herbicides - weed control
2. Insecticides - insect control
3. Fungicides - disease control

Of the three groups, the insecticides are the most dangerous to handle. Care should always be exercised whenever handling any pesticides.

Broadleaf plants, such as dandelions, plantain and thistles, are best treated in early to mid-summer. Standard rate of 2,4-D amine formulation is less than one pound active ingredient per acre. Check the labels and follow the directions. On knotweed, chickweed, clover, etc., dicamba at 1/8 lb. active ingredient per acre is ample when added to 2,4-D, or MCPP.

Many annual grasses, such as crabgrass, foxtail and barnyard grass, can be controlled by applying pre-emergent chemicals in mid-spring prior to germination. These may be granular (on fertilizer) or liquid. Timing is critical as toxic concentration, whenever seedling starts, is necessary.

Insects are generally only a minor problem, yet they may cause serious turf damage. By all means keep out grubs, and if needed keep sod webworms from eating the leaves. Insects, such as leaf hoppers flying around the face and getting in eyes, nose and mouth, are bothersome to players and can distract them.

In areas where high humidity combines with high temperatures, damage caused by fungi can become a serious problem. It takes an experienced person to be able to tell which diseases are present and their seriousness. In some cases a broad-spectrum fungicide, or the "shotgun" approach is acceptable. Actually, preventive application of fungicides is the best way to keep diseases in check. For example, on leafspot in bluegrass, four applications a year may reduce damage to low levels. Again, it is necessary to read the label and follow the instructions if the chemical is to do the job properly.

Overseeding

Overseeding is a good supplemental program to aid the grass already growing, plus establishing new grass in the thin, worn-out areas. The grass seed used should be of the same variety or species already established on the field unless newer varieties are preferred. The seed should be sown down the center of the field, or on any worn areas before each home game. The cleat action during a game will help push the seed into the soil.

Where climate permits, don't hesitate to overseed the fields late in the season, even though the temperature is too cold for germination. The seed will lay dormant through the cold weather, and germinate the following spring when the weather warms up. When plans are made to aerify and topdress the field, seed, if needed, should be sown ahead of these operations. Aerification and topdressing will mulch the seed and create a favorable seedbed.

The practice of overseeding will work best if there is little use of the field in the spring. Often ryegrasses are added if a quick stand is desired. However, this should only be considered a temporary solution to the problem.

Drainage improvement

Most fields have too little drainage for wet weather conditions. Prompt removal of water from the surface of the field is important if a player is going to have good footing. A wet, soggy field will slow play, and create a field which is detrimental to good football games. Injuries are least when players get expected turf responses.

Surface slope aids in slowly moving the excess water towards the sidelines. In most cases a crown will be built into a field during construction for this purpose. From center to sideline, a 12" crown should be considered minimum, while 18" is ample. Surface slope alone is usually not enough for modern heavy use.

Another method which aids in excess water removal is narrow vertical trenches. These are made 2 to 3" wide, 12 to 24" deep, and 10 to 20' apart. After partial backfill with fine gravel, use fine or medium sand for the last top 3 to 6" to overflow. The purpose of the sand is to give a little more water holding capacity at the surface where the roots are growing. The narrower the trench, the quicker the grass will bridge it. The trenches should be connected into the tile system around the perimeter of the field so that the water can move out of the trenches. If a tile system is under the entire field, then the vertical trenches should connect with them whenever possible.

Plugging

Putting sod plugs into a field is the surest way of filling in damage during football season. The sod plugs should come from a sod nursery which has the same type of grass. The plugs should be cut at least 3" deep, and have a 4 to 6" diameter. Care should be taken to insure that when the new plug of grass is placed in the field that it is flush with the existing turf. A cup setter, similar to that used on golf course greens, is the best tool available for this job.

Rolling

Where needed, rolling in late winter or early spring, whenever frost heaving and weather permits, can help to level the field, and push the crowns of the grass back down into the soil, thus protecting them from desiccation. Care must be taken

not to roll the field when it is too wet, or to use too heavy a roller. The turf can be rolled lightly, as needed, at other times during the year provided ample aerification has been accomplished also.

As mentioned earlier, selection of vigorous grasses, regular mowing, ample fertilizing and careful watering should be the basic practices of every athletic maintenance program. A football field requires regular maintenance just as buildings do. Initially a large sum of money was spent on the building of the field, and it should not be allowed to deterioate. The manicuring techniques will greatly improve a playing field. However, the budget might prevent some of them from being used.

In summary, the best possible football field will be obtained only if there is an adequate budget, a trained or interested person in charge, and correct application of the agronomic practices.

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THREE BASIC WAYS OF BUILDING ATHLETIC FIELDS

W. H. Daniel, Turf Specialist, Dept. of Agronomy,
Melvin Robey, Supt., Athletic Facilities
Purdue University, Lafayette, Ind.

Prompt removal of surface water is necessary for today's athletics. Fields always ready for use are the desired aims regardless of rootzone, grass or weather. The old idea of deep field tile under soil is obsolete - too slow. Shallow, porous, narrow vertical trenches with porous backfill is the more modern way. Thus, System I is - SOIL & VERTICAL DRAINAGE - ECONOMY -

Compaction will be a continuing problem with annual intense cultivation needed. Surface and suits may be muddy in wet weather. The system can upgrade existing fields, or be started as new fields start. In it soil is the basis of management.

System II - Thin Compacted Porous Rootzone. A limited layer of sand over soil assures fast water absorption, and minimizes compaction. Turf surface and players suits should stay clean. Turf must be kept dense. (System widely used in Northern Europe - developed in Sweden by Bjarne Langvad).

Soil and Frequent Vertical Drains - Economy

On existing, or new fields, improved playability via prompt removal of water is the key concern. Compaction will be a continuing problem. Surface and suits may be muddy in wet weather.

Slope - use 2 - 3% off of field, 1 - 2% on field (center 12-18" above sidelines). Avoid surface water running onto track.

Soil - (Save and conserve topsoil). Work only when dry. Slope to grade. Mix in ample fertilizer (1000 lbs. 16-4-8, or equal, inside track).

Trench -

a. Make on 45° angle at 5 yd. interval, narrow (2 - 3") vertical trenches (12-20" deep)
b. Spread or remove dug soil
c. Hand clean and check trench. Use narrow spring tooth on added handle.
d. Place 2" ID corrugated, slitted drain pipe in each (Hancor's Cor-flow, or equal)
e. Backfill with pea gravel (doesn't bridge). Cap last 2 - 4" with washed sand to overflow trench.

Planting -

a. Smooth, loosen between trenches as needed.
b. Preferably seed and mulch - keep moist
c. Alternate sod (cut thin), then use Greens-aire and topdress within 1 - 2 weeks (to establish some vertical openings over trenches)

The above is superior to deep field tile in that excess surface water can be promptly removed; then the soil absorbs the rest. Good slow irrigation is needed. Also, annually intensely aerify, deep verti-groove sideline to sideline, and add more trenches if needed.

Thin Sand Over Vertical Drains

System 2

To upgrade old fields, or build new fields. This assures fast surface absorption and minimizes compaction. Turf surface and players suits should stay clean. Turf must be kept dense. Keep surface rolled firm and smooth. (System widely used in Northern Europe - developed in Sweden by B. Langvad).

Slope - Use 1% on field, and 2% off field as needed.

Subgrade- Topsoil preferred. Use anything. Fertilize, till and loosen. Shape 5% below final grade.

Sand - Spread 5" of sand (fine, washed preferred - avoid coarse sand and gravel) Back trucks onto field - push sand with bulldozer. Minimize compaction.

Trench - Make 9 - 12 long parallel, nearly level lines from end to end of field 20' - 15' apart (have 20" deep in center - 12" deep at sidelines so all lines are near same depth). Use track trencher for support on sand.

Extend, join and/or bring all outlets to small covered pit, 1 end or both.
Have adjustable outlet within control in pit to
Hold water in tile as desired during summer, thus some subsurface watering.
Spread and scatter soil from trench over sand to one side
From other side push in clean sand to overflow of trench
Back flush each tile line with pressure

Surface -

1. Keep sand moist
2. Spread 30 - 50 tons of fine calcined aggregates
3. Spread 60 -100 cu. yds. of peat (or equivalent)
4. Spread 1000 lbs. turf type fertilizer (16-4-8, or similar)
5. Mix into top half of sand by repeat light cultivation.
6. Smooth, compact
7. Plant, mulch, keep moist.
   a. If sodding, then use 5/8 tines on Greens-aire within 10 days, plus spread reserve topmix (save part of mix above) at some time. Also, about Aug. 1 repeat Greens-aire and topmix again.

Water System - Strongly suggest padded pop-up in 3 or 4 row arrangement for automatic watering. Put pipe in drain trench also. Also, have water outlet at drain pit for sub-watering as desired.

Grasses - Since surface binding is desired -
Use coarser Bermudas where possible - southern
Use Zoysia and bluegrass where adapted - Midwest
Add quackgrass to bluegrass - in northernmost

System III - The PAT (Prescription Athletic Turf) goes to plastic sheeting, compacted sand, plus overflow and sump pump for complete water control.

These three ways of building, each detailed to accomplish, allow the architect, engineer, contractor and users to select that one most desired for their needs, climate, etc.

PAT - (Prescription Athletic Turf)

Good news! Advances in Special Turf. Uniform, tough, wear tolerant, close-cut turf for maximum play execution and player performance, plus a porous, well-drained play-in-the-rain, firm but resilient rootzone has been researched and is now available. Gone is the cloppy, wet, muddy field. Gone is the bare ground, and uncontrolled play. New installation of five major ideas give new dimension in professional athletic turf care. Now, it is professionally designed turf care possible -

. New installation of five major ideas give new dimension in professional athletic turf care:

1. Minimum surface slopes for best use and viewing.
2. Porous rootzone with suction drain and absolute water control.
3. Soil warming with assures safe thawed soil.
4. Powered field covers for insulation on cool weather extremes.
5. Zoysia (makes a mat) and new bluegrasses (gives color and rhizomes), which combined give close groomed, tight, divot-proof turf.

Expensive? No! Tedious! Yes! Easy to maintain? Yes! When can it be built? Just finish by July 4 for fall football.

What's the reason for this news now? Research in all five areas above when tied together makes a package. A prescription, a method, the "PAT System," system of installing, of management, which allows the widest possible use and controlled results.

Look! The new NCAA ruling of only 1/2" cleats gives a new chance to keep turf, but there must be dry, firm footing.

Oh, yes! The injury reports on artificial turf are discouraging, and coaches are seeing too many first string men out for extended time. Sure, where 200 events are scheduled annually turf wears out, and artificial turf gives results. But, for twenty uses or less, sometimes more, new technology packaged into a system can produce that uniform, firm, safe turf, plus the TV look needed.

REASON FOR PAT

Slopes. Free water on playing surface is always to be avoided. A 10" crown

or 1% slope is enough. But, 18", even 24", crown has been touted as the answer in that water should run off - eventually it will go 80 feet in maybe one hour, except in cleat marks and divots. So DON'T depend on slope alone. It is too slow at best! Players are used to some slope - actually the less slope the better!

Porous Rootzone. Completely new! Always before, clay and silt packed and the soil was too hard, wet, dry, slick, soft, muddy as weather changed. Now, fine clean sand compacted - above level, plastic sheeting - with controlled outlet drain pipe laying on plastic. This saves nutrients and water, keeps sand moist and firm, and the grass turgid. O.K.! But, the ideal comes now - Suction pumps on drain outlets can assure prompt water removal downward immediately as it falls. Play ball! Now, it's not cover and fret! It's pump and forget! Water control is finally here. Playing is always on a moist, firm surface.

Oh, yes! Add peat, fine calcined aggregates, vermiculite and fertilizer mixed into the top 2 inches for best playing conditions. Golf greens are already being built by this PURR-WICK Rootzone System.

Soil Warming. Electric heating cable assures thawed soil water penetration, more grass growth, and snow melting. So, back to the 11 game schedule, and just flip on the switch - extend fall and bring spring on early - protect the grass too.

Powered Insulation Cover. With holes! What? Yes? Since water goes into rootzone readily, don't shed it off. Why cover? - To conserve soil heat; to reduce surface frost effect, and to encourage more cool weather growth. A powered one-piece cover which two men can change in fifteen minutes is available. Use 6 mil clear plastic with 3/8" holes every 2 inches. And, a covered storage seat bench off to one side anchors and stores cover safely.

Bluegrass and Zoysia Turf

Dense, strong and tight turf is essential to success over porous media. Bluegrass - the newer are better - alone won't do the job when tackles meet or runner cut. But, add Midwest zoysia and its strong surface runner, rooting at every node, gives that binding desired. And, the short cleats offer new hope here for best performance.

The soil warming, the field cover, the porous rootzone assure Zoysia's survival, thus increased wear tolerance. Research with wear machines proved Zoysia's wear tolerance exceeded any other turfgrass available.

And, let the band perform every time - the surface needs to be tight, compact and firm.

Details and Specifications

PAT system assistance is available to architects, or physical plant engineers, toward discussing concepts, materials and alternatives. At least the bill of materials can be closely estimated. Contracts review and discussion is suggested in the early stages to assure the PAT system as a completed unit. For example, inadequate porosity negates all other controls also. Lack of binding of Zoysia would negate stability of surface. (In Bermuda country its preference would be obvious). Soil warming would assure cold weather performance, and covers move the weather interface up. In 1971, the ideas combined are new, but the need is old. Good players strive for perfection. Let's install and maintain that quality of turf too. The PAT (Prescription Athletic Turf) System is ready!

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GOING THE EXTRA MILE IN ATHLETIC FIELD CARE

Melvin Robey, Supt. of Athletic Facilities
W. H. Daniel, Turf Specialist
Purdue University

As anyone would expect, three months of fall football practice leaves very little bluegrass growing down the center of a practice field. This means that during spring practice a field would not have the uniformity required of a playing surface. In order to re-establish turf, reduce the mud, and create a safer playing surface, a technique using clear plastic was tried. It appears that by improving this technique much more turf can be available for spring practice.

At the end of the fall practice season about 85% of the area covered was bare with just sparse sprigs of grass surviving. Before the last practice a mixture of Kentucky bluegrasses was sown on the surface of the ground.

Each 6 mil plastic sheet, 40 ft. x 100 ft. was perforated with half inch holes on 2 inch centers - (made by the Greens-aire machine before unfolding sheets). On November 24, 1969, three sheets were placed down the center of the field to cover an area about 40' x 290'. The plastic was held down with old automobile tires and wooden crate slats, which were shifted periodically. The covers were removed on April 6, 1970, after 103 days.

The average temperature on the 24th of November was: air, 38°F., soil surface, 45°F., and bare soil at 1" depth, 42°F. During the month of December the average temperatures for bare soil at 1 inch depth ranged from a minimum of 29°, to a maximum of 31°F. There were four days in the first half of the month when the temperature rose above freezing. The rest of the time the bare ground at 1 inch depth was frozen. The air temperature dropped below freezing every night, and for the last eleven days of the month the daytime temperature never rose above freezing.

Although the air and soil temperature under the plastic was not recorded, visual observations indicated seeds under the plastic covering germinated in early December, and were approximately a half inch high before the ground froze under the plastic the first week in January when the temperature dropped to -20°F.

Abnormal temperatures and heavier snow than normal persisted throughout the month. The average temperatures for January were: air 15°F., soil surface, 28°F., and bare soil at 1 inch depth, 29°F. At the end of January the weather warmed and the snow melted during the days. At night the temperature dropped below freezing, and an ice sheet caused temporary sealing of the holes, but no effect on the grass.

In February the average temperature (air, 26°F., soil surface, 26°F., and bare soil at one inch depth, high 32°F. -- low 26°F) were higher than the previous month. By the end of February the soil under the plastic was thawing during the day and freezing at night.

In March, the average temperatures were: air, 35°F., soil surface, 43°F., and bare soil at one inch depth ranged from a minimum of 32° to a maximum of 43°. For the entire month the air temperature rose above freezing every day but one, but the temperatures dropped below freezing every night, except for three times (March 2, 3 and 4). The bare ground temperature at a one inch depth rose above freezing every day except for five days, and dropped below freezing 14 times. The bare ground under the plastic did not freeze during the entire month of March, and by the end of the month the grass was growing rapidly.

On April 6, 1970, the day before spring practice sessions began, the plastic was removed from the field. The new grass plants were already to the three and four leaf stage of development. There was considerable regrowth from the old plants.

Temperatures for normal areas. Comments on grass and seed development under the vented plastic cover.

	Temperatures (Fahrenheit)						
			Bare Soil				
	Air		Surface		1" depth		
Date	Min.	Max.	Min.	Max	Min.	Max.	Conditions under plastic
Nov. 24	28	50	27	63	33	50	A few sparse worn tufts of grass Overseeded blend of bluegrass
Dec.*	21	35	25	37	29	31	Seedlings up 1/2 inch high by end of month
Jan.*	7	25	25	31	29	29	Surface frozen after Jan. 6
Feb.*	17	36	25	47	26	32	Soil at surface thawed during days
Mar.*	28	43	29	54	32	43	Soil not freezing under plastic
April 6	32	53	28	72	32	59	Seedlings to 3-4 leaf stage Tufts of old grass were 4-5" high and spreading

*Average temperatures for entire month.

By extending the growing period into the last of December and causing the plants to break dormancy a month earlier in the spring, the grass under the plastic had developed far beyond that unprotected.

Although we used bluegrasses, the improved ryegrasses (Pelo, Manhattan, and Pennfine) offer the best combination of characteristics for use under plastic coverings. They become established quickly, do best in cool, moist soil, show good winter hardiness, and tiller profusely. It appears that these ryegrasses in a mix with bluegrasses would be adopted for use on heavily played athletic fields where a rapid establishment of dense turf is desirable.

The principle of conserving heat energy using clear polyethylene plastic, was demonstrated to be an effective way to increase the growing season by 45 to 60 days per year. It is possible that by using this technique, and by selecting the right grass, a football team could have a much thicker turf for spring practice.

(Note. Powered, two-man controlled field covers are in use on 10 - 20 stadiums in Europe. These use plastic without holes, and can be put on or off within 15 minutes.)

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NEEDS OF GOLF COURSE ARCHITECTS TODAY

David Gill, Golf Course Architect
St. Charles, Illinois

Let me read you a letter I received from a medical doctor (Obstetrics & Gynecology) in Bloomington, Indiana. Also, it was a xerox copy. He probably sent one to every architect he could find:

"Dear Sir:

I am in the preliminary stages of planning a golf course for our new country club. I have aerial photographs of the land in which we are interested in construction the course on. I would appreciate knowing your costs of roughly plotting out the course after looking at the aerial maps and topograph map. Sincerely,"

This points up the No.1 need of the golf course architects today -- RECOGNITION AS TO THE FUNCTION OF THE PROFESSION. We all know this, and there is no need to belabor the point. There are other needs which are not quite so obvious. We need help from manufacturers, suppliers and contractors. We need them to help us keep up on all the new materials, methods and procedures involved in the construction of a modern golf course.

We get on the average 40 pieces of mail a month concerning technical advances on materials which can be used. Unfortunately most of this mail goes into the standard round file at the end of the desk. We need the manufacturer's representative to stop by with this information about once every 4 months. If this could be done 40 manufacturers would get about 3 hours a year of personal selling or instruction time, and each ARCHITECT would spend 120 hours a year learning. This is equal to a four hour college course - three years of this and you've earned a Master's degree - another six years and you've got your Doctor's. We can well afford it - it's only 1/2 hour a day.

We need suppliers to keep us informed constantly as to the availability of the items we need, or would like to use. Some manufacturers are prone to be very optimistic about deliveries; whereas, suppliers must be more realistic. They must deliver. We need contractors and builders to keep us informed as to the actual installation costs which, because of the advances in equipment and methods, change almost day by day. A guestimate is no good unless an estimate can be made from it. An estimate is no good unless the course can be built within the estimated cost.

Probably the most important thing we need -- is something we all can have -- "THE ABILITY TO LISTEN TO SOME OTHER PROFESSIONALS AND EXPERTS." We all have our own design concepts, and these are all basically good. We all have a second professional specialty. It might be Agronomy, Geology, Engineering, Irrigation, Maintenance or Construction Experience, but I do not believe any of us have the capabilities and can keep up with all of the fields related to golf course construction and design, and still practice Golf Course Architecture professionally.

Now, we need to listen ----

The Agronomist - Listen good; this is why we are here today.
The Geologist - What's under that pile of clay you plan to build a course on? Any water down there; is it salty? Suppose I want to build a lake, will it hold water?
The Engineers - Different kinds that can tell us about different things. And, they are allright.

The Biologists)
Zoologists)- They have different things to listen to.
Entomologists)

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ARCHITECTS AND PUBLIC TRENDS

David Gill

My three reasons for being here -

1. Bring you folks up to date on what golf architects are doing.
2. Let you know how you can help us the most
3. Give you some thoughts to assist you in your own planning, operation and promotion.

Unfortunately the golf course architect is considered by many to be - egotistical, self-centered, high-handed, status-seeking, conceited money grabbing snobs.

Golf Course Architects are looking for ways to maintain interest and strategy in the game of golf, while cutting down the manpower costs (walk-thru traps - mechanical rakes, triplex greens mowers, the three "T's" - Traps - Trees - Tees. We are giving ALL golfers and public, as well as country clubs, the finest golf possible.

We have dropped the idea that a public course must be wide open all the way to get maximum number of players through in a day. A public golfer is more important to the golf industry than any club golfer, and there are five times as many of them.

Look at the Public Fee Courses Today!

The N.C.R. course in Dayton for all intents and purposes it's a public course.
Look at Torry Pines in San Diego - A great municipal course, and look at the other Great Muny Courses in California.
How about No. 4 at Cog Hill, and The Village Links of Glen Ellyn near Chicago?

What about all of those Florida courses - they call them country clubs? They are no more than vacation-oriented public fee courses.

How about Sea Island, or Jekyll Island, Georgia, or Hilton Head Island, or maybe Sam Sneed's Greenbrier?

Now, look at some oldies like Pinehurst Country Club - that's a resort. You can play there, and it was designed before 1920 by Donald Ross. Mid-Pines Country Club is another Ross course we can all play; in fact, all those North Carolina courses are open - they depend on the daily or weekly fee player.

We are using the latest innovations in equipment and materials in our designs, and at times we design our own parts to make the course operate better. A public fee course, whether it is privately or municipally owned, must be operated for both fun and profit.

A successful Muny course development is in Coon Rapids, Minnesota because it is selling at a profit - Great golf with Tees, Trees and Traps - and both big and little yardages.

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BALL MARK, BOUNCE AND ROLL

W. H. Daniel

Energy must be dissipated. Rootzones may be hard, dry, soft, wet, slick, gritty - depending on the surface rootzone. Shoot for the pin - the ball sticks - a short putt, and a happy golfer! Oh! What makes such utopia in golf?

Wet up the greens! They're too hard! Can't hold! Too fast! Slick as ------, or too soft - too wet - too mushy - too much rain, or topdressing, or thatch, etc.

Seeking facts - want to improve your game -

Overspin - backspin - pinch the ball - take a divot - bounce - hold.

Technique is vital to good golf - so see your Pro and get some refresher lessons; develop sound basic game techniques; then use your various clubs for wise approach - for the green - over the traps - go for the flay - roll up for 1 putt (hopefully).

Uniformity and Good Maintenance. All 18 greens played uniformly today! That's great - the architect - the contractor - the current superintendent and his crew of workers (plus the weather) all had a part.

Mowing, watering, combing, freshening topdressing, spiking, cultivation, sprinkling, fertilizing, draining, fungicides, etc. all had contributed.

The wetness of the morning turned to hard and dry by mid-afternoon, and thus the trend to calcined aggregates, more sand, more peat and LESS SOIL in newer root-zones for greens.

By the way, U.S.G.A. Green Section personnel figured 250,000 spike marks made on each green each day is normal use. No wonder it compacts!

Test Procedure

The Lafayette Country Club Pro using a 9 iron from 100 yards out shot over 150 ball to the green. As the ball hit, one person estimated the height of bounce, another measured the ball mark, another the distance of roll, and the type of mark made. In summary, a ball mark of 6 - 12 mm deep, a bounce of 2 ft.,and a roll less than 20 ft., plus turf that does not tear, seemed the desired.

Rootzone	Roll in feet		Ball mark	Bounce
	Avg.	Range	mm.	ft.
Dune sand (PURR-WICK)	11	6-15	13	2.0
#3 sand, pit, do	14	6-22	12	2.0
Sand and soil	21	11-31	12	3.0
Soil some topmixing	27	20-44	11	3.2
Desirable	≤20'		6-12	2.0

Thus, the initial give in porous media (sand) assured more uniform ball response as less bounce and roll.

In a depression test, a golf ball was beat into the 41 rootzones. The dropping of a known weight 15" against the ball made a depression which was immediately observed as millimeters depression. Both wet (excellent moist playing conditions on 7/20/71) and dry (some needing irrigation badly on 8/7/70) were recorded.

Rootzone	Dry mm.	Wet mm.	
Soil	3.2	4.5	Wetting softened
Sand & soil	3.2	5.2	do
Sand, peat,cal. clay	5.7	5.2	Stays uniform
Sand, peat (new)	6.2	6.7	do

From this initial data of depression stimulation and actual ball marks, it was evident fine porous media was able to maintain uniformity for quality golf.

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MANUFACTURED MATERIALS FOR ROOTZONES

W. H. Daniel

Once we discard clay and silt as necessary ingredients in a rootzone, then wide vistas of new concepts and approaches can be dimly seen.

Historically, a good silt loam soil, with ample organic matter, earthworms, aggregation and structure have been good for growing cultivated crops. Often under compaction such soils become plastic compacted and impervious. It is true we can aerify, avoid extremes and do much better today in managing those soils.

Today it's construct hurriedly, and in spite of what may be desired,known or preferred. Sometimes good intentions can be carried out. Nevertheless, new materials can serve today as we specialize in achievement.

The peats, sludges, barks, hulls, composts, manures, mechanically separate, structurally improve and release nutrients as they deteriorate. These vary widely in composition and availability. The long lasting types are preferred. The calcined aggregates, Floromull, exchange resins, and chemicals manufactured offer an array of textures, long term stability and compaction avoidance. Sand textures can and do offer a basis for incorporating these.

The calcined aggregates - Lu-Soil, Terra-green, Turface and Prep are made from attapulgate clays heated about 1800°F. for 20-30 minutes. The Dialoam is diatomaceous earth similarly treated. These have 60 - 80% pore space, weight 30-40#/cu.ft. dry, have some base exchange capacity, and are quite stable. After 13 years in our green, their particle shape and all features show desirable stability, and infiltration continues very ample.

With no soil used - I now prefer the finer particles (30-60 mesh) when mixed with finer sands.

The exchange resins, both anion and cation, offer unique possibilities formerly claimed by clays and humus fractions. Even 1/10 of 1% in the upper 2"

of mix can equate a sand to a silt loam in exchange capacity. Sure it's expensive, but the initial point is they can perform. In experience we find the compacted, moist sands and additives to provide useful rootzones.

The Floramul and Hygromul of BSAF are being used in Germany, and are now introduced into the USA. These very light substitutes for peat and slow release nitrogen may pry open new doors. Vermiculite being 7% K_2O is attractive as an additive.

Currently W. B. Davis of California has published a progress report on 5 sands, 8 organics and 5 mineral additives. For example, one sand of uniform fine texture was acceptable with 10 - 20% of any additive. It couldn't be ruined. In contrast, one sand with very fine fractions was not acceptable with any of the additives. You see it's the basic limitation which is the key - in this case sand size.

Thus, it would behoove us to be alert technically and financially to wise usage of manufactured materials for rootzones. We do have new tools of construction.

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PRINCIPLES IN SOIL DRAINAGE

David S. Ralston, Miller, Wihry, and Brooks, Inc.,
Louisville, Kentucky

Water is essential for plant growth, but an excess of soil moisture in the rootzone can interfere with normal metabolic functions in the plant, as well as interfere with the intended use of the turf area. Standing water can weaken turf, make it more susceptible to disease, and even cause death by scald if the sun heats the water to a high enough temperature.

Excess water can also interfere with the user of the area whether he be the golfer trying to putt through the puddle on the green, the football player trying to maintain his footing on his pass cut, the homeowner trying to play badminton with his children on his day off work, or the sod grower trying to get his product out of a wet field to meet his customer demands. Soil drainage is essential for both maintenance and use of quality turf areas.

Three things can happen to water which falls on a turf area:

1. It can move across the surface and run off
2. It can infiltrate into the soil
3. It can remain on the surface until it evaporates.

Surface drainage is imperative for removal of excess moisture during a heavy rain so that we are not dependent on the soil plumbing system, or soil pores to remove large volumes of water at one time. Good surface drainage is the key to being able to maintain a uniform stand of turf on any heavy use area.

In addition to good surface drainage, good internal drainage is needed to move water through the rootzone. Infiltration into the soil is dependent on the size of the pores at the surface, as well as the percolation rate of water within the rootzone. Water movement into the soil can also be influenced by a thatch layer

at the surface which can, by its hydrophobic nature, prevent water from reaching the soil surface.

The third alternative, that of evaporation at the surface, occurs when neither good surface drainage, nor good internal drainage is present. Water retained in depressions is undesirable because it weakens the turf, and can cause death by scald if the sun heats the water in the puddle to sufficient temperature. It is also objectionable from the observer and user standpoints. Therefore, it is necessary to provide for good surface and internal drainage to avoid the presence of standing water.

Water found in soil can be described in the following three ways:

1. Hygroscopic water
2. Capillary water
3. Gravitational water

Hygroscopic water is held tightly on the surfaces of the soil particles, and is not available to plant roots. Capillary water is in the fine pores, and is the primary source of water for plants. Gravitational water moves down to the water table through the larger pores, and is out of the reach of plant roots within a few days after a rain.

We are most concerned with capillary water for the turfgrass needs. This is the water which remains in the finer soil pores after the excess or gravitational water has drained out of the larger pores. Capillary water movement in the fine pores is dependent on the adhesion of the water molecules to the soil particles, and the cohesion of the water molecules to each other. Their forces overcome the downward force of gravity so that capillary water movement can occur in any direction in the soil. The rate of water movement and the height to which water will rise above the water table is dependent on the pore size.

As the soil continues to dry down, the water in the capillary pores is absorbed by the plant roots, and is lost at the surface through evaporation. Eventually the pores become empty, and the remaining water in the dry soil is hygroscopic water which is held to the soil particles with stronger forces than the plant root is able to overcome. Thus, hygroscopic moisture is not available to plants.

Let us take a closer look at what really affects the size of pores within the soil. Pore size is determined by both the size of the individual soil particles and the arrangement of the particles. Texture refers to the size of the particles, e.g., sand, silt and clay. Structure refers to the arrrangement of the particles in the soil. A granular soil is one which has the individual sand, silt and clay particles arranged in a somewhat spherical shaped aggregate or peds. The cementing agent which holds the particles together is usually either large organic molecules, or iron oxides.

Fine pores exist within each soil aggregate due to the arrangement of the sand, silt, and clay particles. Through combination of many such aggregates or peds together in the soil, large pores are formed between the peds which serve as channels for water movement through the rootzone. A well-aggregated soil is one in which the excess water can move through the rootzone in the large aeration pores for rapid drainage. At the same time, moisture is stored in the finer pores within the peds to supply the requirements of the grass between showers.

This system works well until the aggregates are subjected to stress, particularly when wet. Compaction due to traffic causes the cementing agent in the

aggregates to lose its bonding strength and the aggregates to disperse into their individual sand, silt and clay components. Therefore, we reduce the large pores between the peds, which conduct water readily to small pores between individual particles which are slow to conduct moisture. The infiltration rate is greatly reduced by compaction, and surface runoff must then handle excess moisture.

All soil, no matter what the texture, is subject to compaction. Under good field conditions the total soil volume would be composed of about 50% pore space, of which half would be large pores which would drain readily to provide air channels, and half would be smaller capillary pores which would retain moisture for plant needs. However, with traffic on the area from both people and maintenance equipment, the soil can become sufficiently compacted until only small capillary pores, which greatly restrict water movement, remain.

Unfortunately the turf manager cannot afford the luxury the farmer enjoys of being able to plow the soil to alleviate the compacted conditions. Even if this could be done, the soil, by its very nature, would still be subject to compaction, and in the long run would have the same problem all over.

What can be done to provide for good drainage in a rootzone? The logical way to construct a rootzone, which will drain regardless of compaction due to traffic, is to eliminate the need for structural pores. In other words, the pores between the individual soil particles must be large enough to conduct water rapidly even when they are compressed as tightly as possible in the rootzone. To achieve this, particles sand-size or larger, are needed. Hydraulic conductivity of medium sand is adequate to handle the desired percolation rates.

Building a rootzone of 100% medium sand will solve the drainage problem, but unless measures are taken to conserve moisture for plant needs, it could create a very droughty condition. The most effective way of conserving moisture in sand is to underlay the rootzone with plastic sheeting, and place the drains above the plastic so that excess water can be removed. Plastic-lined sand rootzones are referred to as PURR-WICK Rootzones, and they are covered in detail in other talks.

Another method of conserving moisture in sand is to add just enough soil and peat to provide some capillary pores for moisture storage without blocking the larger pores needed for drainage. The amount of soil needed depends on the texture of the soil and the uniformity of the sand. In general, at least 70 to 90% sand is necessary to insure adequate drainage pores after compaction. Thus, the challenge is to add just the right amount of soil and peat to sand to provide for water retention without reducing the effective pore size after compaction to the point -- that internal drainage is restricted.

For renovation of large areas, such as athletic fields, fairways and home lawns, it is usually a better practice to add organic materials, such as peat and humus, to the soil rather than to try to dilute the soil with sand. When only a little sand is added to soil, one can virtually make cement after compaction due to traffic. Unless at least 70% sand is used, and the area is small enough that the material can be thoroughly mixed off-site, then use organic materials for soil modification.

The use of drain pipes in the soil can be an effective method of removing excess gravitational water, which will provide for improved air circulation within the rootzone. The main purpose of the drain lines is to lower the water table, so they should be placed at least 2 to 3 feet deep in the profile. It must be remembered that the presence of a drain line at three feet will not improve the infiltration at the surface if the pores in the soil are compacted and will not conduct the

water to the outlet. Therefore, for quick infiltration and removal of surface water drain pipes are not the answer unless they are connected to the surface with a vertical trench filled to the surface with fine gravel.

Vertical trench drains are an effective means of getting water into the soil rapidly. They are usually from 1 to 6" wide, from 1 to 3 ft. deep, and as long as necessary to get the water into the soil. It must be emphasized that they will only function for drainage if they are kept open at the surface. No soil should be allowed to seal the surface of the trench or the trench will lose its effectiveness for drainage. Fine gravel or coarse sand can be used for backfilling the trench. It is not necessary to have a drain outlet at the bottom of the trench, but it is desirable where possible.

To summarize, all soils which depend on the large pores between the aggregates for drainage are subject to compaction. Compaction due to normal traffic creates small pores which will not conduct water rapidly, and therefore reduces the infiltration rate. Good surface drainage is then the only effective method of removing excess water. The way to avoid the adverse effects of compaction is to build rootzones so that the pores between the individual compacted particles will permit an adequate hydraulic conductivity rate for good drainage. This means straight sand, or sand with a very low percentage of soil. Unless a sandy rootzone material is used, the problem of compaction at the surface will eventually occur.

Drain lines will lower the water table to provide a better environment for turf roots, but they will not necessarily improve the rate of water movement into and through the soil. Vertical trenches can provide a practical means of getting water into the soil rapidly so that the surface is ready for the user. Adequate soil drainage is vital both for the maintenance of fine turf and for the unrestricted use of the turf area.

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BUILDING GREENS TODAY

Brent Wadsworth, The Wadsworth Company
Plainfield, Illinois

Our subject is "Building Greens Today." As the title suggests, it pertains to a particular facility regarding the game of golf. As one of those interested in serving this game, mainly in the field of construction, it would be proper to dwell for a moment on the requirements of the game rather than those of our special interests pertaining to the physical structure of greens.

It is the game and those who play it who shall demand and dictate what is finally acceptable. Anything that we do as researchers, or installers, or turf managers must provide a surface which is to their liking for providing:

1. A base which is rolling in contour, not too steep or too level.
2. A surface which is firm enough to allow foot traffic without impressions, and yet not too firm that a ball will not bounce or react to spin.
3. And finally, because of universal and aged acceptance, a grass type ground cover - most preferably no imitation types.

In order to achieve these varied demands, there have been through the years many different things tried and utilized from the non-grass type surfaces, such as oiled sand (now almost extinct), and netting through the grass-like imitations to varied medias for growing the ultimate surface cover. Remember when the amendments of cocoa shells, sawdust, vermiculite, and pearlite were popular? And still the calcined clays are used with great acceptance, as well as the many other common organic and inorganic amendments, such as sand, peat, and fertilizer which all contribute to the alteration and modification of soil physical properties.

Our subject has then the great quality of invoking more discussion, ideas, theories, rationales, and downright arguments with everyone and anyone involved with the game than probably any other subject - and that includes the subject of grass in any and all its forms.

But, we in the construction field are vitally interested in green construction as it comprises a great part of our work. It is a builder's position to install the greens to the architect's design and specifications. How well he does his job is how well he follows the instructions given to him. On the other hand, it is most certainly the architect's responsibility to research his requirements, and specify what he believes is the best available structure for the needs of his client. And finally, it has fallen to the researcher and experimenter to develop the many ideas available, or should we say opportunities available?

But, in the never ending search to achieve the best putting surface, experimentation continues. We all must give credit to the efforts of those who are developing new ideas such as the completely controlled rootzone PURR-WICK system, along with the presently accepted U.S.G.A. recommended type of construction. And there are other ideas which revolve around the mixture, and the mixing of the many kinds of soil amendments. Certainly there still exists the possibility of great new things to be developed in the area of green construction in the following ways:

1. In the grass growing medium within the base itself.
2. Within the area of irrigation, both underground and overhead.
3. Within the area of subsoil drainage.
4. And finally, within the area of turfgrass development for use on the putting green surface.

All these areas and/or combinations of several, such as the PURR-WICK and U.S.G.A. ideas certainly lead to varied experimentation in order to achieve fine results.

So, what are the basic structural parts that we must work with in building a modern green today? -

1. First of all, there is the sub-grade. Generally this is the earth work which is placed on a particular location, and molded to an architect's design. Here is a possible part of a green that is often overlooked for the support of basic functions which a green requires. It can and should be molded to obtain the best possible drainage qualities available. A well located, shaped and sloped sub-surface affords the least problems of maintenance. Many of you have noticed that the best greens are those which are well-elevated and ventilated properly. Those greens which are low and positioned in poorly ventilated areas are the most susceptible to disease, and require the greatest care.

2. The second part is sub-surface drainage. Today we have generally accepted the fact that a system of tile, either clay, bituminous fiber, or plastic types, do this job adequately. They are installed either within the sub-surface, or on the sub-surface base with gravel and sand placed over them in a blanket fashion. The system of gravel and sand, as well as the tile, formulate the

the sub-surface drainage system. This is required to remove excessive water after heavy rainfalls, or over-watering, which is not uncommon on low parts of greens.

3. This third part is the irrigation system. This may be a system of overhead, pop-up sprinklers, or manual inserted sprinklers fed from piping that is brought into and around the greens. The PURR-WICK system uses the underground type of irrigation system where there is no overhead requirement. The water is actually placed underground through the pipes and seeps through the sub-soil, feeding the roots as needed - quite an idea.

4. The fourth part of a green is the growing medium itself, referred to by many as the green base, or greens mixture. This is where a prescribed or chosen combination of sands, topsoils, peats, as well as other amendments that we spoke of earlier, are mixed in various fashions, and installed to various depths and finally contoured into the finished green.

5. The last part is the putting surface cover itself - and by that is meant the type of grass which is going to be utilized. This is actually what all the previous elements are put into place for, to provide a medium to grow the best grass possible.

But, what types of greens are being built today outside of those which are for experimental purposes only? Generally, I would say that they in large part consist of greens which make use of local materials. They most always are built of a combination of sand, peat, and topsoil, with or without some type of sub-surface drainage system, and a common manual or automatic sprinkler type irrigation system. The different soil amendments or materials are measured and mixed following rough contouring either on the green surface or nearby, and placed on the green to the desired thickness. I am now speaking of the general number of golf greens being built today, including the many rural courses that are built and never receive the great amount of play that the city-type courses are forced to accept.

Given courses without a great deal of traffic, we could all put our efforts to better things. Traffic in the form of shoes and balls under all sorts of conditions downgrades a surface continually. Therefore, there is the constant effort to continue to work toward more acceptable playing conditions to overcome those situations which reduce the surface quality. That is to say that work continues on not only improvements for better construction, but also for improved turf management as well. But, if the growing medium can decrease the problems of management, then by all means we should continue to work in this direction.

But, why aren't more greens being built to the new standards with new ideas incorporated in them? It's pure and simple - Available Money. Very few are able to be built to where a budget is of little concern. False economy you say. Sure it is when you stop to consider that as a general rule the cost of maintenance on a golf course today is 25% of the cost of a particular golf course as it was built. In 5 years the maintenance on a golf course exceeds the construction cost. Can you imagine a building or road being built to this ratio?

Let's see now, maybe we can maneuver spending around to include more for the green and less for other things.

But, every golf course needs earth moved to conform to generally accepted standards, and provide the architect with his requirements. This contouring is what the golfer sees and on which he enjoys playing. If there are trees to be removed this cost must remain. Today the builder is faced with pollution problems

connected with burning as the superintendents are being forced to deal with pollution chemical controls, and this has caused clearing costs to become even higher. Could we by today's standards ever think of not fully irrigating a golf course? Hardly; in fact, now the automatic principle is so accepted that very few courses are being built without it. Drainage, bridges, car paths, new maintenance buildings, maintenance equipment, grass seed, fertilizer, and so it goes - all vitally necessary expenditures.

But, you say the greens - they're the foundation of every golf course. They sure are, and we all better believe it. But, just try to get an extra buck to put in something super or try to exclude something else, and ..... well, you know the story.

If methods for green construction are to be developed which produce not only a superior grass, as well as a superior putting surface under all kinds of problematical conditions, and further, if such developments involve the use of labor, it must be a type of construction which limits the labor aspects of the installation. Otherwise only those golf courses with high construction budgets will be able to afford such an installation. Or, as is happening at many golf courses today, the golf course superintendent is remodeling the greens with his own lower cost personnel to the newly accepted ideas. With low budgets and high wages, the squeeze is really on today. And generally, construction is going to be the one which will have to accept the showdown. In fact, it has already begun. Our government is forcing the construction industry to change its ways.

In this area in recent years, between 1965 and 1970, labor costs in the construction industry have risen 47%. Golf course starts are considerably down in 1970 and probably will be so in 1971. As builders, we are faced with extreme problems of labor costs, and moreover, are forced to accept unwanted work rules and increased fringe costs.

In addition to dealing with high labor costs, the builder today is also faced with the problem of obtaining materials which meet the specifications with which he is required to deliver. For instance, it is now generally accepted that the best sand for putting greens base must range between .30 (30 hundredths) of a millimeter to 1.00 (one) millimeter in size. It is generally not possible to purchase a sand with this gradation in the quantities needed for green construction on a local level. Nor will anyone produce this gradation especially for you. So the question is raised - is it worth the extreme expense to haul the proper sand from a long distance and pay an extremely high premium? It is a matter of judgment which the person who is spending the money for the construction will finally make. But also, the researcher and the architect must reckon with these problems as they do affect the final installation.

Again, most greens being built today are still being built by the so-called shotgun mixing method, utilizing various magical percentages of peat, sand, and topsoil, plus subsurface drainage tile with great variances in the amount and the design of the drainage, and generally utilizing local materials. If this trend is to be changed, then new ideas must be developed by research and development agencies, both public and private, and they must satisfy or increase the carrying capacities of each of the following objectives:

1. For the architect, a golf green which meets the generally accepted standards of design, size, shape and contouring.
2. For the golfer, a putting surface which eliminates ball marks, foot marks, and other depressions, and yet will be consistent in the ball-holding qualities.
3. Will accept heavy rains, prolonged droughts, or great temperature variances without adverse affect during all seasons of the year.

4. Will give the golf enthusiasts and players a natural type of vegetation.
5. For the golf course superintendent, a surface which may be managed with particular ease and without excessive cost in relationship to the balance of the golf course maintenance operation.
6. And finally, for the builder, accomplish all of these benefits by allowing for an inexpensive installation in relation to the installation costs of the rest of the golf course.

If these objectives can be produced, then we will have fine greens for all the golfers everywhere. If we do not achieve these results, then selective courses only will achieve greens of the best qualities, and the market will be laid open to the new imitation grass development.

We are able to be here discussing this very subject because and only because the imitation grasses have not taken over our game as yet. How soon will it be? We know they have already taken over football and baseball. Dr. Fred Grau, during an informal discussion at the end of the Midwest Turf Conference three years ago, said the following, "We must find new answers and we must find them fast. We have not the time to waste nor the time to be ineffective."

Have we achieved the results of which I have listed in today's newest developments? It's for sure someone is trying. My personal hope, however, is that everyone's answer will take place within the development of superior grass requiring very little extra growth medium requirements. In other words, it will be simple, simple, and simple, so no one can miss - not even the golfer. If we can do this, then we will have made one of those giant steps forward, and put the imitation grass out of reach for the golf course green. This is my challenge as a builder, and we must achieve it if we are truly to keep genuine greens turf modern.

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INSTALLING AND USING INTIMATE MIXES

Stephen K. Gipson, Supt., J. D. Wright Recreation Center
Chesterland, Ohio

For many years superintendents realized the quality of golf greens left something to be desired - they were either too wet, too dry, too hard, too soft, and any other "too" in the long, long list. Demands upon golf courses become greater with each passing year, and inadequacies become more evident as play increased. The center of attention was and is the putting green. As superintendents, we could be forgiven less than desirable conditions on our golf courses in areas other than those associated with the putting greens. We wanted and needed to improve the quality of our greens.

In 1948, the USGA Greens Section became interested in the quality of golf as related to putting greens. Research began at that time at places like Beltsville, Maryland, Oklahoma State, University of California, and since 1954 Texas A & M. Soil physicists began postulating theories, performing laboratory tests, and field tests. Over the years, the method of greens construction that has become popular is the USGA Green Section Specification Method. This method has attempted to replace the "by guess and by gosh" approach with laboratory testing, evaluation, and scientific recommendations.

The greens constructed by the USGA method have proven themselves to this superintendent. There are, without question, many other methods of greens construction. These methods range from use of native soil, to sand amendments, calcined clay amendments, to systems similar to the PURR-WICK system. Many of you work with these variusly constructed greens on a daily schedule. However, a great many of you are not satisfied with your greens such as they are - this fact is evidenced by your yearly efforts to improve your greens. Nearly every superintendent will modify the soil mixture of his greens if the soil is not a USGA green or high in sand content.

The USGA green is expensive to build,and if we analyze this type of construction we can see the cost factors. The green should be constructed by excavating an area slightly larger than the eventual putting surface. This excavation should be to the full depth of all materials involved, 17 to 18 inches, or as close to this depth as possible. At TRW we used an Allis Chalmers HD-11 EP, comparable in size to a Cat D-6 at $ 23.00 per hour, including the operator. This operation requires close to a full day of work per green, and a great amount of finesse on the part of the operator. The subsoil base of the green must match final green contours with a plus or minus one inch.

Next comes the necessary tile system. The pattern type used for the tile system can be herringbone, gridiron, or some variation of either type. These patterns are the easiest to work with in most situations. Trenches cut into the subsoil contour should be to a depth of 4 to 6 inches. The tile is then placed in the trench on a bed of pea gravel and covered with pea gravel. The spoils from the trench can be spread evenly over the bottom of the green area, or better yet, remove them entirely. We were able to tile four greens per day with one trencher and five laborers. The trencher cost $ 12.00 per hour, including the operator. We used 500 to 800 linear feet of 4 inch perforated rigid plastic pipe per green at a cost of 27¢ per foot. Labor cost $ 8.50 per hour per man.

Next came the pea gravel. This material was applied in the same manner as we would the greens mix material. The pea gravel was dumped around the perimeter of the green on the subgrade. This material was then spread to a depth of 4 inches using a small 450 dozer, and two laborers with rakes. We could complete 4 to 6 greens per day.. Our cost for the dozer was $ 15.00 per hour, including operator. Laborers were $ 8.50 per hour per man. Based on 7500 sq.ft. per green we required 120 tons of pea gravel per green at a cost of $ 2.95 per ton delivered.

The choker layer of 1-1/2 inches of material was applied next in the same manner as the pea gravel. We used the same machine and crew as on the pea gravel stage, and the per hour rates would be the same. The material used for the choked layer goes by the names of filter bed grits and shot rock in our area. This material is not a sand, however. This material was graded to 1/8 inch in size and our cost was $ 4.70 per ton. We used approximately 40 tons of this material per green. The USGA recommends course or concrete sand. I have used the grits on two courses and I prefer the grits. We felt that concrete sand would contain some fines which would wash into the pea gravel and possibly into the draintiles. This washing will not take place with the grits, and they support the greens mix material as well as the concrete sand.

Our greens mix ratio was 7 parts sand, 1 part soil, and 2 parts peatmoss. This ratio was established by Agri-systems based on tests of our sand, soil and peatmoss. These ratios are for our own materials and they should not be used on any other course. Materials can vary so much from one locale to another that it is imperative that your materials and sources be tested for your corrected ratio.

It is my understanding that there is now another laboratory approved by the USGA for testing of the greens material.

The sand used for our mix was a silica type costing $ 3.05 per ton delivered; the peat was $ 6.50 per cu. yd. delivered. The stockpiled material was then pre-mixed one time using a TL-645 rubber tire loader at a cost of $ 26.00 per hour including operator. This was a 4 cu. yd. loader, and things were moved rapidly - however, it does take some time to pre-mix 10,000 cubic yards of material.

The pre-mix material was then processed by a shredding machine at the rate of 65 cu. yds.per hour. The TL-645 loader was used to charge the shredding hopper. The hourly rate of the shredder was $ 41.00 per hour, and that, coupled with the loader cost $ 26.00 per hour which gave us a total of $ 67.00 per hour.

Whenever we had a sufficient stockpile of shredded material we would load it into tandem trucks and haul the material to the green. The small 450 dozer would then spread the material starting at the edge of the green and work it to all portions of the green from one dump point. The dozer remained on the material at all times. We noticed no damage from the weight of the machine to the soil structure or tile lines. We were apprehensive about the machine weight when spreading the pea gravel. However, we made spot checks of the tile lines, and as long as the machine crossed a tile on four inches of gravel and perpendicular to the tile line, then no damage occurred.

Two laborers accompanied the dozer to check depth, contours, install plastic sheeting, and to hand-fill around the plastic to prevent machine damaged. We installed 4 mil clear polyethylene sheeting 18 inches high around the perimeter of the green. The double thickness sheeting was held in place by driving stakes into the soil on 3 to 5 intervals, and stapling the plastic to the stakes much the same way as insulation is installed. Once the mix material has been installed the stakes can easily be removed by pulling them from the soil, leaving the plastic in place to act as a vertical barrier. With the plastic in place you have a barrier, although a poor one, to tree roots. The prime importance of the barrier is to prevent water from being attracted to the small pore spaces of the surrounding native soil from the greens mix. USGA greens not having the plastic barrier do have a tendency towards dry collars and putting surface edges.

The operation of installing the plastic and greens mix required two laborers at $ 8.50 per hour each, a 450 dozer at $ 15.00 per hour, 4 tandem trucks at $ 12.00 per hour each, one TL-645 loader at $ 26.00 perhour. With this arrangement we could complete three to four greens daily.

The small 450 dozer was able to rough grade and compact the mix. The final contouring of the greens was done with a farm tire tractor and grade box. The operator would smooth out and blend the rough green into a finely contoured putting green. We could complete four greens per day at a cost of $ 19.00 per hour with this tractor.

Once compaction was achieved, we applied fertilizer to the surface, and worked the material into the soil. We then applied C-15 Toronto stolons by the hydro-stolonizing method. The green was covered at a rate of 8 bu. of stolons per 1,000 sq.ft. With this method we could stolonize 9 greens in less than eight hours. The stolons were priced at $ 3.00 per bu., with the cost of the hydro-stolonizer, labor and mulch adding another $ 1.50 per bu. to the cost.

All of the above sounds like a lot of work and expense for a putting green. There is no question that it is just that, but I feel the advantages far outweigh the expenses. If we, as superintendents, can alleviate some of our problems due to

water and compaction at the start, then many of our headaches are solved.

Greens that will adequately disperse excess water, or absorb needed water, will be in play sooner after a heavy storm, and take the needed water during periods of stress. They resist compaction by virtue of their raw materials, but these greens do require aerification.

You can also expect an increase in watering rates. However, these greens make more efficient use of the water available to them because of the perched water table system. Water will move freely down through the soil mixture until it meets the gravel layer. At the interface of the soil mixture and gravel layers the water will not pass into the gravel layer until the weight of the water in the soil mixture accumulates enough weight to break the surface tension of the water at the interface. When the surface tension is broken, then the water from the mix flows freely into the gravel and tile system. This layer forces the soil mixture to hold more water than it normally would, and provides adequate soil moisture for good growth.

Many times during heavy rains field capacity is reached rapidly. However, field capacity or something slightly less is enough to start the greens draining. I have experienced rains of between two and three inches per hour in intensity, and have observed greens ready for play less than three hours later, which is long before the rest of the golf course will be ready for play.

It has been observed that the USGA greens will withstand more wear, hold shots better, have less drainage problems, have fewer disease problems directly associated with compaction and high water content, have less compaction than greens built with heavier soils. The USGA greens are not free from problems, however. They require more water, they tend to crust in early stages of development, they do require more fertilizer due to high porosity, and establishment of a good putting surface takes additional attention.

The associated problems of cost, labor required for installation, and day to day problems with this method of construction seem a very small price to pay in the long run. I prefer this method of construction, and I will use it every time I'm given the opportunity.

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A PURR-WICK GREEN

William Story, Supt., Carmi C. C.,
Carmi, Illinois

I went to Carmi Country Club in 1965 as manager and superintendent, which was my first experience of operating a golf course, although I had played golf for forty years. I set up a five year improvement program to improve the course as much as possible in the very low budget available.

The year of 1969 called for rebuilding the Par-3, No. 3 hole. The small old green was very small, built in a low spot, surrounded by trees with poor air circulation. After checking cost and labor to build a U.S.G.A. green, I found it impossible to build this green on the $ 2,500.00 available. After talking to Dr. Daniel I became interested in building a PURR-WICK green.

I finally got the O.K. to go ahead on it in June, 1969. On August 13, we bulldozed out the old green, and cut the grade for 4000 sq.ft. We hired no extra labor, our own crew did all the work just as we had time. We got everything ready to apply the sand, and had a 13 ton load of sand arriving every 15 minutes. We spread 280 tons of sand from 8:30 A.M. to 3:00 P.M.

We raked in 2 tons of calcined clay, and 1 ton of Michigan peat into the top 2 inches. We planted with Penncross on September 4, and mulched with wheat straw. We removed the straw on September 12, and mowed the green on the 15th for the first time.

The green was opened for play on October 10, and has not been closed to play since. At first the footprints were a problem, but after three topdressings - 1 in late fall and 2 in the spring - we had a very smooth putting surface, and the green plays the same regardless of whether it is wet or dry. The members are very happy with the playing conditions.

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A PURR-WICK GREEN

Jack Maurer, Supt., Belle Meade C. C.,
Nashville, Tennessee

In 1969, I attended this meeting to receive information on the PURR-WICK system, and we decided to rebuild our putting green. The two basic reasons why we used PURR-WICK -

1. For better control over drainage because the biggest problem in the Nashville area is pythium disease, and good internal drainage - an asset for the control of pythium.

2. Lower construction cost of the green.

The first slide showed a cross cut of our PURR-WICK green, showing the 2" PVC slit pipe; how we created our reservoir pool and control of the height of the water. Showed 16" depth of the sand, and the topmix of peat and calcined clay which I tried to keep at 2" mix.

Next, showed the end cut of the green where it showed 4" Crangeburg pipe to drape the plastic over, and showed where the drain pipe was located. The upper terrace, where we taped the plastic together, and the lower terrace showed where I used the 4" pipe as a terrace divider. We used 10 mil 20 x 100' sheets of plastic.

Next, reservoir pools on the lower terrace - the upper terrace was one large pool with the plastic taped together. A 6" lip along the internal edges of the upper terraces would help in controlling the siphoning.

Where you use a pipe as a divider would like to caution you to pack sand along the side of the pipe to support the plastic.

The base of the green can be undercut just a little, then use sand to get the level.

To go through your plastic wall with drain pipe, take two flanges with two gaskets - one on each side of the plastic - bolt them together. Then cut out hole in the plastic.

To put sand on the green, it seemed best to spread each load as it is delivered onto the green. Constantly keep it watered. This will enable you to compact the sand, and spread and pushed out.

The application of peat was applied with a top dresser, set wide open. Possibly two applications would have been better.

We used 2 tons of calcined clay. I believe another 1 - 2 tons would have been helpful. We used an Easy-flo spreader to apply the calcined clay. Working the peat and calcined clay into the top 2 inches we used a Ryan Mat-Away - went over it several different ways. This worked very well. Need a rope pull to keep it moving easily.

The construction of the green was started on March 24; seeded on April 15, and our first mowing was May 4. We opened the green for play around July 5.

The cost was $ 3600.00, or about 64¢ a square foot for the 5500 sq.ft. I feel the cost of this green was higher than necessary. A saving can be made in time, labor and equipment. We did have to remove the old green first.

It was fertilized about every 2 - 3 weeks on up to around the middle of July until a bad case of brownpatch; then we stopped fertilizing until the latter part of September.

We seeded with Penncross seed, 2 lbs. per 1,000. I did not mulch the green - just seeded and watered - germination a little slower than expected. I am sure mulch would have been a help to us. If I had added a little more peat and calcined clay this would have been helpful also.

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FERTILIZERS, TOPDRESSING, INSECTICIDES AND FUNGICIDES

Used on the PURR-WICK, 50000 sq.ft. green at the
Owensboro Country Club for the 1970 season

George Lumpkins, Supt., Owensboro, Kentucky

This PURR-WICK green was seeded and mulched on November 6, 1969, using 1-1/2 lbs. Penncross seed per 1,000 sq.ft. The seeding was late in our section of the country - about 65% germination. The winter passed very slowly. I suppose I was in too much of a hurry to see the green grow and have the members playing on it.

At the first sign of spring I was ready to remove the straw from the green. However, we had more bad weather. On April 1 we removed the straw, soon had 3½ inches of rain. The green had covered very well, but the grass was tender. The temperature dropped into the teens, so we had to re-cover the green. Luckily we had just pushed the straw off to the side of the green. On April 17 we uncovered the green for good. This green was opened on the first Saturday in May for weekends. Then it was opened on June 10 for full play.

Watering the Green

We would let the green go approximately 4 days without adding water. In a hot windy 24-hour period we found the free water in pipe would use approximately 1.5 inches. This is estimated to be about 1/3" of actual water use (from pore space) per day.

Dr. W. H. Daniel, who developed the PURR-WICK idea, stopped for a look in June. He suggested that we add 6" nipples on outlets in each tier just as an experiment. This idea worked well up until the last two weeks in July when the algae problem came along. Then we knew we were saving too much water and went back to only 4 inches of reserve water. I had very good results with this amount of water being carried in each tier.

Before watering the green the junction box was always checked for amounts of water in each tier. The watering was simple. We either poled the dew from the green, or double drag the dew off with two tractors with the hose between.

Fertilizers Used on PURR-WICK Green, 1970

Date	Material	lbs./1,000 sq.ft.	N	P_2O_5	K_2O
May 1	Milorganite	10	.6	.5	.1
June 1	38-0-0	[illegible]	3.8	0	0
" 28	22-5-5-FF	4	.8	.2	.2
July 12	18-5-10	5	.9	.25	.5
Aug. 10	22-5-5-FF	4	.8	.2	.2
Aug. 24	6-3-0	10	.6	.3	.0
Sept.28	18-5-10	10	1.8	.5	1.0
Total		269	9.3	2.0	2.0

Topdressing PURR-WICK

The topdressing was 65% sand, 25% peatmoss, and 10% calcined clay. This was used at 1/4 inch (8 cu. yds. per 1,000) on June 7, lighter on August 17, and 1/8 inch on October 14. In 1971, we will aerate the green, and break up the cores at least once, and then topdress at least two more times.

Spraying, Fungicides, Herbicides, and Insecticides

Spraying the PURR-WICK green was just like spraying a regular soil green. We are on a preventative program of 4 oz. Thiram, and 1 oz. of P.M.A.S.M. We spray on Tuesday and Friday during hot, humid weather - July to September. Koban was used only twice as we had a few spots of pythium on this green. I am well pleased with the green and the control of the pythium. We had no brownpatch.

As for herbicides, chlordane granules were applied at 10 lbs. per 1,000 sq.ft. on May 29, and again at 2 lbs. (to control cutworms) on August 5.

We started mowing the green at 1/2 inch, and kept lowering until at 3/16 during the early summer; then going up to 1/4 inch during the very hot season. I had one problem getting the grass to grow near one edge. Dr. Daniel advised plugging with 2 inch plugs from my sand nursery. This we did and it completely healed in.

We are in the process of building two more greens in the very near future. I'm sure these will be the PURR-WICK type. For our area of the country I think this is the best way to reduce the disease problem. It also will help during those summer showers to rid the green of water.

For winter play this green does not heave and thaw like a soil green, nor footprint as badly during the winter. I am sure we will see more of these greens being built in the future. It is cheaper to buy sand and peatmoss and calcined clay than to buy good topsoil. We have found a way to build a green and save too.

Weather Chart for Western Kentucky, and
Factors Concerning PURR-WICK green

	Section of Sprinklers on Water									Root depth	
Date	A	B	C	D	High temp.	Dew pattern	Humidity	Rain	Weather	H.A.	L.A.
6/24/70	5"	5"	5"	5"	86°	Heavy	70%	.42	Showers	8" -	.10"
7/27/70	6"	6"	6"	6"	96°	Heavy	80%	.25	Hot-humid	10" -	12"
8/13/70	4"	4"	4"	4"	85°	Heavy	70%	0	Used pop-up	6" -	8"
9/23/70	2"	2"	2"	2"	92°	Heavy	66%	0	Hot-humid P.Cloudy	8" -	10"
10/12/70	4"	4"	4"	4"	70°	Medium	80%	.52	Cloudy,cool	10"-	12"
Root depth in regular soil green											
July										3" -	6"
August										4" -	8"
September										6" -	8"
October										6" -	8"

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PURR-WICK GREEN

Ariel C. Hunt, Ass't. Supt. Parks
Evansville, Indiana

Our PURR-WICK was built in 1970 - began August 25, and finished September 30, 1970. It is approximately 6,000 sq.ft., and cost approximately $ 2,900.00.

Seeded with Penncross at the rate of 2 lbs. per 1,000 sq.ft., and young grass established before cold weather. I would have liked to have seeded earlier, but inclement weather and labor shortage prevented this.

It is very important to draw plans and calculate as near as possible what materials are going to be needed before initiating PURR-WICK construction. The shape, size, variation in elevation, particle size sand, and average depth should be determined beforehand.

(Editor's Note.) It is of interest that plastic figures so obviously in the PURR-WICK system. Any item giving zero tension could be used. Plastic sheeting may be bought from 2 mil to 30 mil thickness - 10 mil seems adequate. The smaller corrugated plastic tubing, already used in Europe, is being made by at least two companies in the U. S. in the 2" size. Earlier models used regular water pipe cut with a coping saw. Plastic irrigation pipe and sprinklers, plus use of plastic covers for growth encouragement during wintertime, are other examples.

Impervious Layer		$ 154.00
Plastic sheeting 4 rolls (8 mil)	$ 80.00	
tape 4 rolls (2" x 100')	8.00	
4" pipe for internal ledges	58.00	
rods to anchor pipe	8.00	
Water Control		200.00
2" PVC 530'	$ 141.00	
Fittings, etc.	43.00	
Concrete pit and cover	16.00	
Rootzone		1282.00
Sand, 22 tons coarse	25.00	
604 tons, masonry fine	1027.00	
Peat, 12 cu. yds.	110.00	
Calcined clay, 2 tons	50.00	
Fertilizer and seed	70.00	
Materials		1636.00
Labor, 438 hours, avg. $ 2.75		1204.00
Grand total		$2840.00

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CONTINUED PROGRESS WITH PURR-WICK

Birdie Shelton, L & N Golf Course
Brooks, Kentucky

As reported last year, the L & N Golf Club built a 5,000 sq.ft. green. It included 4 tiers. 425 tons of sand were placed in a range of 12 - 18". The estimate of material value was 40¢ per sq.ft.

When using heavy equipment the upper tiers were damaged so that neither retained surplus water as free-ponded reserve. Conversely, the lower section tends to have excess water because of the contributions from the upper portion. Thus, it was necessary to water the upper areas more, and the lower least.

Last year we built a tee and sodded it with Zoysia. It needs very little water because of the reserve created in the base.

Overwinter a new green is being built. The sand is now in place. The material cost should be about the same as before.

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EXAMPLES OF CONSTRUCTION COSTS

W. H. Daniel

Where Who	Size - When	Cost/sq.ft. Materials	Labor	Total
C. C. of Owensboro, Ky. George Lumpkins, Supt.	5000 sq.ft., 4 tiers Nov. 6, 1969	.30	.14	.44
Belle Meade C.C.,Nashville,Tenn. Jack Maurer, Supt.	5500 sq.ft., 2 tiers April 15, 1970			.64
Carmi C.C., Illinois Bill Story, Supt.	4000 sq.ft., 4 tiers Sept. 4, 1969			.40
Helfrich G.Course,Evansville, Ind. A.C. Hunt, Supervisor	6000 sq.ft., 3 tiers -	.27	.20	.47
L & N Golf Club, Louisville,Ky. Birdie Shelton	5000 sq.ft., 4 tiers Oct. 26, 1968	.40	.20	.60

Sand costs reported varied from over $4. to less than $2/ton.
General averages per green are:

Impervious layer	$ 200.00
Water Control	200.00
Rootzone	1600.00

plus irrigation and seeding, or stolons, as desired.

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THE SOIL CHEMICALLY

John P. Bryant, International Min. & Chem. Corp.
Libertyville, Illinois

We need to refresh our memory on some of the basic principles of soil fertility so that we can more fully appreciate some of the things that happen to our soils, our fertilizers, and eventually our turf. You will recall that all matter on earth is made up of 104 elements, and occur as atoms. Some are oxygen (we breathe), iron, aluminum (familiar metal) nitrogen and phosphorus.

Atoms have an electrical charge either positive or negative. This means that they would have an attraction for each other - much like a magnet attracts metal. When one or more positively charged atoms fit together with one or more negatively charged atoms, we call the new formation a COMPOUND. In forming compounds, the charged atoms fit together in such a way that the resulting compound doesn't have any charge, that is, it is neutral.

Of all the soil material - sand, silt and clay - only the clay is important in most chemical and physical properties affecting growth of plants. A clay particle is made up of mainly 4 atoms - silicon, aluminum, hydrogen, and oxygen. And, they always fit together to make this clay particle a flat, plate-like, or sheet-like structure. The clay is neutral - these broken, ragged edges leaving some of the atoms exposed as a negative charge. Therefore, it has the ability to attract and hold anything with a positive charge, or repel anything with a negative charge.

Now, why is all this significant? Most plant nutrients have positive charges. Potassium has one positive charge; calcium, magnesium, manganese, iron, copper and zinc have two positive charges. Therefore, since the clay has a negative charge, and these nutrients have positive charges, the clay attracts these nutrients and holds them.

Now, on the right side of the screen you see some nutrients with a negative charge. Nitrogen, for example, combines with oxygen in the soil, and forms nitrate which you see here. Nitrate has a negative charge, just like the clay does. Therefore, it is repelled by the clay and is kept pushed out in the middle in the open spaces between soil particles, so when it rains, the nitrogen is simply flushed through the soil. This is why we can never depend on any significant carryover of nitrogen - we have to apply our total requirement every year.

You can see on this list that sulfur is the same way - it forms sulfate in the soil, and since it, too, has a negative charge, is flushed out of the soil readily. Fortunately, plants don't require nearly as much sulfer as they do nitrogen. Also, decaying organic matter supplies some sulfur, but many researchers warn that if we use fertilizers containing little or no sulfur - like most of our common fertilizers today -we should watch for sulfur deficiencies within 3 to 5 years. Phosphate nutrient exists with a negative charge, but for some reasons that are not fully understood, soil clay attracts phosphorus very strongly. In fact, the clay holds phosphorus tighter than it does any other nutrient, and phosphorus leaches almost zero. So, we say that phosphorus doesn't move in the soil. This is why it is so desirable to apply phosphorus as deep as possible.

But, this doesn't mean that phosphorus is lost for good - we've already said that phosphorus never leaches - but what is not used is simply stuck on the clay and goes into a reserve. And, the phosphorus level in the soil builds higher and higher and, in time, it will be gradually released back into the soil for plants to use.

pH

We know that most plants grow best at a range of 6.0 to 6.5. Soils are made acid either by hydrogen or aluminum. Over the years the clay can get pretty well saturated with hydrogen; becomes quite acid. We want to replace the hydrogen with something alkaline to bring the pH back up -- the cheapest way to do this is with limestone. We could do the same thing with certain kinds of potash, or with magnesium.

We know that fertilizer and the whole fertility program is just one part of the overall management program. But, other factors may limit quality of turf. We want to eliminate fertility as a factor which would limit the quality of your turf. We have traditionally considered only N, P and K; yet, in recent years we've learned that secondary nutrients like Ca, S, and Mg, or the micro-nutrients like B, Cu, Fe, Mn, Mo, Zn, and Cl may be limiting.

One reason for the rapid growth of tissue analysis in recent years in turf production is these deficiencies exist, but we don't know where. So, we take samples of the actual plants and analyze exactly how much nitrogen, phosphorus, magnesium, zinc and other nutrients these plants have at a particular stage of growth. A soil test indicates how many nutrients are stuck to the clay. The more of these nutrients it is holding, then obviously, the less we'll have to apply as fertilizer.

If your soil test reads a "high" or "very high" level of phosphorus in your soil, but your pH is about 5.0, very little of your phosphorus will be available to your plants. Well, it's obvious that we can't have both - we can't have a pH of 6.5 to keep the phosphorus available, and a pH of 5.0 to keep the micro-nutrients available. So, since plants do best at a higher pH, it's been found that at a pH of about 6.2 to 6.3 we can have some of all of the good things. Obviously, the availability of micro-nutrients has been reduced. The rising pH has literally cut off their availability.

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SOLVING PROBLEMS IN IRRIGATION

Thomas J. Kramer, Kirchdorfer Irrigation, Inc.,
Louisville, Kentucky

In the field of Turfgrass Management, one or many things may be wrong with your irrigation system. You may have major or minor difficulties with performance, control, operation, or maintenance. Your system may simply be too old, in which case everything seems wrong.

Those of you considering a new irrigation system, stand to gain the most from this discussion because you can learn by the mistakes of others. And, if profiting by someone else's mistakes helps you to acquire a problem-free, efficient irrigation system, well so much the better. Those of you that do have problems can't expect to find a solution here in only a few minutes. But, by understanding the reasons why some of your problems exist, perhaps you can derive a method to solve your particular problem. You will probably need the help of a qualified irrigation consultant who understands your problem, who knows the feasibility of the solution, and who can keep the solution within your budget.

Every successful irrigation system is the result of hard work by a team of qualified individuals. You, as the golf course superintendent, are the team captain, so to speak. You will ultimately bear the responsibility for success or failure. With the help of your team mates, you will plan, coordinate, and execute the project. Assisting and working with you are the designer, contractor, and several manufacturers. Each has certain responsibilities that he must perform for the team to be successful. Problems occur when one or more of the team members fail to perform their job. These problems usually manifest themselves in one of the following areas: operation, performance, control, or maintenance. We must look at the responsibilties of each team member and see how he can help or hinder the entire effort.

It is the superintendent's responsibility to coordinate the project from inception to operation. He, with the help of his irrigation committee, must

select a designer. He must explain to this designer his maintenance program, local soil conditions, and any other existing or future conditions that will affect his watering program. He will tell the designer what he expects in the way of operation and control.

The designer has the responsibility of planning the golf course superintendent's needs into a framework of sound irrigation practices. He must explain to the superintendent the various types of systems available, and have rough estimates for each so that the superintendent can decide which is the best for his course. The designer must have thorough knowledge of all the component parts of the irrigation system. By knowing the capabilities and limitations of each, he can select the right combinations for your system. By designing the system with ease of maintenance in mind, he can save the club many dollars in maintenance costs.

The contractor, as the third member on the team, is responsible for installing this complicated piece of machinery in accordance with the plans and specifications. He must understand how to install the component parts properly, using the manufacturers' recommended installation procedures. He should have the best equipment available, and men that understand the capabilities of the equipment in order to make field changes that often occur. If yours is an existing installation, he must take the best possible care of your course.

The contractor will be responsible for turning the system on and off the first time, and explaining to the superintendent proper use of the system. Last but not least, he will guarantee his installation for a period of time ranging from one to three years. He must live up to this warranty so that you, the superintendent, can have some measure of protection.

The various manufacturers that provide materials for your system make up the balance of the team. Although they often work through suppliers and/or contractors, they have a very real obligation to provide you with the best materials available. They, like the contractor, provide a warranty, usually one to seven years, that they must live up to. If a manufacturer balks at this obligation, the only way to "collect" is through expensive legal procedures. It becomes the responsibility then of the rest of the team to specify and use only the most reputable manufacturers.

The manufacturers should keep the rest of the team aware of new products and procedures. By continuing research and development with new materials and designs, and by improving present products, they are meeting your criteria of efficiency and economy. They should also provide readily available replacement parts to make the superintendent's maintenance task easier.

With the help of his designer, and acting upon the advice of other superintendents, a list of acceptable contractors must be drawn up. When the contractors submit their proposals, he must be familiar with and understand each proposal and make the decision of who will do the installation.

The superintendent is the logical person to oversee the day by day construction. He can readily see if the contractor is following the plans and specifications. He will assist in turning on and adjusting the system so that he will be thoroughly familiar with it. After the designer and contractor have left, he is responsible for the correct operation and maintenance of the system. If the golf course superintendent executes his portion of the assignments correctly, the irrigation system is well on its way to success.

As you can readily see, each team member has certain responsibilities and obligations to perform if the project is to be successful. Let's look at a couple of problems and see how they might have occurred.

Problems in the area of maintenance are perhaps the most time consuming and expensive of all problems. These are usually the result of failure of the component parts. This failure can be due to a number of reasons. Each reason can be attributed to the failure of a team member.

Piping system, electrical system, valves, and sprinklers can fail due to defective material. This is why you have the obligation to use only the finest materials on your course. These failures can also occur if the contractor performs sloppy workmanship. The component parts may fail due to improper design. If the designer is not aware of the limitations of the material, he can provide the club with years of headaches.

But you, as the superintendent, bear the ultimate responsibility. It is up to you to operate your system in accordance with the operating instructions. Failure to do so will fatigue the component parts prematurely. As you can see any failure of a component part may be due to:

a. Defective material
b. Improper design
c. Faulty installation
d. Improper operation

Problems associated with operation and control, however, are more the responsibility of the superintendent and designer.

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LIGHTNING

Walter J. Wilkie, March Irrigation and Supply Company
Muskegon, Michigan

Man is a creature of impulse, and as such, reality comes as a very late development in the lives of living creatures, most of whom as far as I know get along admirably in daily life without ever reconciling themselves to it. But, can they?

Well, consider for a moment lightning. Lightning is a unique phenomenon that we, in our combined fear and ignorance of it, have tended to ignore. But, since it has been estimated that 1,800 lightning storms are in progress over the surface of the earth at any given moment, and because the electrical discharges that are occurring during these storms are known to strike the earth an average of 100 times per second, I'm wondering if we can.

I say this because I know that ligtning is caused by the vigorous movement of the cloud formations where, when the accumulated electrical energy exceeds the insulated strength of the air, it releases the same. And, as it does, it sends it crashing to the earth where its strength is dissipated in a manner that parallels the ending effects of a rising musical crescendo.

We, then, in attempting to isolate and define the effects of this tumultuous release of energy, have found that as it strikes the earth, it has a sinusoidal pattern that contains from one to 42 electrical impulses in which the amplitude of the leading impulse has a current carrying capacity that sometimes reaches 100,000 amperes, and that the time lag between each impulse is usually around 60 millisecs (1000th of a second). All of which means that if we could in some way harness the power reserves contained in just two strokes of lightning we would have accumulated enough electrical energy to provide for the simultaneous operation of six 100 watt light bulbs for a full year.

Accordingly, if we were to equate all of this to the fact that we know that, in any wiring system, the amplitude of the surge voltage that can be induced into the electrical equipment by lightning is -

1. Directly proportional to the area of the wire loop of the wiring system servicing this equipment

2. Inversely proportional to the distance of the strike from the wire loop of the wiring system

3. Directly proportional to the maximum amount of current in the lightning discharge

we would have to conclude that in the case of an automatic underground sprinkler irrigation system, protection of the control equipment is essential. Thus, the reason, I'm sure, that researchers are attributing more and more the damage that is being caused to electrical systems to lightning, for as the above shows, lightning can induce the damaging effects of a voltage surge into the wire loop of a wiring system that is more than three miles away from the control equipment it services.

This is why numerous types of lightning protection devices have been developed to give this kind of protection. But, since the Arc Discharge Type has proven itself to be the most reliable when equated in terms of response time, power handling capacity, ruggedness, cost and ease of maintenance, it's the one we would suggest you use. For here, when a voltage surge of sufficient magnitude occurs between the electrodes, an ionization of the pressurized gap takes place between the same which results in a low resistance and high current carrying path to ground. This, then, dissipates the excess electrical energy and allows the device to automatically reset after the arc is over, and to again be ready to give you protection from the inevitable damage caused by lightning.

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UTILIZING POA ANNUA AND EARTHWORMS

Ted Woehrle, Supt., Oakland Hills C.C.
Birmingham, Michigan

Since moving to Oakland Hills Country Club in the Detroit area in 1968, I have noticed that growing Poa annua is not the problem that it was in the Chicago area. At first I believed that it was entirely due to porous sandy soil and the good drainage. These, of course, are very important, and no doubt have a great deal to do with the success of growing healthy Poa, but I also had some sandy,

well-drained areas in Chicago, and I couldn't keep Poa during these times of stress.

In taking a closer look at a few other variables, I noticed the absence of thatch - I noticed deep roots - more dollarspot because of leaching - an enormous earthworm population, and different cultural practices used in the past in comparison to Chicago. This reminds me of a question I used to ask many of my fellow superintendents in Chicago - WHICH CAME FIRST, POOR SOIL OR POOR GRASS? Did we ruin our soils with poor management practices of over-watering, over-fertilizing, and the over-zealous use of pest controls?

First, we killed grass by over-watering - a great thing this irrigation. Wet soils and grass make a great place for diseases to do their dirty work. The grass dies, the weeds come in and, of course, Poa annua is right there with the rest of the weeds. We killed the cutworms and other insects, and inadvertently killed our old friend - the earthworm.

The Oakland Hills C.C. have almost a pure Poa annua turf. We've killed all the other weeds chemically - dandelions, chickweed, knotweed and clover, along with crabgrass and goosegrass.

From what I understand about the history of my Club, we were about to have the 1951 U.S.Open Golf Tournament, and it was a disastrous year for turf. Several members went to Canada and purchased enough Poa annua to seed all the fairways. They got good germination, good survival, and the Club ended up with the finest playing fairways. To this day we still have good Poa fairways. Sure, we lose some turf to winter desiccation or ice damage, but seldom do we lose Poa in the summer.

A cross-section of a turf sample has deep white roots on the Poa almost at any time during the summer, usually around 5 or 6 inches deep. There just isn't any thatch. In checking past records insecticides have rarely been used. There is a great abundance of earthworms - (Polish aerifiers as we call them).

I becaome interested and began asking questions, reading some old textbooks. Then Jack Welch of Scotts sent me a collection of research papers from around the world, and I was amazed to find out that these little critters are indeed the most important tool we have on the course. Dr. Jack Butler at the University of Illinois, and the Turf Department of Michigan State University have been doing thatch studies, including the effects that the earthworms have on the control of it.

Let me take you on a little trip through the land of the worm by reviewing some of the findings that have come about by scientists around the world. Incidently, most of the work on worms has been done in England, Germany, Russia and Australia.

As early as 1882, Darwin recognized the fact that earthworms play a part in the formations of agricultural soils. Since that time, some investigations have been made on the effects of earthworm activity on the physical, chemical, and biological properties of the soil. Workers concluded that the air capacity of soils was increased by earthworm activity, and the aerobic processes, especially nitrification, were stimulated.

Earthworms eat soil and organic matter, excrete casts, and make holes, thereby perforating and granulating the soil. Aside from the pure mechanical aspects of earthworm activity, it has been shown that the water stability of soil aggregates is increased in soil worked by worms.

It appears probable that earthworms are important in maintaining good soil physical condition; thus, water infiltration rates are higher (3 to 4 times more rapid) where they occur in large numbers. Hopp and Hopkins report several populations for ordinary field conditions of over 1/2 million worms per acre.

Studies show that it normally takes a worm about 1 and 1/2 hours to burrow into the soil. 22% of the surface four inches moves through the earthworm's bodies each year. Up to 25 tons of dry weight per acre of earthworm casts are deposited annually on the soil surface. Not quite equivalent to 1/4 inch of topdressing per acre per year.

Worms are prolific reproducers. The average worm has 50 to 60 cocoons, or hatching, per life span, mostly during the spring. The heaviest worm populations are found in spring and early summer. After July 1 there is a steady decrease. After October 1 we noticed the population again increases. The eggs are hatched during the summer. Most of the worms found in the fall are immature worms.

Other factors Affecting Population

Soil pH ssems to affect the earthworm population. Few worms are found in very acid soil (lower than pH 5), and this could be nervous sensitivity to soil acidity, or of nutritional requirements which acid soils fail to meet. It has been shown that worms tend to neutralize soil pH. They can make acid soils more alkaline, or they can make alkaline soils more acid.

NOW, A NATURAL QUESTION

Do earthworms increase soil productivity, or merely live in greater abundance in the better soils without contributing to productivity? It has actually been proven that where poor soils have been inoculated with worms, there was considerable improvement in the soil in a short period of time - 2 years.

Here are other factors affecting the worm population. A 35 year study in England showed that of 16,000 worms examined, there were 10 species found of which 5 species made up 95% of the total. Their plots have been treated with six cultural practices, or factors alone, and in combination with each other.

Sulfate of ammonia and sulfate of iron both decrease worm populations slightly. When applied in combination, they become synergistic in nature, and almost eliminate the worms completely. Lime applications, topdressing with organic matter, and spiking or aerifying improve the population immensely. Also, superphosphates improve the population. They still use Mowroh Meal on greens to thin populations, but not kill them completely. Some herbicides kill worms - not certain how - perhaps killing food supplies.

Insecticides controlling worms -

Carbaryl - quick results, poor persistence
Chlordane- slow reacting, but quite persistent
Dieldrin and Aldrin - useful
Lead and calcium arsenate - good long lasting control

If you want to thin populations, use chlordane up to 4 & 5 lbs/A, and in two years you will be back to normal.

In conclusion, earthworms do very definitely improve soil structure by increasing aggregate content and porosity, thus facilitating aeration, water absorp-

tion, root penetration and drainage. The main benefit, chemically and biologically, of earthworm activity is the digestion of plant material and its intimate mixing with mineral soils.

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RECALLING THE EARLIER ZOYSIA

Roy F. McCawley, Supt., Hurstbourne C. C.,
Louisville, Kentucky

My experience with Zoysia grass goes back into the thirties. I was employed as an assistant superintendent on the four City Municipal Golf Courses in Louisville, Kentucky, from 1933 to 1939 with Mr. C. D. Bohne, who was supervisor on these golf courses. Mr. Bohne knew Dr. Monteith, Director of the U.S.G.A. Green Section, which was located in Arlington, Virginia, where the Pentagon Building is now located.

Dr. Monteith had a small plot of Japonica and Matrella Zoysia grass in nursery at Arlington, and he sent us a small portion of the Japonica and Matrella stolons. We planted the stolons in a row - 25 ft. long each. This was in April, 1937. The Matrella is a fine texture blade, and the Japonica of coarse texture. By September, 1937, five months, the Zoysia had spread 2 ft. on each side of row. In September we removed the 25 ft. of Matrella, and planted 6 rows 150 ft. long, the first year.

We also planted in stolon form a plot 100 sq.ft. of each type of Zoysia, fine and coarse, to work with as a green and tee turf. By May 1, 1938, the rows and plots of Zoysia began to green up. We fertilized the rows and plots with a complete fertilizer - a mix of 10-6-4 ratio. We fertilized every three weeks through August. In the middle of May we topdressed the plots of Zoysia, and kept one-half of the plots cut at 1/2 inch and 5/16 inch.

The finer texture Matrella made a good putting surface cut at 5/16". The Japonica cut at 1/2" made a good tee surface. In September, 1938, the 6 rows had spread 2 ft. on each side of row. We removed 3 rows and planted 58 rows, 150 ft. long.

The Department of Parks sold stolons to clubs in Louisville for tees in 1939. We planted Zoysia on the Par-3 holes on the Municipal courses, and it held up very good under traffic. In August, 1939, I was checking seedheads on the Zoysia. We sent some seed and a picture of the Zoysia nursery to Dr. Monteith, U.S.G.A., Green Section. I left the City Municipal Golf Course in 1939, and located in West Virginia, and did not have a chance to work with the Zoysia plots any more.

(Editor's note: The next article moves 31 years later in the same city).

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PUTTING ZOYSIA INTO AUDUBON C. C. FAIRWAYS

Tom Sams, Supt., Louisville, Kentucky

After years of frustration trying to grow a consistent desirable fairway cover at Audubon C. C., I now have a good chance of achieving this ambition. This past season (1970), I supervised the plugging of 2" Zoysia plugs on 9" x 18" centers in 15 of my fairways (all but 3 Par-3's). It required four months of hard labor to complete the job. Total cost of the project was $ 51,600.00.

If you live in the Ohio Valley area, it's very easy to understand the "whys" of such a venture. What with, as Louis Miller so aptly described as the hot 100's staring you in the face each year, trying to grow the bluegrasses (annual and perennial), the bents and Bermudas with any amount of consistency, became an almost impossibility.

When the hybrid Bermudas came upon the scene, for a while things looked rather bright. It wasn't long before winterkill and spring deadspot began taking its toll. We, as turf managers, again looked for help. It was a well known fact that the Zoysias would make a very desirable cover for fairways in the Ohio Valley. The main problem was that Zoysia had to be propagated vegetatively. Combine this with its slow growing habits, and you can readily see why very few had attempted to plant 35-plus acres on an established golf course in one season.

Of all the turfgrasses that I have ever come in contact with, the Zoysias consistently performed among the best. Very drouth tolerant, they performed well under all fertility ranges. About the only disease I have noted on the Zoysias is rust which usually occurs in early fall. Another plus factor is the shade tolerance of established Zoysia, especially Matrella zoysia.

After assuring myself that I wanted Zoysia on my fairways, and realizing there was not a short-cut method of propagation, I set out to convince my Greens Committee and Board of Directors of the feasibility of such an expensive undertaking. With their approval I set out to find the best and the safest method for propagation.

In April we purchased truckloads of Meyer zoysia sod, putting it down in the rough areas. This served as a source for hand-plugged pieces. The three tandem, low trailers permitted a man to sit in each, with plugs just over his lap which he set into holes as pulled very slowly by small tractor. The holes were cut by an RMF hole cutting machine with 2 cutters removed so as to make holes every 9" x 18". After noting the growth in the first year, which was much greater than we dared hope for, we should have some fine looking fairways in approximately three years.

I have been asked if the same situation presented itself - would I again attempt such an undertaking. I can only say that if the question were asked this past summer, my answer would have been an emphatic NO, but if it were asked now, after the frustrations are behind me, I would say YES, because the sense of satisfaction that one feels with a job well done is worth the chagrin and frustration.

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ZOYSIA PLANTING SYSTEMS - PLUGGING

Peter J. Hitch, Supt., Meadowbrook C. Club,
Ballwin, Missouri

Meadowbrook moved to its present location in 1960 after a fire destroyed the clubhouse at the old course. When the new course was built, the fairways were planted in U-3 Bermuda, and they remained in satisfactory condition for the first few years. Then, with spring deadspot and winterkill, it became a constant battle to get the fairways in shape each spring. During the winter of 1967, it was decided by the Greens Chairman, and then superintendent, the late Mr. Thomas Hayes, that Meadowbrook would go to Meyer zoysia fairways the next year.

I was hired as Mr. Hayes' assistant in May, 1968. We obtained two plug planters that cut a small furrow, spread it open, then roll it closed after the operator sets a 2-1/4" x 2-1/4" plug of Zoysia into the open furrow. The planter is pulled by a tractor, and is raised and lowered by the tractor's three point hitch. During a test run we found that the four speed tractors had to be idled in order to maintain the slow speed required to plant at the desired spacing. We also noticed that the tractor would not charge the battery while idling, so a spare battery was obtained.

The Meyer zoysia plugs were obtained from a local nursery, and a truckload was delivered to us each morning we planted. The night before a fairway was to be planted it was watered generously to soften the ground and make it more pliable for the planter's plow and roller. The planting crew started each day at 5:30, and the hole was closed to play daily until we stopped planting at 2:00 P.M.

Plugs were planted an average of 16" apart in rows 12" apart. The five high school boys and crew chief averaged 14,440 plugs per day, which is less than 1/2 acre per day, and 2400 plugs/man/day. The fairway was immediately watered but not saturated. The hole was then opened for play for the rest of the day, so the fairways were not completely out of play. That evening the fairway was watered heavily, and was watered every night for two weeks.

One week and three weeks after planting, 1 pound of nitrogen was applied. In two months, June and July, we planted all fairways with the exception of two Par-3's, an area of 30 acres. The costs of the planting include:

Plugs	$6,666.00
Labor	3,764.00
2 planters & spare battery	1,040.00
Total	$11,471.00
Per acre	382.00, or 1.25¢/plug.

I would estimate at least 90 - 95% survival of this planting.

Since that time we have planted the 50 yards in front of the greens, and next year I intend to plant the 100 yards near the tee that were skipped during the original planting. The labor costs of these subsequent plantings was absorbed in our regular budget as the regular crew did the planting, and at our own convenience. We also used our own Zoysia nursery for these plantings.

In the two complete years the Zoysia has been in the ground at Meadowbrook, it has spread nicely, and we now have about 60% coverage. I would estimate that

we will be completely covered in one more year.

The spring after the original planting, I went to a tri-calcium arsenate program to eliminate the Poa annua competition. This seems to be doing a fairly good job of controlling the Poa annua.

As of yet, I have not seen any evidence of the billbug, nor any sign of chinchbug damage. However, I do keep an eye out for both. Evidence on the subject of these insects, in relation to Zoysia, indicates that both pests desire the lush, thatchy type of growth associated with high heights of cut. By cutting the Zoysia low, we can reduce the thatch accumulation. If it does develop, we have the equipment to get rid of it.

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HYDRO-MULCHING ZOYSIA

Lee Redman, Supt., Bellerive C. C.,
Creve Coeur, Missouri

On those golf courses which had had Bermuda fairways, the past winter had taken its toll and left severe winterkill on most all Bermudas. The Westwood strain of Bermuda at Westwood C. C. had better regrowth than any other type.

The U-3 Bermuda on the fairways at Bellerive C. C. had constituted about 80% of the turf, with the rest being made up of Meyer zoysia. For the past four years Zoysia had been strip-sodded in approaches to greens, and some fairways had been plugged. The Zoysia had provided excellent turf and the members liked it. In the spring of 1970, the Zoysia at Bellerive C. C. was one month ahead of the U-3 Bermuda in greening up. Our tees are U-3 Bermuda also, but they are covered all winter with straw and came through the winter very well.

To further complicate our Bermuda loss, a pre-emergence for crabgrass was applied in late April, 1970 before the Bermuda failure was realized. Therefore, an overseeding of common Bermuda or bluegrasses would not work.

Our yearly allocation of funds for Zoysia sod would plant more acres if it was planted as stolons rather than used for sod. By using a hydro-seeder to apply the stolons they could be kept as moist as possible. Therefore, the decision to use the hydro-seeder was accepted, and I was to plant as many acres of Zoysia as possible with available funds.

I used a Howard rotor-vator to till the soil 6" deep. Old Bermuda thatch is hard to work up. Therefore, the area was worked as many as five times with the rotor-tiller, and a disk also proved helpful. It became very important to get a good loose bed of soil, with a minimum of thatch clumps on the top. The clumps of thatch material on the surface prevented Zoysia stolons from being firmed into the loose soil.

Zoysia stolons were taken from our own nurseries by using an aero-blade and a Rogers powered sweeper. The turf was aero-thatched once, and then swept to remove the excess clippings. The turf was then undercut thinly with a sod cutter. The Aero-blade was used to cut the sod three different ways, and then the power

sweeper began to pick up the stolons. The stolons were kept moist and as cool as possible. They were cut and used the same day to prevent drying out. The mortality rate is high on Zoysia stolons if they become dried.

The Conwed Hydro-Mulch (a cellulose wood fiber) was used at a rate of one ton per acre. The mulch material mixes with the stolons and helps to hold moisture on the stolon when sprayed onto the soil. It also will help to prevent erosion on sloping areas.

The loading of the hydro-machine took twenty minutes. The materials that were loaded included:

40 bu. stolons
400 lbs.cellulose mulch
1200 gal.water

which covered one-fifth acre. Three acres of Zoysia can be stolonized in one day. The stolons and mulch are pumped by the hydro-machine and sprayed onto the soil. The green color of the mulch material is helpful in indicating the coverage.

Before the stolons can dry they are to be mixed into the top inch of soil. Good results were obtained using the Aero-blade to mix the stolons with the soil, and re-level the seedbed. A disk also was used very lightly, and set with very little angle of cut. Proper adjustment of either machine will result in a smooth, evenly mixed discharge of soil and stolons.

Then the loose soil and stolons were rolled two different ways to press the stolons firmly into the loose soil. Complete coverage of a Zoysia stolon with an inch of soil will result in death to the stolon. Irrigate as soon as possible, and keep the area very moist until new leaves appear. This will take about ten days for good rooting and new leaves to start. Then the water can be decreased gradually, but still keep the soil moisture high.

The little Zoysia plants are slow in growth when compared to Bermudas. After two months of growth, the new Zoysia had covered 60% of the prepared area. Two growing seasons are expected before complete Zoysia coverage will be achieved. By overseeding with bluegrass or common Bermuda, a playable turf can be achieved faster. The Zoysia will continue to crowd these grasses out, and soon provide an all Zoysia turf.

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WHICH GRASS FOR LOUISVILLE? - BENT

Louis E. Miller, Supt., Louisville, C. C.,
Louisville, Kentucky

Up until about five years ago the use of bentgrass for a suitable fairway turf in the Louisville area was considered a pipe dream. There were simply too many variables involved, and the minuses far outnumbered the pluses. The last four years, however, have proven that bentgrass can indeed be a reality in the hot and humid Louisville area of the Ohio Valley.

First of all, I think we should go back to the beginning and answer the ever-pressing question of - why bentgrass? In 1965, the membership was looking for a better type of fairway turf. The fairways at that time were unwatered bluegrass, which was more a Heinz 57 varieties than true bluegrass. At the same time, the courses that had Bermuda were suffering extensively from spring deadspot, and it was midsummer before some of the Bermuda courses began to fill in. The membership wanted a turf that greened up early, was low cut, and allowed the ball to sit up rather than hestle in the turf. Somebody said "let's try bent" - so five years later here we are.

A lot has transpired in the past four years in order for this program to be successful. After the original establishment, the next problem was to eliminate the weeds. MCPP at the rate of 5 pints per acre eliminated clover, chickweed, knotweed, etc. A tri-calcium arsenate program was initiated to eliminate soft crabgrass, goosegrass and Poa annua. After four years of this program, the material has done an excellent job of controlling crabgrass and goosegrass. The Poa annua has been reduced from about 30% to 2% of the fairway turf.

Mechanical maintenance is an absolute necessity, not only from the standpoint of proper aeration but also for thatch control. This is accomplished by aerifying 2 to 3 times a year using 3/4" closed spoons and dragging the cores with a chain-link drag. We also employ a vertical knife operation in the fall of the year, using a thatcher with the blades set on 6" spacings, and a sweeper to remove the material from the turf.

The insect problem of cutworms and sod webworms is handled adequately by two applications of Sevin 80% wettable powder, and one application of Diazinon 14% granular.

By far, the most prevalent problem in a bentgrass fairway program this far south is disease. There has been a great deal of work done in the fungicide market in the past couple of years with new materials. This has, indeed, made the problem of disease control easier, but by no means eliminated it.

Disease control is accomplished by using a basic program of Thiram and PMAS, zinc and manganese base compounds, cadmium chloride,Koban and Tersan SP. The two major diseases that we are confronted with are large brownpatch and pythium. There has been extensive work done by the major chemical manufacturers concerning systemics. I feel that in the very near future we will see longer residual on fungicide applications, and a broader spectrum of control. We have sprayed as few as ten, and as many as twenty three times in a single year for disease control, and it is by far the most varied portion of my operating budget.

The fertilizer program consists of an application of 200 lbs. of Ureaform in the spring, and 200 lbs. again in the fall of the year. A 200 lbs. application of sulfate of potash is also applied in the fall of the year. Phosphate is eliminated as nearly as possible due to the tri-calcium arsenate program. A light application of 300 lbs. of Milorganite is made in the latter part of July, with timing of the application being governed by the heat,humidity and rate of growth of the grass. Nitrogen level of the grass is kept at about 3 lbs. actual per 1,000 sq.ft. per year.

The one item that I feel has made the whole bentgrass program a success is the installation of a dual row automatic irrigation system. Both water application control, and daytime syringing are an integral part of the operation, and could not be accomplished with a manual system.

Managing a bentgrass operation has also brought about many changes in our routine operation. The majority of our fairway mowing is done in the evening, starting at 5:30 and continuing until dark. The mower is followed by a fairway blower to remove clippings, which reduces the temperature of the grass, and eliminates a big thatch buildup. By removing the clippings it also helps our fungicide program in that the material penetrates into the crown area of the grass plant.

A bentgrass fairway program is not something that you just start over night, or even in a year. It is a program that must be built and added to over a period of time which influences the types of material, machinery and method that you will use in the operation. I will be the first to admit that it is a touch and go situation during June, July and August. If you are willing to take the risks and have a large operating budget, I most definitely suggest a bentgrass operation. With all of its disadvantages, it still possesses some advantages. It is the first grass to green up in the spring, and usually provides a good fairway turf by the second week of April. When injured it does recover quickly, and provides good turf until late December.

Even though it is not the answer for everyone, it is still a workable program, and one of several successful fairway programs being used in Louisville.

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REPORT ON U-3 FAIRWAYS

Ernie Schneider, Supt. Big Spring C. Club,
Louisville, Kentucky

My U-3 Bermuda fairways have been through 12 years of play. At the time of planting, the cost seemed quite high, but during the first five years I was at Big Spring, they had good turf with a minimum of disease problems, such as spring deadspot, etc. For five years I was in St. Louis, then came back to Big Spring C.C. in the fall of '68, I was disappointed to see the poor condition of the turf due to extreme insect damage, such as the grub worm. In the past, I always applied chlordate in the late summer or early fall, but this time I put on 10 lbs. chlordane in February when the ground was frozen.

Along about the latter part of March, we began to see a few dead starlings and blackbirds, and by April I began to find about every type of bird which was most disheartening to me. This had never happened before. Maybe when applied in the fall the insects are on their way down into the ground, and in the spring the insects are on their way up. Or, perhaps the birds are hungrier in the spring since they are coming out of their starvation period, and they tend to over-eat the insects.

At that time also, the pH was low in the fairways, so 2 tons of lime per acre was applied.

We did no renovation in '69 because we were putting in an irrigation system, but even so the fairways started to respond very well. The winter of '69-'70 was a disastrous year for most Bermudas in this area, but Big Spring suffered the least damage. The only damaged areas were the high ridges, and the areas in front of the greens which had been used heavily by carts. These areas were plugged or

sodded in Zoysia. During the playing season of 1970, we had excellent turf on the fairways. Some of the spring deadspot areas that I plugged to Zoysia back in '62 and '63 are 5' to 15' across today, and have blended in with the Bermuda very well. In the past two year I haven't seen any spring deadspot.

My fertilizer program on Bermuda grass is - around May 10, when Bermuda is starting to have some growth, 14-7-7 at the rate of 350 lbs. per acre is applied. A month later we apply Milorganite at the rate of 500 lbs. per acre; then in July I apply about 350 lbs. Milorganite per acre. The next application of fertilizer is in August - this is Urea 45 at a light rate 3/4#N/1,000. The latter part of September, Milorganite is again applied at the rate of 500 lbs. per acre. I believe this late application is necessary to send your Bermuda into dormancy on the fat side instead of on the hungry side.

The fairways were heavily infested with winter weeds, such as chickweed and henbit. We got good control with a pint of 2,4-D, and 1/2 pint of Banvel-D.

In '69 there was a good deal of hard crab. I sprayed with di-sodium methyl arsonate at half the recommended rate, plus 4 oz. 2,4-D to the acre, three applications four days apart. This was very effective, so in '70 we sprayed where the winter injury was and in the flooded areas. I intend to thatch the fairways heavily in May, and to double aerify in June to control thatch. I am using all different types of materials for Poa control to see which one does the best job here, and that will be the one that I will use overall.

This year I saw my first chinch bug damage on both Zoysia and Bermuda. In September, I also saw billbugs on the Zoysia - both were treated the same - 4 ozs. Diazinon per 1,000, repeated the following week at the rate of 2 ozs./1,000. The members of Big Spring have received their money's worth out of the U-3 planting, are happy with it and with Zoysia.

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DESODDING AND RESEEDING IN A FAIRWAY RENOVATION PROGRAM - 1970

Clem Wolfrom, Supt., Detroit Golf Club
Detroit, Michigan

After careful study of our fairway problems at Detroit Golf Club, it was decided that the best way for us to improve our turf was completely stripping the old sod and thatch, and reseeding to Fylking bluegrass. This method was chosen because of the excessive thatch that is present. We felt that any other procedure would only be a temporary solution to our turf problems.

It was decided by the Board of Directors that one fairway should be renovated this first year to prove to themselves, and the membership, that we could complete our renovation program, and have playable turf in 7 to 8 months (August 15 - March 15). Number one fairway on the South Course was selected to be the trial area. It well represented the problems we were trying to correct, it had an abundance of thatch (some places up to 2"), about 80% Poa, and the remainder in concentrated patches of bent. Dr. Daniel was very instrumental in getting this program underway.

Procedure on 2.2 acres

August 17. We started stripping the sod and thatch. A Ryan Sod Harvester (Model H 24-1) with a conveyor extension attached to rear, cut and elevated sod directly into trucks, eliminating handling. The first day resulted in some problems with themachine (automatic cut-off), resulting in low production.

August 18. We worked for 8 hours with no problems, until rain at 3:30.

August 19. We finished stripping the sod about 2:00 P.M., a York rake gathered small pieces of sod. A Jacobsen Sweeper (Model 720E) picked up debris, grass plants, etc.

August 20. A York rake graded the fairway, as needed, to improve surface drainage. The fairway was then spiked in two directions with a 3-gang Maple Lane Spiker. A complete fertilizer was then applied - 10-40-5. (Being a test to show members we could grow grass in a hurry, we felt the use of the high phosphorus was necessary even though we knew it would hinder us somewhat in our following Poa annua control). After fertilizing the fairway was again spiked.

August 21. The fairway was seeded to 100% Fylking seed at a rate of 70 lbs. per acre. After seeding, we spiked once more and rolled the fairway. Done in one week.

August 29. First seedlings appeared; seedlings appeared in each spiker hole. Very good germination.

September 17. Mowed for the first time at a height of 1-1/2".

September 22. Fertilized with Milorganite - 600 lbs./acre.

October 7. Lowered mowers to 1".

October 8. Fertilized with Nugreen 100 lbs./acre.

October 16. Fertilized with Nugreen 100 lbs./acre.

October 26. 8 lbs. Chipcal per 1,000 sq.ft. was applied. Other Poa annua control methods are being tried before we settle on any.

In my judgment, this fairway was ready for play by October 7. It was not put into play because of construction of a new green for this hole - started on October 1. The green was completed on October 15 (sodded to Toronto C-15 bent), and the hole will be ready for play at the beginning of the 1971 season.

The exact costs of fairway renovation were as follows:

Labor	341.5 man hours	$ 415.00
Material	Seed & fertilizer	723.00
Equip. rental	4 yd. dump truck	128.00
	Ryan Sod Harvester	550.00
Equip. purchased	Used conveyor	100.00
Total cost		$ 2,216.00
Average/acre		$ 1,000.00

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MY EXPERIENCES IN USING NEWER GRASSES

Ray Geyer, Geyer's Willow Grass Farm
Columbia City, Indiana

I would like to start from the beginning of our sod operations. Earlier on my farm we grew only mint and potatoes.

Our first seed to sow was Windsor. This grass was new, and little was known about its sod qualities. We sowed it in the spring, and in less than four months we were cutting a little sod, and finding out afterwards that this was some kind of a record. This was accomplished without any irrigation, but a lot of fertilizer. So, here we had a grass that had a good color, it grew sod fast, and at this point it looked good.

Then came a bad spring, high humidity, no air movement, hot days and heavy dew at night, and I think most of you know the trouble we were in. We had leafspot, not only in our fields, but all of our customers had it too. We then turned to the professionals - Scotts, Purdue and the chemical companies, and found that we could control this to a certain degree. However, the expense added to our other rising costs made it much too expensive to produce.

The next year we sowed some Merion and Merion blends. Straight Merion for the Fort Wayne area was fine, but for Indianapolis, blending it with some of the old line of bluegrasses, such as Newport, Delta and fescue (as fescue does very well in shaded areas), we found this to be a much better sod. This is still a very good all-around blend, and we still use it in about half of our operation. The seed costs are not as high, and this being the case, we are able to keep somewhere in the price range of other growers.

Now, to the Sodco, Prato, Pennstar and Fylking.

Fylking, which we have been raising for the past three years, is a very low growing grass, has a good color, and makes a good tough sod. It fills in good on scuffed areas, and covers the ground fast. We have had a good chance to test this as a grass and as a sod. It is very disease resistant. I have not noticed any leafspot. Only once have we noticed any disease and that was dollar-spot. This was in a very small area, due to extreme weather conditions. This was treated immediately with RZ Acti-dione, 2 applications, 7 days apart, and in 5 to 6 weeks it had recovered completely.

This grass is drouth resistant, takes much less watering, and a medium amount of fertilizer. We recommend this grass on any area that has a lot of traffic, such as a playground, golf courses and football fields. This grass can be mowed very short, 3/4 inch. We have it on many golf courses and several foot-ball fields. The seed price on Fylking is still very high, and must be sold as a premium sod.

We have some Sodco. This grass looks very good,has an excellent color, and a fairly good rhizome system. But, it is going to take a little longer to develop into sod than others. This grass has not been cut as a sod yet by our nursery, but we can tell better after this year.

Prato is another new grass. Grows flat to ground,above average number of leaves per tiller. This has not been lifted as a sod and will be next fall before we know how this will be as a sod.

We have also sowed seed last fall with a blend of Fylking, Prato and Pennstar. This blend looks very good. Covered the ground completely in 30 days. It is all low growing, all tolerate close mowing, and all is supposed to be disease resistant. It should make a good blend, but again all this seed is very high in price and will be sold as premium sod.

Most of our seed we sow for general use as a sod contains fescues;they do better in shaded areas. However, mixed with other bluegrasses in open fields, after two years the bluegrass has a tendency to crowd the fescues out.

We have sowed three of the fescues, Pennlawn , chewing red and creeping red. Pennlawn and creeping red in times of drouth goes dormant, creating a patch effect,and color which is not desirable for sod operation. Chewing reds seem to be the best on our soil. I am sure you will find soil does make a difference.

I want to remind you that these are my own opinions and for my type of soil. You might take some of these combinations of seeds and try them. These seeds and grass may or may not be what you want for your operation.

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EXPERIENCES IN USING NEWER GRASSES

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

Huber Ranch Sod Nursery is located 25 miles south of Hammond, Indiana. Our marketing area covers the northwest part of Indiana and Chicago.

In the Chicago area it appears, for the present at least, that Merion is the sod that is used in most cases. In the outlying areas and south of Chicago, blends seem to be the most popular. In our experience, we sell approximately one-third Merion and two-thirds blend. Our present blend consists of Merion, Delta, Fylking and Pennlawn. This will be changed as interest changes, but it appears that a blend of superior grasses has the most to offer to the general public, as well as sports, industrial and volume housing interests.

As far as a sod farm is concerned, it would seem to make a great deal of sense to put almost all of your production into one blend of grasses. In this way, a lot of duplication could be avoided in areas of preparation just prior to marketing. It would also prove economical to be working in only one area when it comes to more mechanized sod harvesting equipment.

In relation to newer grasses, it appears that there is a definite place for a particular grass that can prove itself in a given area. Our only experience has been with Sodco. We were very pleased with its performance and acceptance, though we were a little worried for a while because the germination was low. After the second winter it had filled in nicely and was ready to market. We only had one acre and it moved out rapidly at a 10¢ premium. Once the first job or two was done, it sold itself. We plan on seeding more this spring, and in the future hope to keep a certain amount of premium grass ready for certain applications at all times.

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PLUGGING AND SODDING VEGETATIVE BLUEGRASS

Ben Warren, Warren's Turf Nursery
Palos Hills, Illinois

There are several reasons why plants are reproduced vegetatively. Some of these are the failure of a desirable plant to form seed, or the amount set is so small that it is not economically feasible to produce the strain commercially, and a third reason is that the seed produced is not the same as the parent.

This last characteristic is found in both Warren's A-20 and A-10, and is the primary reason why we are growing these vegetatively. There are several secondary advantages that are interesting. Plantings by this method are made satisfactorily in most of the frost-free periods of the year. One has the use immediately after planting of all the herbicides used on mature turf. This is particularly valuable when planting in Poa annua contaminated soil, as an application of Balan, following placement of plugs, aids greatly in controlling this pest. The broadleaf controlling chemicals, such as 2,4-D and Banvel-D, can be used when needed without concern for delicate seedlings.

The two vegetative methods being used, of course, are sodding and plugging. Sodding is familiar to all, and a considerable amount is done with various grasses on such areas a tees, collars and approaches. Some 50 to 60 golf courses now have A-20 in use in such places, and with the growing awareness on the part of superintendents and players of the superiority of this strain, the question is arising - why not on fairways?

This can be handled very nicely on new construction and rebuilding old fairways if sufficient time can be allowed out of play by the plugging method. Two courses are seriously discussing sod as a way to get A-20 fairways. This sounds a little expensive, but when consideration is given to the facts that the cost would be considerably under an automatic irrigation system, and experience shows that three or four waterings per season should see A-20 through almost all year, the idea does not seem so far out.

Plugging in our nurseries has gone beyond the experimental stage. We have over 800 acres planted by this method, which was adopted after experimenting with such ideas as hydro-mulching, vegetable planters, the Pray planters, and manure spreaders.

The equipment being used is made by the Beck Company, and is an elaboration of their small 2- and 3-row planters. It is tractor drawn, and plants 9 rows, 9 inches apart, dropping plugs every 8 to 10 inches. With this machine 6 men can plant one to 1-1/2 acres per hour, utilizing about 300 yds. of sod per acre.

There are several variations to be considered regarding use or non-use of companion grasses when plugging. If conditions require a solid stand as quickly as possible, such as a deadline for opening a new course, seeding one of the ryes, or possibly common Kentucky bluegrass should be considered. A-20 would take over either of these, but the achievement of solid A-20 would be somewhat delayed.

When 9 to 12 months can be allowed between planting, the use of the companion grass can be eliminated. If the soil is badly contaminated with either fast-growing annual grasses or Poa annua, Balan is suggested, except on steep slopes. In such places a light seeding of oats will control erosion.

The rate of rhizome development and the spread of the plugs is directly related to the height of cut. Mowing at 2 to 3 inches is practiced until about 90% coverage is achieved. At that time, the mowers are gradually lowered to the desired permanent mowing height, which may be as low as 5/8 to 3/4 inch.

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SEEDS - FACTS AND FANCY

G. H. Valentine, Jr., Pres., Seaboard Seed Company
Bristol, Illinois

If we seedsmen have a consistent failing, this probably is that we consider our work unique in the American economy. This really isn't true at all. We are merely participants in a total marketing scheme - our function is somewhat analogus to that of the steel industry. We each start with raw materials in a relatively crude state; then, through the application of technical skills and highly specialized equipment, we deliver refined products - the steel industry to a myriad of manufacturers and fabricators - the seedsmen to sod growers, packagers, blenders, etc.

In each of these total marketing schemes, a complete two-way flow of knowledge, based on current conditions and observations, is an asbolutely essential ingredient. As the steel company in my analogy must seek out new and better ways of performing its function, we as seedsmen must also devote a significant portion of our time, money and energies toward improving our products, and the means of handling them.

Today I would like to show you just a few of the steps involved in discovering, evaluating and producing a new variety of Kentucky bluegrass. Several years ago, during a routine visit to Michigan State, one of our research people noticed the striking color of the plot on this first slide. He found that it was one of the new New Jersey selections, P-106. Our management then determined that a more thorough investigation was warranted.

Our first stop in this investigation was, logically, Rutgers. When compared to Windsor and Delta, the P-106 impressed us because the devistation caused by Helminthosporium vagans - leafspot - has been of great concern to a number of our customers these past few years. Apparently P-106 has excellent resistance to this infection. In a fertilizer trial plot area, P-106 proved to be outstanding.

The breeder of P-106 is Dr. Reed Funk. While in New Jersey, our man visited several sod growers who had been cooperating with the people at Rutgers in their program. He found excellent drouth resistance of P-106 as compared to Merion and Windsor on Long Island. P-106 showed a striking dark green color. P-106 gave a tight turf with the striking dark green color in Rhode Island. Here P-106 had dense turf and dark green color.

Our evaluation group then decided that this variety warranted inclusion in our seed growing program. The breeder's seed was planted in flats; then five weeks later the seedlings are transplanted at the rate of 100 plants per flat in sterile soil; then into a fumigated field. Each cube containing one plant is set 18 inches apart in 3 foot rows.

Seed increase plot a year later produced the first seed crop. Based on the data available from the experiment stations for three years of the excellent rating of P-106 in each of these 6 classifications, we decided to include the variety in our marketing program. P-106 is only one of the many excellent new varieties of Kentucky bluegrass which will be available to you within the next few years. Close cooperation with your experiment stations, your seedsman and, if possible, the establishment of your own plots will enable each of you to properly evaluate these new varieities, and determine which ones are best suited to you and your clientele.

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SEEDS - FACTS AND FANCY

Dwight M. Brown, Geo. W. Hill & Co.,
Florence, Kentucky

I would like to preface my remarks by saying that I do not in any way consider myself qualified in the technical aspects of the sod industry, especially harvesting and marketing. It is my feeling that I was asked to be a part of this program, perhaps, to point out certain aspects of the "Sod-Seed" picture that those of you deeply engrossed in growing and marketing sod need to be reminded of from time to time. Therefore, I will try to make a few thought provoking comments. During the conference you will have seen and heard much aboutnew selections of grasses. My purpose will be to possibly inspire the proper use and application of them.

Your end results must basically be the same as those of the seed merchandiser. The sales of seed or sod must bring satisfaction to the user. Our responsibilities would, therefore, seem to be:

1. To sell the type or strains of seed or sod to do the job in any given market area.

2. To furnish the user with either:
   a. The proper know-how to prepare a sod bed, handle and lay the good sod you sell them.
   b. If sold on "laid-down: basis, be sure your sod bed preparation will create a fair chance of establishment. (No different than a good seedbed).

3. To furnish the customer with proper information on care and maintenance of new sod, including feeding, watering, mowing, etc.

The key point we wish to enlarge on, of course, is No. 1 which includes proper knowledge of the strain or strains to be used for production of any sod. The farsighted sod grower not only runs trials of his own, but has them tried out by other local users. A suggestion would be some practical market trial applications, such as with specialized users like cemeteries, playgrounds, athletic fields, and so on, as well as the homeowner, where basic management practices may be minimal.

With these you may <u>also</u> father further useful knowledge where varying <u>soil conditions</u>, <u>weather</u>, and consequently <u>turf</u> <u>disease</u> <u>exposure</u> may be present even in one market area. You all well know that just as no two golf courses react the same

to all uses of chemicals, fertilizers, etc., no two situations with sod are exactly the same. Under stress the differences will show up.

All of this information will better help you to determine how many different types of sod you will need to raise for your particular market area, and whether in some you will use a single strain or a blend. If it is a blend, it is important to know the relative vigor of each, and the correct proportion to get your sod into marketable condition quickly.

From a marketing standpoint, you need to know "what will sell." Here you can take advantage of the variety promotion given by growers and marketing associations advertising in many different media. Let's take an example or two. Let us say you, as an individual sod grower, now have two well-established strains of bluegrass seed available to you that could be used.

1. One strain may have as one of its plus features an extremely aggresive rhizome and tillering ability. This is good, but may lead to some excessive thatching, particularly under heavy management. This would seem, therefore, to make the sod excellent for fast healing in traffic, or heavy usage areas, such as, recreation or athletic areas, Tees or commercial areas,where they are under the supervision of people knowledgeable in Turf Management, and with the equipment to do the thatching.

2. The other new strain mah fit an entirely different market picture. Since we know that the average homeowner does not tend toward high management, and many wouldn't know what "thatching" even meant, this strain which is much less aggressive than the first, but disease resistant and persistent may be just the answer. Cemeteries, for example, I would feel prefer turf with less tendency toward thatching because of the obvious difficulty in the thatching operation in and around monuments and head stones.

Since so much momentum has been generated in recent years by states and private enterprise in the selection and development of superior strains of grasses, especially the bluegrasses and fine-leaved fescues, I am sure we, in the sod and turf seed industry, will continue to have increasing opportunity to furnish our markets with improved turfgrasses. It is simply a question of making the best use of the known characteristics of them.

I would like to close with this thought that even with all of our fine new strains, there is strength in numbers, and many turf authorities and golf superintendents are finding the use of some percentage of high grade common bluegrass, with its myriad of strains, gives a good starting base to which can be added the proper portions of many of these new strains. I do not say that this is always the way to go, but use of common bluegrass in blends does give the opportunity for some of the better strains to take over as survival of the fittest takes place.

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USING NEWER GRASSES

Robert W. Miller, Dept. of Agronomy, Ohio State University
Columbus, Ohio

Kentucky Bluegrass (Poa pratensis

This grass species is most often used for turf in the Midwest. The fine texture of the leaves, along with the capacity to produce numerous shoots and rhizomes, makes this grass well suited for use in home lawns, golf course fairways and tees, cemeteries and recreational establishments, such as parks and playgrounds.

In 1936 Merion was selected at the Merion Golf Club near Philadelphia. Research in Ohio has shown Merion to be resistant to the leafspot disease, but susceptible to rust and stripe smut. In many cases stripe smut infestations have ruined Merion turf. Merion requires high nitrogen fertilization, and tends to develop thatch. Merion will withstand close mowing and, if managed properly, it will produce a beautiful, dense sod until stripe smut becomes a problem. It has performed better in northern than in southern Ohio.

Windsor is a selection similar in appearance, mowing and nitrogen, and has performed about the same as Merion in research conducted at Columbus and Ripley, Ohio. As with Merion, stripe smut infestations may become a serious problem in Windsor turf. Windsor also is somewhat susceptible to some of the Helminthosporium diseases

A-20 is available only as sod. It has been outstanding in research conducted at Wooster, Ohio. A-20 has been resistant to diseases, and has produced a dense turf free from weeds. Injured areas heal quickly making it well-adapted for use on golf tees, football fields, and other hard used areas.

Pennstar was developed at The Pennsylvania State University, and has been evaluated under research conditions for several years at various stations throughout the United States. First seed was available in 1970. It has excellent disease resistance, and produces a tight weed-free sod. Pennstar shows promise for use in golf tees, fairways and home lawns.

Kenblue is a name given to a mixture of seed lots harvested from several natural bluegrass stands grown in Kentucky. It is resistant to stripe smut, but susceptible to the Helminthosporium diseases. The best use for this variety is in areas under a medium level of management. It will not take close mowing.

Fylking was developed at the Swedish Plant Breeding Station, Svalof. It has not been included in Ohio studies long enough to fully evaluate its performance. It is described as a low-growing variety adapted to close mowing, with good resistance to leafspot and stripe smut. This variety shows promise for use on tees, fairways, home lawns and other similar areas.

Prato is a variety imported from Europe. It has been somewhat better than common Kentucky bluegrass in Ohio studies. Prato is fairly resistant to both some Helminthosporium diseases and stripe smut. It does not produce as dense a sod as Merion, Windsor, Pennstar or A-20.

Cougar has not performed well in Ohio mainly because of its susceptibility to leafspot. Leafspot has been more severe on Cougar than on any other variety tested. It has a low growth habit and wide leaf blades.

Nugget was released by the Alaska Agricultural Experiment Station and Crop Research Division in 1965. It is dark green in color, and is reported to have good disease resistance and winter hardiness. Research in Ohio with this variety is not sufficient for evaluation.

Sodco, a release from Purdue University, is a blend of dwarf types. It was included in Ohio studies for the first time in 1969. It is a low growing variety and shows promise for use on lawns, tees, fairways, and other turfgrass areas. Seed is first available in 1971

Park, Newport, Newport C-1, Nu-Dwarf, Delta, Arboretum and Campus have not performed as well as Kentucky grown common bluegrass in Ohio studies.

Other names varieties in Ohio studies are: A-10, A-34, Arista, Sydsport, Palouse, Delft, Geary, Primo, Belturf and Zwartburg. They have not been included in Ohio studies long enough to evaluate them.

Performance of 14 Bluegrass Varieties, 1965-1968, Niehaus & Davis, Ohio

Variety	Overall rank	Color*	Density†	Percent Weeds‡ 2" cut	Percent Weeds‡ 1½" cut	Leafspot**	Smut††
		1 - 9	1 - 9	%	%	1 - 9	count
A-20	1	3	1	2	2	1	None
Pennstar	2	2	2	4	6	2	15
Windsor	3	3	2	2	8	3	92
Campus	4	3	4	3	9	5	4
Prato	5	4	3	4	10	3	16
Merion	6	3	3	3	7	4	177
Cougar	7	4	3	3	22	5	7
Delft	8	3	4	5	13	5	25
Common (Kentucky grown)	9	4	4	5	14	6	4
Newport	10	4	4	6	11	5	52
Delta	11	4	5	12	37	7	16
Common (Denmark grown)	11	5	6	20	64	6	0
Nudwarf	12	4	5	6	32	7	40
Park	12	5	5	7	28	6	38

*Average rating of 1 to 9, with 1 as best. Includes 4 years of fall ratings and 2 years of spring and summer ratings.
†Two-year average ratings of 1 to 9, with 1 as most dense, 1967 & 1968 on 2" cut
‡Estimated percentage of ground covered by grass weeds, 1967 & 1968
**Three year average ratings with 1 as least disease
††Average number of infected tillers per square foot, 1967 & 1968.

Bentgrass Varieties

The bentgrasses are well adapted to cool, humid regions. High temperatures is the chief limiting factor in producing a good turf. Bent requires abundant moisture either as rain or by irrigation. In recent years, bentgrass adaptation has extended farther south as a result of improved management practices, which reduce the ill effects of high temperatures.

The performance of a bentgrass variety varies greatly from location to location within its area of adaptation. Many times one turfgrass manager is able to produce a good turf with a particular variety, while his counterpart fails. In order to grow top quality bentgrass, it is necessary to select an adapted strain, adjust management practices to take advantage of the strong point of the strain, and to fit local conditions.

Most putting greens in the cool, humid regions of the United States are established with bentgrass. In many cases, Poa annua soon becomes a dominant part of the turf. Bentgrass also is used extensively for tees and fairways. High maintenance requirements limit its use for home lawns. Bentgrasses will do well under semi-arid and arid conditions provided temperatures are not too high, and ample water is available for irrigation.

Three bentgrass species are used for turf in the United States. Agrostis palustris Huds., creeping bentgrass, is used on golf greens and on some tees and fairways. Agrostis tenuis Sibth., Colonial bentgrass, is used on some golf fairways, tees, and home lawns. Agrostis canina L., velvet bentgrass, is used in parts of the Northeastern states, and sections of the Pacific Northwest with mild weather. It is used for bowling greens, golf course turf and home lawns.

Creeping bentgrass is established either from vegetative parts, or from seed. Velvet and Colonial bentgrass are seeded.

The following discussion of bentgrass varieties and strains is based on observations in Ohio. Performance in other states may vary. All bentgrass varieties are susceptible to some diseases; therefore, disease resistance will be discussed on a relative basis.

Creeping Bentgrass Varieties - seeded varieties.

Penncross was developed at The Pennsylvania State University. First generation seed is harvested from the random crossing of three vegetative strains. Penncross is a good creeper, has a vigorous growth rate, is dark green in color, and has a tendency to thatch unless mechanical thinning is practical. It is more resistant to diseases than most bentgrasses. Penncross will do best under high fertility. It has performed well in Ohio studies.

Seaside seed contains sufficient variability to cause the turf to appear as a mass of patches. It produces numerous stolons, has a vigorous creeping habit, and is below average in disease resistance. Seaside has a tendency to grain, but does not thatch greatly.

Vegetatively Propagated Varieties

Cohansey (C-7) has been one of the outstanding varieties in Ohio tests. It is light green in color, not particularly susceptible to disease, has excellent regrowth, and is adapted to a wider range of climatic conditions than many bentgrasses. It is more tolerant of hot weather than most other bentgrass varieties. Cohansey does best under high fertility levels. Grain, thatch and swirl are not major maintenance problems.

Toronto (C-15) is aggressive, dark green, fine textured and has good regrowth. It has performed equally as well as Cohansey in Northern Ohio. Growth is best during cool weather. Thatch, grain and swirl are not excessive. Performance is best under a good fertility level. Disease resistance is good compared to other bentgrass varieties.

Arlington (C-1) was selected at Arlington, Virginia by the U. S. Golf Association Greens Section and the Crop Research Division, USDA. Arlington is tolerant to lower levels of fertility than most creeping bentgrasses; however, at higher levels of nitrogen it has a more upright growth habit and swirls less. It is light blue-green in color, has good disease resistance, and does not thatch excessively if mowed at 3/16 to 1/4 inch. It has not performed well in Ohio studies.

Old Orchard (C-52) was selected in Wisconsin. This variety is light blue-green in color, has good regrowth,and does not thatch, grain or swirl excessively. It does not grow well during hot weather, and is average in disease resistance. A good fertility program is necessary for good growth. It has been inferior to Cohansey, Penncross and Toronto in Ohio studies.

Congressional (C-19), a selection from Maryland, is dark green in color, has excellent regrowth, is average in disease tolerance, and does not have a tendency to grain, thatch or swirl. Growth is good in hot weather if enough water is applied. Performance is best under high fertility. In Ohio studies, Congressional has been inferior to Penncross, Cohansey and Toronto.

Evansville is a dark green variety selected in Indiana. Performance ratings in Ohio studies have been about the same as for Washington, Congressional, and Arlington. Disease resistance is good. Thatch buildup is rapid unless mechanical thinning, aerification and topdressing are frequent.

Pennpar was released by Pennsylvania Agricultural Research Station. Color is best described as dark green. It has good disease resistance, is medium textured, and does not have a vigorous growth rate. Thatch buildup is not a problem if good management practices are followed. Quality ratings have been high in Ohio studies.

Nimisila, an Ohio selection, is vigorous, dark green in color, has excellent regrowth, and is susceptible to brown patch. Although it has performed well on several golf courses in Ohio, it has not rated high in test plot studies at Wooster and Columbus. It produces a good putting surface, and does not have a tendency to thatch or grain.

Washington (C-50) is light green in color during the growing season, but turns to a dark blue-green or purple in early fall. It is tolerant to hot weather, but remains dormant longer during cool weather than most other creeping bentgrasses. Although many investigators have reported good texture, coarseness has been observed in Ohio studies. It is relatively free from thatch, grain and swirl. Dollarspot may become a problem unless a good preventative fungicidal program is followed. Quality ratings have been low in Ohio studies.

Pennlu, Collins and Metropolitan (C-51) have not been extensively studied in Ohio. Twin Orchards, an experimental selection, has performed well in limited studies.

Colonial Bentgrass Varieties

Astoria originated in Oregon. It has a weak creeping habit because stolons are short and slow growing. The color is light green and foliage may be soft and succulent. Best quality turf is obtained under a medium fertility level because of soft succulent growth under high fertility. Thatch is not a problem with this variety. Some variation in seed is found resulting in patchy appearing turf. It has not performed well in Ohio under close mowing.

Highland, released by the Oregon Agricultural Research Station in 1934, has a weak creeping habit of growth, but is superior to Astoria in this respect. It is slow to heal and, like Astoria, does not perform well under close mowing. Some variation in seed is common. Highland is bluish-green in color and has an upright growth characteristic.

Exerter was developed by the Rhode Island Agricultural Experiment Station. It has good disease resistance, is bright green in color, and does not have a tendency to thatch. In Ohio studies performance has been inferior to Astoria and Highland.

Holfior was introduced from the Netherlands. It is dark green in color, has an upright growth habit, and a moderate rate of spread. It has been rated about equal to Exeter in Ohio studies.

Red Fescue Varieties

Red fescue is used for home lawns, golf course roughs, and other turfgrass reas where minimum maintenance is desirable. It is well adapted on sandy soils, is fairly shade tolerant, will not stand close mowing, and will deteriorate under a high fertility program.

Named varieties of fine leaf fescues are Wintergreen, Pennlawn, Illahee, Jamestown, Ruby, Rainier, Golfroad, Arctared, Duraturf, Oasis, Highlight, Boreal, Brabantia, Reptans, Barfalla, Sceempter, Durlawn, Erika, Cascade, Fortune and Dawson. Many of these have not been evaluated for any lenth of time. Illahee and Pennlawn are superior in performance to common red fescue.

Perennial Ryegrass Varieties

Perennial ryegrass has been used extensively as a so-called "nurse crop" with new turfgrass seedings, as a temporary grass, to overseed damaged football fields, tees, etc., and to overseed Bermudagrass greens. Common perennial ryegrass does not produce quality turf. It has a coarse appearance, produces a thin turf especially in hot weather, and is unsightly after mowing. It is often included in cheap seed mixtures. In Ohio studies perennial ryegrass persists in turf.

Of several newer varieties Manhattan has better mowing quality, is finer in texture, and produces a better turf than common. Norlea, NK 100 and Pelo are other varieties that are superior to common. Pennfine is new from Pennsylvania.

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SEEDING WITH MODERN EQUIPMENT

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There are four methods commonly used for the established of turfgrasses: (1) Seeding; (2) Sprigging with stolons, (3) plugging, and (4) sodding. Establishment

by seeding is the most commonly used, and usually it is the least expensive of the four methods. For species and strains that have no commercial seed supply sprigging is the only way of establishment. (These include selected strains of creeping bentgrass, improved strains of Bermuda, Zoysia, bluegrass, St. Augustine grass, and centipedegrass). Successful turfgrass establishment depends upon seeding at the correct time, using the proper amount of seed per unit area, and proper uniform distribution.

Seeding Equipment

Any method which distributes the seed uniformly and provides adequate covering and compaction is satisfactory. The grass seed drill, the hopper-type distributor, the broadcast seeder,and the hydroseeders are the four types of seeding equipment.

Grass seed drills - distribute the seed, cover it, and firm the soil in a single operation. For turfgrass areas this is the least desirable type because it deposits the seed in rows 6 to 8 inches apart. Also, placing the seed at the correct depth is sometimes difficult in light soil with this type of equipment.

Hopper distributors. The simple type broadcasts the seed into the seedbed. An agitator inside the hopper forces the seed through an adjustable opening. The more complex type is designed to broadcast the seed, cover, and firm the soil in a single operation. Many are equipped with fertilizer attachments. Other special attachments that assure uniform covering and smoothing of the soil surface, and proper placement of the seed are available. Sizes range from small units to attach to garden tractors, to 10 ft. wide units suitable for seeding large areas.

Broadcast seeders. The distribute the seed by throwing it by means of gravity from an impillar that rotates parallel to the surface. This method is fast and can cover a swath 6 to 20 or more feet in width. Helicopters may be used to carry this type of seeder quite effectively. With broadcast seeding, some method of covering and soil firming must follow. Sometimes with seed mixtures of different seed size and weight, uniform distribution is a problem.

Hydro-seeders and hydro-mulchers are very effective in seeding, using water, seed and fertilizer, and spraying to distances of 200 ft. This method is effective on slopes or other areas where mechanical equipment cannot operate. A high degree of uniformity of seed and fertilizer distribution can be accomplished. Adding wood cellulose to the mixture aids in the reduction of erosion, as well as serving to improve the micro-climate for germination. Commercial machines are available that are capable of fertilizing and seeding up to 15 acres per hour.

Turf Renovation

In the discussion of seeding with modern equipment, we must discuss turf renovation. The extent of a renovation program is dependent on the degree of turf deterioration. In the past most renovation was either by hand-raking and seeding a few dead spots, or reworking the entire turf area with power equipment. No matter what method is used, the cause of turf deterioration should be corrected or renovation may become an annual requirement.

New equipment is available that can cut through the existing permanent grasses, remove excess debris, aerate and provide a rough seedbed suitable for seeding in one operation. This method prevents seed from being blown or washed away as it can when distributed by broadcast type seeders.

Mulching

The usual practice is to cover a seeded area with some type of mulch. Straw mulch is effective,but straw is expensive, hard to obtain, and often carries weeds. Wood cellulose is becoming very well accepted. The wood cellulose fiber is made from whole wood chips, which are broken down under steam and high pressure into individual fibers, then dried to about 10% water content by weight. The wood cellulose is dyed green so that the equipment operator can spray an even application into the ground.

When applied, the moist wood cellulose forms a protective blanket over the soil, aiding in erosion control. A favorable micro-climate for better germination of seeds is provided. On turf areas where the requirement for vegetation is immediate, the use of hydraulic mulching is excellent. Sprigs may be used instead of seed for even faster vegetation establishment. On a new golf course in Missouri the entire golf course was hydro-mulched, and in ten days the turf was mowed.

With the cost of seed and labor increasing, the need to select the most economical method of seeding is critical. Equipment for seeding has progressed since the days of the wheelbarrow seeder. The future will bring more advancements in this important area of turfgrass management.

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THATCH REGULATION

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What is thatch? The Turfgrass and Crop Terminology Committee of the American Society of Agronomy says: "Thatch is a tightly intermingled layer of living and dead stems, leaves and roots of grass, which develops between the layer of green vegetation and the soil surface." The terms "mat" and "felt" have been used by some authors, but thatch is the preferred term.

Thatch Hinders, Water, Minerals and Pesticides

Thatch accumulation appears to hinder plant growth in many ways. Mineral elements applied on the surface are hindered in reaching the soil, so response to fertilization is impeded. The undecomposed layer of dead plant parts creates a favorable environment where disease organisms and insects multiply and will thrive. This, coupled with the decreased effectiveness of fungicides and insecticides caused by thatch formation, increases pest control problems manyfold.

Water penetration is greatly inhibited by thick thatch layers. More water is lost through runoff. The root system of the turf is shallow under heavy thatch, and the plant makes less effective use of the water in the soil.

The overall effect of thatch buildup is a turf low in vitality, easily subject to drouth, and often affected by disease and other pests. The weakened turfgrass plant is easily injured by any stress conditions which may develop.

What Causes Thatch?

Why does thatch develop? Any condition that increases vegetative production and the subsequent death of plants or plant parts favors thatch development. Likewise, any factor that slows down organic decomposition favors thatch formation.

Although most turfgrass species are perennials, parts of plants are continually dying and being replaced. The majority of roots of most perennial grasses die each winter, and new ones are formed in the spring. In addition, management practices used to grow quality turf produce more plants and more vegetative growth per unit of area. This is one of the reasons why the worst thatch problems are found in turfgrass grown with intense management systems.

Factors Affecting Thatch Buildup

Clay soil - More thatch is known to form on heavy than on light textured soils.

Disease and Insects - diseases and insect problems when severe enough to kill grass add to the thatch problems.

Weeds - some weeds, such as nimblewill, contribute to thatch buildup.

Soil compaction - more thatch will form when soils are compacted provided it is not compacted enough to greatly reduce growth.

Nitrogen fertilization - excessive nitrogen fertilization speeds up thatch formation.

Soil pH - although low soil pH has often been talked about in relationship to thatch, research to date has not shown it to be a major cause of thatch dvelopment.

Mowing height - the higher the grass is cut the more thatch will develop.

Use of pesticides - The use of insecticides, which kill earthworms, such as Chlordane, Aldrin and Dieldrin, as well as arsenic, will speed up thatch formation. It is also thought that the use of fungicides may favor thatch dvelopment.

Mechanical Control Recommended for Thatch

What can be done to control thatch? Today most of the effort is toward mechanical control. The thatch layer is physically dug out by use of vertical thinners, or other mechanical devices, and removed by raking. Aerification and topdressing is one of the most effective ways to control thatch.

Thatch should be removed from most bluegrass or bentgrass areas at least once per year. After considerable thatch has accumulated, it is difficult to remove without drastically injuring the turf. There should be green growing points remaining between slices after the renovation is completed, otherwise brown areas may be too severe and extensive. Inexperienced operators, on the other hand, are often afraid to remove enough thatch and vegetation. Removal of the thatch and up to 50% of the green grass may be desirable.

Renovation Program Should Include Fertilization

On bluegrass and bentgrass renovation is most often done in the fall. Spring is also an acceptable time provided the job is completed very early. Fertilization is generally favored at the same time. On golf greens, topdressing with soil is often used. If a thatch layer has already developed, repeated vertical mowing and aeration followed by topdressing is usually necessary.

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RESEARCHING GROWTH REGULATION

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In our continuing research with potential growth regulators, the answers to several Turf Management problems have been actively sought. Included among these are: weed control, drouth reduction, Poa annua seedhead inhibition, and mowing frequency reduction.

Many of the chemicals that elicit desired responses have to be abandoned due to excessive cost, toxicity, or discoloration of the turf. The outlook is promising, however, for already on the market are several growth-regulating compounds encompassing many of the problems listed above.

There are many well-known growth regulators in use for weed control. Among these are:

2,4-D
2,4,5-TP (Silvex)
Dicamba
Picloram (Tordon)

Certainly there are other herbicides to be discovered.

For many turf areas, partial or complete control of seedheads is now possible. Marketed products include Po-San of Mallinckrodt, and Maintain CF-125 of U.S.Borax.

Improved chemicals that completely restrict excess leaf growth have long been sought, not only for industrial sites, fences and ditch banks, but for home lawns as well. Marketed products currently being tested for this purpose include:

MBR-6033 of 3M Company
TD-1756 of Pennwalt
Maintain CF-125 of U.S. Borax
Po-San of Mallinckrodt

Many new products are also under investigation. Yes, chemical growth regulators have a big future in Turf Management.

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NEW REGULATIONS IN NEW YORK

Cecil F. Kerr, Chipman Division, Rhodia, Inc.,
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In July of 1970, New York State issued a list of 72 restricted pesticides. The original intent of the new regulation was that these restricted chemicals would be applied only by a custom applicator. In the original document, chlordane could be used only for termite control. Arsenicals were restricted to 4 lbs. of active ingredient per acre. Mercury compounds and DDT were banned completely.

Several superintendents and golf course superintendent associations wrote letters to Henry L. Diamond, New York Commissioner of Environmental Conservation,

defending tri-calcium arsenate, chlordane and mercurial compounds. They also described the professional qualifications of a golf course superintendent. Many leading researchers wrote letters defending chemicals, and the right of a golf course superintendent to apply restricted chemicals with a permit on a prescription basis.

Dr. William Daniel wrote: "Turf areas under the care of professional turf managers who qualify for permits, may be treated with persistent type pesticides according to label, since their goal is long term turf care." He further wrote, "Within the state of New York there are over 700 golf courses. Many of these have college trained superintendents. Most all have already attended conferences. All can attend certifying schools and get the training to make environmental aims effective."

Dr. Paul Alexander, Director of Education, Golf Course Superintendents of America, wrote: "Golf course superintendents, because of their expertise, knowledge and clear-cut sense of agronomic responsibility, have been leaders in the development and the use of plant protectants covered in the list generated by your office. These same men are keenly aware of both the plant and mamalian toxicity characteristics of the chemicals they use; hency, the excellent safety record enjoyed in this profession."

Alexander M. Radko, Research Director of U.S. Golf Course Association, Greens Section, writes: "Golf course superintendents are professional grass growers, educated in Turfgrass Management. There are some who attended two-year courses at credited universities, some who have four year degrees, and some who have completed graduate study. These men are not only schooled, but are experienced in the handling of pesticides. Additionally, they have access to the experience of researchers when in doubt about safety and uses.

Superintendents also attend monthly meetings to discuss mutual problems, attend field days, and have personal contact with university research and extension men, as well as with the research people from industry. No group is more aware of the hazards involved in the indiscriminate use of pesticides."

We sent to Henry L. Diamond, New York Commissioner of Environmental Conservation, data from the U. S. Golf Association, Green Section, from the 1940 issue of Timely Turf Topics showing tests where liberal quantities of arsenate of lead were applied to the turf, killing wedworms and earthworms. The birds did not eat or carry to their young any of the treated insects. The birds left the treated areas and found a plentiful supply of insects in nearby untreated areas.

I sent an article to Commissioner Diamond, summarizing the medical uses of arsenicals for treatment of sleeping sickness, nutritional disturbances, malaria, diabetes, and the gauntlet of hematologic abnormalities.

Phenyl arsenic acid is being fed to chickens, turkeys, swine, rats and calves as dietary supplements at concentrations of .005% to .01% of food.

Arsenicals are not accumulative beyond the biological amount naturally found in the human body. Most species excrete arsenical dosages in the urine during the first 24 to 48 hours. Many animals can withstand extremely high dosages. The health and vigor improves with light dosages of continued feeding.

Single heavy application of arsenicals can kill animals just as heavy applications of aspirin have killed nearly 1000 people each year as reported by the National Safety Council. There has not been a <u>single</u> casualty to humans with continued usage of tri-calcium arsenate for <u>Poa annua</u> control for over 18 years.

I have attended many meetings in New York State explaining safe usage of tri-calcium arsenate to Environmental Conservation Pesticide regulatory personnel. I keep a record of over 1000 golf course superintendent's soil conditions and tests which are regularly analyzed, and also the salesmen's calls are regularly tabulated. Tri-calcium arsenate is applied on a prescription basis on most leading golf courses in the nation.

We have explained that tri-calcium arsenate is part of a program for removing Poa annua. We have emphasized the importance of draining the low areas, correcting soil acidity, eliminating phosphorus in the fertilizer program, aeration, overseeding, varying arsenical rates according to existing conditions, emergency use of liquid P_2O_5, and maintaining control level of arsenicals.

Our educational program has brought results. Commissioner Henry Diamond wrote on September 3 to Melvin Lucas, Jr. The Garden City Golf Club, "Operators of golf courses will qualify as commercial users for the application of pesticides which may be used in management of golf courses."

It is necessary in New York State for a supplier to secure a commercial permit. He must estimate his total needs at the beginning of the year. The golf course superintendent must apply for a purchase permit. Application blanks are available at regional environmental conservation pesticide inspectors and university extension offices.

There are three classifications of permits:

A. Highly Toxic - The superintendent must fill out a permit and submit to his regional office. There are 55 chemicals listed in this class A class including Guthion, parathion and Paraquat. Only one application is submitted for substances listed in this group.

B. Long Residual - There are seven separate chemicals listed in this group. A separate application must be filed for each separate use of a substance. Arsenical rates per acre and total amount needed must be submitted. A separate permit must be secured for each use of chlordane. One grouping would be for Asiatic garden beetle, Japanese beetle and European Chafer. Another grouping would be ants and termites. Another grouping would be grubs and weevils in commercial sod.

C. Not Permitted - There are ten chemicals that no permit will be granted. These include Bandane, BHC, DDT, endrin, mercury compounds, toxaphene and others not specifically related to the turf industry.

The Department of Environmental Conservation has assured us that golf course superintendents will be granted a permit to apply tri-calcium arsenate on a prescription basis.

It is likely that all states will eventually follow the New York State's pattern of restriction of usage of pesticides. It is imperative that golf course superintendents continue to prepare themselves for this day. This should include attending short courses that would prepare them for any testing that their respective states may require. The certification standards that the Golf Course Superintendents of America are proposing will be an excellent foundation for continued usage of pesticides.

The intelligent, prescribed elimination of unsightly weeds, diseases and harmful insects by trained superintendents on golf courses creates a beautiful environment enabling our population to enjoy both nature and recreation.

Accidental Ingestion of Household Products
Subject to the Hazardous Substances Act

Household	1969 Incid. all ages	Incid. under 5 yrs.	Hosp. under 5 yrs.	1968 Incid. all ages	Incid. Under 5 yrs.	Hosp. under 5 yrs.	1967 Incid all ages	Incid. under 5 yrs.	Hosp. under 5 yrs.
Lighter fluid	1000	952	118	1111	1071	142	924	873	131
Solvents	882	718	83	596	552	91	564	504	74
Total	5066	4043	644	5352	4819	788	4192	3712	663
Polishes	797	696	134	1019	975	178	863	832	162
Cleaners									
Bleaches	204	178	15	273	239	29	284	262	18
Total	3503	2679	255	3481	3130	280	2828	2470	223
Do-it-yourself kits	1879	1484	46	945	890	33	661	494	37
Yard & garden	1833	1425	33	1412	1268	39	986	849	37
Miscellaneous									
Paint	1162	932	25	229	222	30	(Category breakdown not available for 1967)		
Total	2300	1811	88	1151	1046	91	641	552	56

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THE BUMPY ROAD WITH CHEMICALS

Stan Frederiksen, Mallinckrodt Chemical Works
St. Louis, Missouri

It's good to know that those of us who are concerned with the present and future of chemicals, not only from the standpoint of the ecology and the environment, but also from the standpoint of their usage as Turf Management "tools," can get together.

Some ten years ago, or thereabouts, turf chemicals were more or less taken for granted as part of the overall turf maintenance picture -- as much a part, for example, as mowers, watering, thatch removal, and the other maintenance practices. Even then the "road" for a turf chemical, from the time of its conception as an idea to the time of its commercialization, was far from a "smooth" one. Yes, even in those early days of turf chemicals the road was "bumpy." And, outstanding turf men like Bob Miller, who just talked with you, and many others, spent plenty of their time explaining the tedious process of going from the germ of an idea for a turf chemical, to the point where you turf managers should have a chemical that would perform an important maintenance function in your overall programs. This was true whether the chemical was a fertilizer (and we are sometime prone to forget that fertilizers are some of the most important chemicals that we use), or whether it was one of the more exotic chemicals of recent vintage that will do things to modify grass plants that are almost magical -- or even bordering on the miraculous.

However, if we really consider the progress of turf chemicals as a "road,"

we'll recognize that during those early days the "bumps" were really nothing more than small "potholes." The time taken to achieve registration, even when accomplished via the mails, was relatively short - sometimes within a week or two. On occasions Bill Small has flown to Washington in the morning, presenting the registration documentation to the proper authorities during a relatively brief visit, and returning home the same afternoon with registration fully completed. At that time the USDA had full authority over turf chemical registration. Only a relatively few people in Washington had to go over the facts presented, assure themselves and the public of compliance with all laws, regulations and health considerations.

In the early sixties, due at least partially to the publication of Rachel Carson's book "The Silent Spring," the public eye and the eyes of US government officials were focused upon chemical pesticides. The chief concern was that these materials, when used indiscriminately, were creating serious hazards as regards the health and welfare of our country. As a result, and sometimes with very little objectivity, many pesticides were ruled off the market.

This made the chemical "road" far "bumpier" that it had ever been before. These small "potholes" have now become literally "bomb craters" - - so tremendous, in fact, that they now threaten to discourage further research in agricultural chemicals, including turf chemicals - - - and also to cause any number of formerly strong companies in pesticide research to "turn back" - - actually to go out of the agricultural chemical business.

Recently governmental scrutiny has "zeroed in" on persistent pesticides, with special emphasis on DDT, other chlorinated compounds, and some of the "heavy metal" pesticides, such as arsenic and mercury. The reason, of course, is a good one - these are potentially hazardous compounds - indiscriminate usage could readily cause harm. No chemical company wants to cause harm in any way - every reputable company wants its products to do the job they're intended for, without undue hazard, and certainly without any harm whatsoever to the environment, or to the balance of nature.

At the same time, it is important for all to recognize that everyon'e overall job is to consider people first and foremost. No small part in this extension of the human life span has been brought about by the proper use of good pesticides. In other words, chemicals have played a big part in bringing about not only a longer life for people, but also a better life.

You and I have read just recently of the tragic situation in Ceylon where the insecticide DDT was banned from routine usage some seven or eight years ago. Since then the deaths and serious side effects from malaria spread by the mosquito (which had long been held in check by DDT), rose from a very few cases just prior to the ban, to over 2.5 million in 1968 and 1969. (The DDT mosquito eradication prcgram was reinstated in Ceylon in 1969).

What is needed, above all else, are FACTS. In other words, just what is being done to our environment by this or that chemical, and is the result justified by the use of the chemical in the particular use pattern? With the facts at hand, what is the best judgment as to whether any chemical in question should be continued in use, or should be restricted or banned? In other words, how best can the facts be weighed - - and how best can they be made use of?

At Mallinckrodt we are tackling the problem with facts - scientific facts - and already have come up with some mightly interesting information, especially with respect to the mercurials. Over the recent past we've been conducting exhaustive studies, under the sponsorship of university experiment stations throughout the country, to determine what happens to mercurial fungicides when applied

to turf. The fact that suspicion has been cast upon the mercurials in this use pattern is one of the "bomb craters" we're talking about in considering this "bumpy road with chemicals." Gathering and interpreting the facts, and disseminating the information derived from these university-sponsored studies is at least one way we've adopted to repair and/or "get around" the mercurial "bomb crater."

Here, in my hand, is the initial study just as it has been presented to the officials of the Environmental Protection Agency, now in overall charge of the pesticide registration procedures in Washington, and under which the Departments of Agriculture, Interior and Health, Education and Welfare are currently operating, as regards the use or non-use of pesticidal chemicals. In order to develop the information in this study, we did a number of things:

1. Searched all the literature in our own and other libraries on the subject of mercurial compounds in the environment - especially pesticides.

2. Discovered that there are no reported cases of harm or injury to persons, animals or fish, or contamination of water or the atmosphere due to mercurials used in the professional turf maintenance use pattern.

3. Engaged the services of major universities throughout the country to sponsor actual tests of golf greens and other professionally maintained turf which had been treated with mercurial fungicides, to ascertain the effect, if any, of the use of these materials in this use pattern.

4. Drew information from the major authorities in the entire country on the use of mercurials in turf maintenance, and also from authorities in other countries, such as Canada and others.

5. Conducted tests under university sponsorhsip, of water, mud and fish, in streams, ponds and other bodies of casual water, upstream from, right at, and downstream from mercurial pesticide treated turf areas, to determine what contamination, if any, these mercurial applications might have in the environment in, around, and at some distance from, the areas of actual treatment.

6. Submitted the entire study and its results, prior to the deadline date, February 1, 1971, to the Environmental Protection Agency in Washington.

7. Included in it the actual results of a nation-wide survey among more than 3000 golf course superintendents, to whom we had sent letters and questionnaire cards on the subject of the use, in turf maintenance, of mercurial pesticides. The result of this survey, by the way, was to show us that more than 90% of all turf managers use mercurials in their programs, that none have ever suffered harm from their use, nor have the men under them doing the actual work suffered harm; that more than 90% of those using mercurials either feel there are no adequate replacements for these mercurials in golf course maintenance, or do not know of materials that will be adequate to replace them.

8. Concluded that not only are there no adequate replacements for the mercurials in the turf use pattern, but that there is no appreciable contamination of people, animals, fish, water, or any other part of the environment from mercurials in golf course use. As an example, we found that water, mud and fish, from samples taken upstream from, at the site of, and downstream from a green treated with mercurials over a lengthy period, all contained the same traceable amount of mercury - less than 1 part per billion in the water - and there-

fore, that the treatment of the turf with the mercury had no appreciable effect in the environment. In fact, all the mercury used in the treatments over the years was found tied up as insoluble mercury compounds, mostly within the top 6 inches of soil at the site of treatment - - and that there had been no appreciable lateral movement of the mercurials to contaminate nearby water or the fish therein.

It is our desire that all interested persons and organizations should share in our findings, and make use of them whenever they will help you, the turf manager, to maintain these important "tools" as items in your arsenal to combat the pests that are so much a part of the forces you battle every day in your careers to maintain and groom fine turf. To do this we"ll need a written request from you, preferrably on the letterhead of the association you represent, and preferably where you are working up your presentation under the sponsorship of a university experiment station. You should request a copy of this document, stating that you intend to use the material in it as part of a presentation you are developing for the authorities of your local or state government, to preserve the mercurials for continued application in your use pattern. Under circumstances that will have to be approved by our Department of Research and our Legal Department, we'll be more than happy to send you the copy. When we do, we'll include any stipulations we feel must be followed by you and your organization in using the material in the report.

Yes -- the "road" with chemicals is a "bumpy" one. However, the best people to help smooth out the "bumps" are you, the turf managers, to whom these important chemicals can really mean so much, in not only your peace of mind, but often in the maintenance of your jobs as well. When we, as a chemical company, speak on this subject we are viewed with suspicion by the authorities because we, in the minds of the authorities, "have an axe to grind" - - we are in business - - we are producing products - - we stand to make a reasonable profit from the sale of these materials. But, when you speak, as experts in your own field, who need these materials to provide recreational turfgrass areas, particularly if you can speak as an association in your state, backed up by your Experiment Station, the authorities will pay attention, at least, and be significantly impressed by your needs, as well as being persuaded to take action that will be to your benefit. In short, here is an important case where your best action is to take action to help yourselves.

"The Bumpy Road with Chemicals" promises to get "bumpier" before you and we are able to "smooth it out" again.

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THE MAN IN THE MIDDLE

James C. Walker, President, Outdoor Equipment Company
St. Louis, Missouri

The word "distributor" defies simple definition in the turf industry. We must go back to the word "distribute" as a starting point. To "distribute" is "to divide and give out in equal shares," or "to scatter or spread out." Further research into definitions leads us to the word "distribution," defined as "the system or process of distributing commodities to the consumer." We get a little warmer in the word game when we reach the word "distributor," defined as "an agent

or business firm that distributes goods to consumers." This definition is over simplification to say the very least.

In the market place today distribution is a much more sophisticated concept. Distributors are business men who must use every management ability they have, plus every dollar they can put their hands on, to run a complex operation at a profit - - - I repeat "at a profit" because we must have this element if we are to grow and continue to serve our two masters - the manufacturers we represent, and the customers we serve.

A distributor is selected by a specialized turf equipment manufacturer to perform the field sales and service function that the manufacturer cannot perform economically. We can perform these functions more economically because we spread these operating expenses over a number of lines, thereby reducing the sales costs, service costs, warehousing costs, and the hundreds of other elements comprising the cost of doing business.

The second function the distributor performs for the manufactuere is warehousing and financing. It would be unreasonable to say the distributor performs all the warehousing and financing functions for the manufacturer, but the distributor certainly carries a large share of this burden. In a seasonal business such as the turf industry, no manufacturer is able to produce, finance and warehouse twelve months production that must move into a five to six months market. The manufacturer must establish optimum production runs to achieve economies in the purchase of raw materials, and economy in the manufacturing process. He must work against unsurmountable obstacles in the form of lead time in procurement of engines, steel, castings and other purchased components necessary to fabricate the finished product. The more specialized and complex the machinery, the more difficult this balanced production becomes.

Using his crystal ball, the distributor attempts to forecast your requirements six to nine months ahead of the market,and give his supplier a firm commitment for delivery in the off season. Hopefully the manufacturer will be able to schedule and produce more carefully and effectively, and in an orderly manner ship the merchandise to the distributor's warehouse.

After the goods have moved to the distributor's warehouse, they are turned into cash for the manufacturer by the simple and painful expedient of the distributor making payment from elusive cash on hand, or from money borrowed by the distributor against his own line of credit. Simply stated, the distributor assumes the field sales cost and the field service cost of the manufacturer, and shares the warehousing cost and financing cost of the manufacturer. These elements of the distributor's job result in lower production cost for the manufacturer, and therefore lower factory prices to the distributor, and ultimately lower delivered prices to the customer. The manufacturer-distributor relationship must be one of mutual trust and understanding. An open pipeline of communication must be maintained to handle feedback of engineering, service and performance data, leading to new and improved products.

The second master that all distributors must serve is you - - our customer. The entire relationship of manufacturer - distributor - customer is the concept which must be understood if we are to serve you properly. The distributor's objective today must go far beyond "distributing a commodity to a consumer." We must breathe life into an inanimate piece of iron. We must deal in intangibles that will justify the purchase of the piece of iron. We must train and maintain an organization of intelligent and competent people who are sensitive and responsive to the rapid developments in the Turf Industry. We must work in areas of product applica-

tion, problem solving, technical advice, performance, economy, program selling, value analysis, service features, and experimental testing. The concept of "program selling" through which a distributor can advise the customer on the selection of a coordinated group of products from several manufacturers to accomplish an integrated task, is one of the great benefits offered by a distributor and should be offered without prejudice.

"Value analysis" is another aspect of the distributor - customer relationship on which it is virtually impossible to place a dollar sign. Under this concept, the customer draws on the distributor's knowledge of alternate products to accomplish the same job, and on the distributor's ability to talk in terms of "total job costs" rather than price per machine. The distributor- customer relationship today cannot be concerned with buying and selling machinery at a price. It must revolve about results produced by the machinery in terms of a <u>better job</u>, <u>better performance</u>, <u>lower operating costs</u>, <u>lower maintenance costs</u>, and most important of all, <u>man hours saved or better utilized</u>. The same open communication must exist to handle feedback of engineering, service, and performance data, leading to new and improved products.

It is not the position of the distributor to tell you how to run your course, and he should never intrude in this area. It is the distributor's obligation to offer thoroughly tested and proven equipment; to offer sound advice on its proper use; to guide your selection of what is best for you; to provide the best service possible, and to provide prompt and continuing parts availability. Distributors must perform all of these services for you, as well as performing the multitude of duties to the companies we represent - - - <u>and we must do all of this at a profit</u>. Only when we strive to accomplish all of these things can we truly justify that title of Turf Equipment Distributor. We are truly "the Man in the Middle."

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<u>DISTRIBUTOR SERVICE AND YOUR NEEDS</u>

Leon Short, Leon Short & Sons, Inc.,
Keokuk, Iowa

When Dr. Daniel asked me to talk on this subject of "Distributors Service and Your Needs" I thought it would be easy for an old-timer who has been serving you good people for thirty years, and especially after I heard your past national president make a talk on "What the Golf Course Superintendent Would Like to Have from the Dealer."

I would like to begin how most turf dealers started in business. Most began in an alley, or just as I started, repairing mowers in my back yard. Many of us have gone by the wayside because of poor management, lack of capital, or just too lazy to work.

We are just now beginning to get the Machinery Dealer to a Main Street business. I also can remember when $ 4,000 per year was a large salary for a golf course superintendent. They, too, have raised their status in their profession where they are high respected in their community. We would like to feel that we have grown right along with you.

We now have many more things facing us than we have ever had before. We are forced to stock large quantities of equipment, chemicals, supplies and parts. We have to do our purchasing at least 6 to 8 months in advance of the coming season. This means that we have to borrow large sums of money. Dealers who had to borrow money at the rate of 9 - 10% will find it exceptionally hard to make a profit in 1971.

Pricing - Bids Today

You all know the factory has a suggested list price, with no freight added or setup, or serving. This suggested list price is supposed to give we dealers a fair margin of profit, so we can keep our doors open - but many times this is an impossibility to get this suggested price because of the competition we have today.

We have been asked many times, "Why did Joe get a lower price than I?" There are many things that enter into this:

1. Does your club pay your bills promptly?
2. Is it late in the season and you want to clear your inventory?
3. Did we (the dealer) make an error in over-ordering 6 to 8 months in advance?
4. Is the bank demanding we make a payment on our note?

I could go on and on, but I assure you gentlemen, dealers are trying to make enough money to give you the service you deserve.

Purchasing Equipment & Supplies

Just recently I had a golf course superintendent tell me I was making too much money. He demanded a discount on a $ 1500.00 piece of equipment. I finally sold it to him, but only on the following provisions:

1. The equipment shipped to him in the crate, freight collect.
2. He would have to sign a statement saying his club would assume full responsibility.

Selling this way is about like you buying from a discount house, and gentlemen, this is what will happen to you if you continue to try to play one dealer against another.

You can secure equipment by:

1. Lease
2. Rent
3. 12 month interest free contract - such as we have.

All of these make it much easier for your club to allocate their money, which in turn helps you get the quipment and merchandise you so badly need to eliminate excessive labor costs.

Parts

Most all dealers try to stock an ample amount of parts. Some are more fortunate than others because it takes at least $ 50,000.00 to stock enough parts to give you service. Most of our suppliers will not ship us less than $ 15.00 in parts at any time. To my knowledge our dealers have not passed this on to you, our customer. We would, however, appreciate you ordering by model, serial and parts number.

We furnish Parts Books with every piece of equipment that goes out. If you will only study them it will help you maintain the equipment more economically.

You must remember we have about as much trouble keeping help as you do. This parts man may be a new employee, so help him allyou can - givehim the parts number. Remember a good reliable dealer can save your club money and make your job easier. Inventory, service, financing and delivery are high costs.

Code of Ethics

Gentlemen, I believe we, the Dealer, are working with the finest people in the world. We never have to worry about a kick-back. Very seldom do we get beat out of an account. Some clubs may be a little slow to pay, but if we all work together I believe the future is very rosy for both you and I.

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RESEARCHING ARSENIC TOXICITY TO POA ANNUA

Raymond P. Freeborg, Graduate Research Asst.,
Purdue University

The primary objective of this research project is twofold, i.e., to determine concentrations of arsenic in soil controlling annual bluegrass, Poa annua, L., and the development of an efficient, practical method of measuring arsenic concentrations in solutions. If a soil test procedure, similar to that currently used for phosphorus tests, were available, the turf manager could know the arsenic concentrations accurately, and thereby decide what his future application should be to control P. annua.

The first question of many to arise concerned soil sampling techniques. How deeply should the soil be sampled? To answer this, at least in part, a greenhouse experiment was developed with the placement of an arsenic barrier at varying depths in the soil. Granular Chip-Cal (48% tri-calcium arsenate) was used. An arsenic barrier was placed on the soil surface at 1" and 3" below the surface. Rates of Chip-Cal were: 0 lbs. per 1,000 sq.ft., 18, 36, 54, and 72 lbs. per 1,000 sq.ft. One-half inch of sand was added to all pots, and seeds of Stellaria media, chickweed, P. annua, and sorghum halepense were planted. Chickweed was selected for its sensitivity to arsenic, P. annua is of intermediate sensitivity, and sorghum is relatively tolerant.

Results showed significant chickweed and Poa annua survival even at the 72 lb. barrier when there was at least 1" of arsenic-free soil before roots reached the arsenic barrier. With the arsenic barrier at a 3" depth, chickweed and P. annua showed no arsenic toxicity. From this data it was determined that, for arsenic to be toxic, concentrations should be in the top 1" of soil. Therefore, soil samples should be 0 - 2" depths.

It was also necessary to select an acceptable extractant; one that would extract an amount of arsenic reprentative of that available to the plant. This could not be total arsenic - much of that is unavailable to the plant. Also, an efficient and practical technique for measurement had to be selected and developed.

The same soil used in the previous depth study was screened to remove larger peat and soil particles. Then arsenic trioxide powder (As_2O_3, analytical

reagent) was mixed with the soil to give concentrations of 0, 80, 160, 320, 640, and 1280 ppm arsenic. Pots were saturated with water, and P. annua seed was planted on the following day. These pots were then placed in a controlled temperature and light period chamber. Temperatures were 30.0°C (86.0°F), 22.5°C (72.5°F), and 15.0°C (59°F).

Light periods per day included 8, 12, 16, and 20 hours. According to Beard, J. B. (1) optimum shoot growth should be observed at 15° - 21°C (60-70°F), and optimum root growth at 12 - 18°C (55-65°F). Plants were harvested at maturity - 60 days after germination. Soils were dried, ground and screened, and all soil passing through a 20 mesh screen was collected for analysis.

The next step was to select an extractant. Many potential extractants were examined and discarded in favor of a Bray P-1 extractant (0.03NNH_4F + 0.025NHCl), which is currently used at Purdue as a phosphorus extractant. The final procedure for arsenic extraction is as follows:

1. Collect 1.5 cc (about 1.5 g.) of soil with a scoop.
2. Add 15 mls of Bray P-1 extractant
3. Shake for 5 minutes
4. Filter, collecting all of the filtered extract.
5. Collect 5 mls of filtrate and determine phosphorus, using the ammonium molybdo-phosphoric complex (2)
6. The remainder of the filtrate was then ready for arsenic analysis.

In the meantime, atomic absorption spectrometry had been selected as the most practical technique available for measurement of arsenic in the Bray P-1 extractant.

By using the above procedures, arsenic concentrations in extracts from soil with 1280 ppm. ranged from a high of 46 ppm. at 15.0°C, 45.3 ppm. at 22.5°C, and 28.5 ppm. at 30.0°C, to low rates of 3.4, 2.5, and 2.1 ppm. arsenic extracted from soils with 80 ppm. arsenic added (3).

At 30.0°C concentrations of arsenic in the range of 8.0 to 14.5 ppm. were toxic to P. annua. At 15.0°C and 22.5°C concentrations of arsenic had to exceed 20 ppm. to severely weaken the plant. This information served as a basis for future determinations of arsenic concentrations.

Four Soils as Tested

	% clay	% silt	% sand	% Organic matter	Ppm.P Bray P-1 extract	Ppm. K ammonium acetate	pH
I. Silt loam Crosby	19.0	70.0	8.0	1.5	3.5	4.6	5.3
II. Silty clay loam Kokomo	36.0	54.0	7.0	2.9	6.5	7.4	5.6
III. Muck Houghton	41.0	52.0	6.0	28.5	8.5	2.1	7.0
IV. Sand mix	3.0	10.0	87.0	8.3	9.2	2.0	6.6

Granular Chip-Cal was added to the above soils at rates equivalent to 0, 6, 12, 18 and 24 lbs. per 1,000 sq.ft. on 4/24/1970; then P. annua seeded on 5/7/70. Plants were harvested on 7/30/70, and soils permitted to dry until 9/10/70 when they were rewet.

An additional 6 lbs. per 1,000 sq.ft. of Chip-Cal was then added to those pots having the original rates of 6 and 12 lbs. per 1,000 sq.ft. Thus, pots contained rates of 0 lb., 12 lb. (6+6), 18 lbs. (12+6), and the unchanged 18 lb. and 24 lbs. per 1,000 sq.ft. P. annua was again planted on 9/14/70. When seedhead formation was observed on 11/15/70, plants were harvested. Soils were then dried, ground and screened for arsenic analysis. Concentrations of arsenic extracted vs. arsenic added are:

Arsenic added - lbs./1000		0	12 (6+6)	18 (12+6)	18	24
			Arsenic in extract - ppm			
I.	Silt loam	0	21.0	27.0	22.0	26.0
II.	Silty clay loam	0	25.0	55.0	43.0	64.0
III.	Muck	0	15.0	20.0	10.0	15.0
IV.	Sand mix	0	60.0	88.0	80.0	116.0

In an effort to relate this data to actual field experience, soil samples were also collected from golf courses throughout the Midwest. These courses had a past history of arsenic use for P. annua control.

The first group of samples collected were used to determine depth of arsenic penetration into soils. Soils were collected to a depth of 6" using a 4" diameter plugger. Plugs were divided into a thatch section (about 3/4" deep) when thatch was severe. Plugs were further divided into thatch - 2" (T-2"), 2" - 4", and 4 - 6" sections. They were then analyzed for arsenic. Results from several of the clubs sampled are:

Club	Location on course	Thatch	T - 2"	2 - 4"	4 - 6"
Louisville C.C.	#2 fairway, low spot	-	18	0	0
do	#3 " high "	68	30	0	0
Beverly C.C.	#4 fairway, poorly drained	33	8	0	-
do	#9 " " "	35	10	0	0
do	#15 " well drained	20	28	25	15
Point O'Woods C.C.	#15 fairway	25	10	0	0
do	#16 "	-	10	0	0
Lafayette C.C.	#1 fairway	45	38	10	0
C.C. of Indianapolis	#14 fairway	70	45	25	13
co	#14 green	83	80	83	63

On sandy greens, or sandy fairways, as #14 green at C.C. of Indianapolis, and #15 fairway at Beverly C.C., arsenic penetration to a depth of six inches was in significant amounts. On tight, poorly drained soils, significant penetration was restricted to upper two inches.

Additional samples were then collected from 33 different golf courses in the Midwest. Since more than one fairway or one green was selected per course, this constituted a sampling of 98 different sites. These sites varied in arsenic application rates. Some areas were representative of excellent P. annua control. In others, poor or undesirable results had been observed. These soils have been analyzed and data is currently being evaluated.

Other experiments are now in progress. In these the toxicity of arsenic at rates from 0, 4.5, 9, 13.5, 18 and 22.5 lbs. per 1,000 is being compared with 0, 4 and 8 lbs. per 1,000 sq.ft. of treble superphosphate. Another experiment in progress is to determine the concentration of arsenic in plant roots and shoots when toxicity symptoms appear. Plants used include: P. annua, Poa pratensis, var., Sodco and Agrostis palustris var. Penncross.

In summary it may be said that using the Bray P-1 extractant, arsenic can be extracted from soils in amounts representing plant available arsenic. Also, with the phosphorus extraction procedure both concentrations of phosphorus and arsenic can be determined in the same filtrate and comparisons made as to ratios of phosphorus and arsenic. Arsenic soil concentrations can be accurately and efficiently measured by atomic absorption.

According to Jacobs, et.al. (4), arsenic sorption by soils varies, depending on the amount of clay, and amount of amorphous iron and aluminum oxides in the soil. At present it appears impractical to develop a rapid soil test for amorphous aluminum. However, a technique of acceptable accuracy and efficiency for the extraction of free iron oxides is available and under investigation.

In conclusion, it would seem that future data analysis, including concentrations of phosphorus, arsenic, and free iron oxides, and amount of clay, organic matter and pH should help to determine more accurately the arsenic concentrations toxic to P. annua.

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