PROCEEDINGS

of

TURF CONFERENCE

1967

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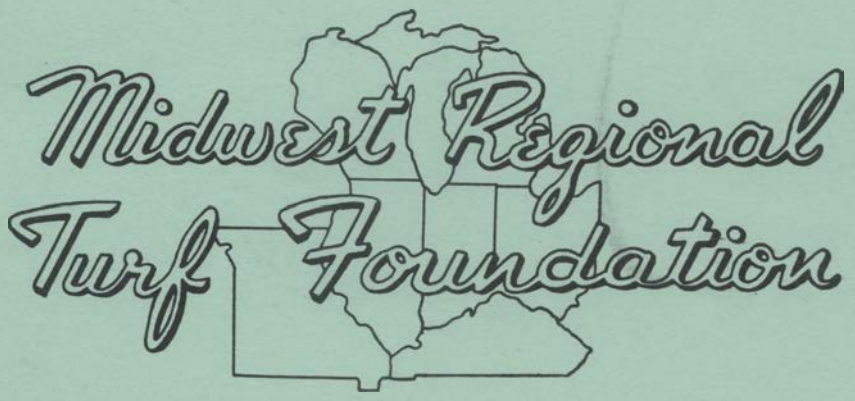

and

PURDUE UNIVERSITY

LAFAYETTE, INDIANA

March 6-8, 1967

PROCEEDINGS OF THE

1967

MIDWEST REGIONAL TURF CONFERENCE

The 40 talks included in these Proceedings are condensations of talks by speakers before sections and divisions of the 1967 M.R.T.F. Conference. We appreciated the willingness of the speakers to participate and prepare material for your reading. See Table of Contents next page. Proceedings of each annual Conference since 1948 have been prepared. A limited number of 1962, 1963, 1964, 1965 and 1966 Proceedings are available at price below.

A copy of these Proceedings were mailed to:

1. The 686 attending the 1967 Midwest Turf Conference.

2. One person of each member organization within the Midwest Regional Turf Foundation not represented at the Conference.

3. List of those in educational activities.

Additional copies are available at $ 1.00 each from:

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

Check below for special articles suggested for first reference as based on your major interest.

For Lawns - first see articles starting on pages

4, 12, 22, 32, 43, 54, 63, 69, 71

For Sod Production - first see pages

4, 10, 12, 28, 31, 32, 40, 43, 47, 53, 54, 63, 65, 66, 69, 71

For Golf Courses - all including pages

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For Athletic Fields - first see pages

10, 20, 32, 43, 47, 51, 54, 63, 65, 69, 72

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PRESIDENT'S REPORT

Norman W. Kramer, Supt., Point O'Woods Country Club,
Benton Harbor, Michigan

I ask you, "What is your problem today?" Around us we hear constantly, "What are we going to do about our labor this year?" The fruit and vegetable industries are working to solve their labor problem with new mechanical pickers, plus many new chemicals.

Now, this brings me to the conclusion that new and better equipment is a part of our answer. As you know, most equipment manufacturers must stand the cost of experimenting with new ideas out of company funds, and it is very expensive. And, how about chemicals for the turf industry? If we were to look at this with a technical eye we could see that, yes, there is research being done. Are we keeping pace with the growing demand of the grass industry? Frankly, I doubt this very much. We still don't have a quick and sure remedy for Poa annua, nor can we kill all weeds without damage to the turf. How about diseases? Still no sure cure for some of the disease problems we face. So, as you can see, there is much work to be done in this field.

Now is the time for each man in the turf industry to help seek out the private country clubs, the public golf course owners, the city and parks people, the large suppliers of chemicals, and, last but not least, the individual person who would like to help overcome our problem of growing healthy turf. Get help through their giving a personal or corporate grant to their favorite university or turf school. In this way you would be able to help the research people with funds so badly needed. If not for research then why not scholarships for prospective turf students? This in turn will most certainly help cut costs of producing healthy turf.

Please go home and look around your club membership -- I am sure if you approach the right people they will be more than willing to help. Remember, the one you are helping most is yourself, plus the man you ask.

In closing I would like to thank Dr. Daniel, fellow-board members and the entire membership for giving me the honor and privilege of being your President this past year.

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SECRETARY'S REPORT

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

So far this has been a banner Conference. Thanks for coming.

The 1966 year was a big year for turf. Fairway renovation became accepted - not just pioneer efforts. Automatic irrigation, even in the humid Midwest, began to make sense. And, the manpower shortage to manage golf courses became real.

Kaye House continues to do a sterling job as office secretary. Robert Seager is very efficient in his turf maintenance work. With five graduate students assisting, we're getting much done. Travel to observe, advise and participate in meetings continue to require about 60 trips per year. Your kindness in assisting at the local meetings is most appreciated.

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SELLING GOOD TURF

Harold W. Glissmann, Glissmann's Inc.,
Omaha, Nerbaska

Effective and Efficient Turf Management can only come from experience, hard work, knowledge of what you are trying to accomplish, and your ability to properly communicate with others about your services and the end product. To be an effective and efficient turf manager you must know what is going on, new varieties of grass, new maintenance techniques, new fungicides and how to properly handle and use them. That is why we attend this Conference.

I have been most fortunate because I have been able to attend at least this Conference for 21 years, plus at least one or two others each year, and sometimes as many as five or six, plus many of our national meetings. I have tried to repay in some small way the many rewards and the knowledge I have obtained - talking to you here today is one of them. I count among my close and personal friends such great dedicated turf men as O. J. Noer, Burt Musser, Fred Grau and Jess DeFrance.

Many fine younger men quite a ways up the hill of achievement include Eliot Roberts, Jim Watson, Bill Daniel, Charlie Wilson, Stan Frederikson, Ralph Engel, Jim Holmes, Joe Duich and Jim Beard. In fact, many fine dedicated men are anxious and willing to help you become Effective and Efficient Turf Managers.

However, there is more than just going to meetings such as this and knowing a lot of big-wheel turf experts. The biggest and main ingredient of effective and efficient turf management is YOU, and you alone. You must be able to answer any questions about WHO, WHAT, WHY, WHEN and WHERE concerning your business and product.

Take WHO first WHO are you? I am John Jones, a turf manager, golf course superintendent, or a sod farm manager, or a retail business or related service. I am active in my community affairs, trying to make my town or area a better place in which to live. I have church and lodge club affiliations. In fact, if there is anything going on in my area, I can be found either up front or helping - at least I am there and people know who John Jones is.

WHY? Let everyone know why you are doing what you are doing and the main reason should be because you enjoy what you are doing and are honestly trying to do the best job you know how, whatever it may be.

WHAT? Here comes the sales pitch. You must let everyone know what your business is. If you are a course superintendent you should be selling new and better ideas to your Greens Chairman, committee, and membership with bulletins and posters. Tell what you are doing, when you expect to start and finish, and by whom it will be done, your crew or a contractor. Then at least they will know who is responsible, and to whom to crab or give praise. If you are in a business that sells a service or a product, you must let the public know what you sell, what the costs are, and above all, what quality they can expect to receive.

WHEN? This may not seem too important but it is a part of the whole picture. Let the people concerned know when the job is going to be done and when they can expect it to be finished, when it is going to be delivered, or when the joint opens up for business, or any other WHEN that is necessary.

WHERE? The following work will be done on No. 8 green and No. 11 fairway. Where John Jones new sod farm is, or office is located, 2 miles north of 89th & Plowed

Ground Drive. When you tie all these WHY, WHAT, etc. together you get one big word, COMMUNICATION. No one can be an effective and efficient turf manager without the ability to properly communicate. I saw a sign once that read as follows: "You seldom succeed without the ability to properly communicate with others."

In closing I would like to read to you a letter and poem from one friend to another. It pretty well conveys my thoughts and philosophy, that has helped me become, at least in some people's opinion, an effective and efficient turf manager. Poem by Francis Cable: "I want the men I meet each day, - - - - - - -."

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Note: Six speakers were asked to express trends for their phase of Turf Management.-Ed.

TRENDS FOR GOLF COURSE SUPERINTENDENTS

Roy W. Nelson, Supt., Ravisloe C. C.,
Homewood, Illinois

Trends include management practices, but we will use the narrower viewpoint, and confine our discussion to the superintendent profession itself. My personal experience has spanned a period of twenty years, which has given me the opportunity of witnessing at least two distinct trends or changes in the image of the profession.

Firstly, the complexion of the profession of golf course superintendent has undergone a very healthy change from the somewhat inarticulate greenkeeper, with the proverbial green thumb, to the neatly dressed modern superintendent, who holds a comprehensive executive position with a salary scale commensurate with the scope of the position. The modern successful superintendent is expected to have a working knowledge of science, engineering, chemistry, forestry, agronomy, horticulture, personnel management, bookkeeping and public relations. The public relations was mentioned last but perhaps it should be first, for without it the others have lost a good deal of their market value.

The second trend is by far the more dramatic. We might better call this a revolution, and it has been in what we might call the "hiring image" of the profession. The "hiring image" is what the present day country club boards and committees are looking for when acquiring a new superintendent.

Years ago the main criterion in gauging the value of a superintendent was length of experience. Most clubs looked for a man who had proved himself at one golf course or another for at least fifteen or twenty years. Unfortunately, such a profession did not tend to attract young men as they often had to spend ten or fifteen years as an assistant at relatively low pay. Today the pendulum has completed the full swing in the other direction. The emphasis today is on youth with either a two or four-year Turf Management degree, plus experience on the grounds crew at some golf course.

An incident occurred at my Club last spring that might illustrate my point. I received a long distance call from a greens chairman of a club in Virginia. A Turf Management graduate, who had formerly worked for me, was applying for the position of superintendent. The question uppermost in the chairman's mind was this,

"Is it possible that a young man 23 years old can do a good job for us?" This chairman obviously was a gentleman of the old school. My answer was somewhat as follows, "If your question had been asked of me ten or fifteen years ago I would have said, 'Ridiculous.' Today the 23-year old young man in question has completed a two-year Turf Management course at an excellent school, has completed four seasons as an apprentice at several golf courses, has already served as a superintendent for two years at a smaller course and performed an excellent service. Today I can honestly recommend this 23-year old as well qualified to do an excellent job for you."

The point to be taken is that the trend today is to hire young men in their early and middle twenties to assume the superintendent's positions at every level of golf course prominence. And, most of the young men have proved time after time that they are capable of doing a fine job of it. What they may possibly lack in maturity is more than compensated for by youthful vigor and enthusiasm and boldly approaching problems.

We have called this pendulum swing to young men in the hiring image a trend. As such it assumes several facets. One of these inevitable facets is that a certain insecurity has been lent to many of the older superintendents who have preferred to rock on their heels rather than stay on their toes. This is the trend and it is as inexorable as the coming of the electric cart. What should the young men do about this trend? The answer, of course, is "Nothing, except ride with the tide."

How about the older men? This is a time to remember the old adage, "If you can't lick 'em - join 'em." The key to the problem is public relations, which means communication, information, salesmanship. The prime desire of the average country club board of directors and membership is the assurance that they have the best possible man on the job. Assure them!

Let us take the word T.R.E.N.D.S. and see if we can get some good suggestions from it -

T - Suggests the word THINK. Too often long tenure in a job tends to induce a sort of mental coasting. Join the mentally vigorous young men! Think!! Ask yourself, "How can I improve my job, my service to the club - myself??"

R - Stands for the word REPORT. Many superintendents use periodic reports to keep their greens committees and membership up to date. This is one of the best methods of communication and information.

E - Is the first letter of the word ENTERPRISE. It suggests vigor and resourcefulness in action. Do something new at the club. This could be a new flower bed, a clever evergreen planting, a rock garden, a new putting green. Let them know that you're around.

N - Stands for a forgotten word - NEIGHBOR. It is wise to be neighborly especially with as many fellow superintendents as possible. The exchange of ideas and information is invaluable.

D - Suggests the word DIPLOMACY. It means wisdom and tact in dealing with others. Particularly is this true in dealing with fellow department heads at the club. Never make enemies for the position of superintendent is too vulnerable to have vindictive people, who happen to have the ear of the membership, in a position to "Chop You Up." Go out of your way to make friends with everyone. It will pay off handsomely.

S - Is the last letter and stands for SALESMANSHIP. This is the day and age of Salesmanship. The superintendent sells a product called "service." In this competitive age a product not kept before the public is a product forgotten. Good public relations not only spells security, but progress. Today we do not stand still - we either move forward or backward. The choice is yours.

The pattern of the past gives us an insight into the future - The image of the profession is going to assume more and more the character of an executive position. Effective public relations will add greatly to personal satisfactions, remuneration and prestige. It will be neither a young nor an old man's fame, but one in which initiative, vigor and ability will create their own rewards. The young men should remember to stay on their toes because one of these days they will be one of the older men.

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TRENDS FOR TURF MANAGERS FROM THE TURF SUPPLIER'S VIEWPOINT

Robert C. Meier, Jr., Turf Equipment Sales Company
Cincinnati, Ohio

My subject today could be considered a short course on the current state of the economy of the country. According to government statistics we are in the midst of a delightful business boom,but if you talk with any number of men in business, they say that they are having a hard time to find capital to expand plants, produce finished goods, or even to sell what they can produce. Almost all classes of consumers are willing to buy, but must restrict their purchases to absolute essentials.

Because of the high cost of borrowing money throughout the chain of manufacturing, distribution, and finally sales, I believe that there is a definite possibility of shortages or delays in obtaining equipment and parts. Some of the recent delivery schedules, which we receive weekly from various manufacturers, indicate that their present orders equal production. Of course, another reason for possible shortages is the unprecedented demand for equipment by the many new golf courses, parks, and recreation areas that have been built recently, or that are now under construction.

We suppliers normally place orders with our manufacturers in the fall for delivery in February in order to meet your spring requirements. By placing your orders as early as practical you can assure yourself of delivery when you want it, plus you can frequently buy these materials at a more favorable price. When your supplier can order early, he is sometimes able to pass on to you the savings from consolidated freight shipments, volume purchases, or special factory early order discounts.

Another outlook for the coming season is that the golf course or park superintendent, as well as we suppliers, must develop or expand our technical knowledge, in order to cope with the increasing variety of sophisticated equipment and chemicals, which are coming into use, in order to keep maintenance costs at a reasonable level. Those of you who were at the recent National Conference in Washington saw a big sod cutter - a $ 25,000 piece of machinery - whose sole purpose is to cut sod in volume so it can be marketed at a reasonable price.

Automation in golf course irrigation is coming into much wider usage because of increased player traffic, and high labor costs. It was rather surprising to me to learn that it isn't just the relatively few wealthy country clubs that have taken this step. A large number of municipal and daily fee courses have found that automatic irrigation has reduced their labor operating costs considerably.

We recently delivered a mowing tractor equipped with an array of headlights so that the superintendent can mow fairways before dawn and after dusk due to his golfer traffic. I did not tell him that they are going to lighted fairways next year.

The net result of the advanced development of equipment and irrigation is that the superintendent is forced to become a full-fledged mechanical engineer as well as an agronomist, and we suppliers must try to keep ahead of our customers in technical knowledge. Personally, I find that an increasing amount of my time is devoted to reading trade publications, and many superintendents have told me that they are building up regular libraries of the technical information that they receive almost daily. A side effect of the growth in turf technology is that my Company is reducing the variety of lines of equipment and other supplies which we handle in order to offer our customers better knowledge of the remaining lines.

Superintendents will be asked to prepare budgets for major equipment expenditures for three years ahead rather than for one year.

Another phase of finance, for the benefit of the suppliers, is the collection of accounts. Suppliers normally have to pay manufacturers for materials received within thirty days. Although we do have working capital, whether it is our own or borrowed, it does not take long to have most of this money tied up in inventories or accounts receivable.

In general, private country clubs do pay their bills within the allotted time. Occasionally one of them will get in a bind due to the swimming pool leaking, or a new locker room. Municipal courses are good credit risks because they must have the funds before they can authorize any expenditure - even if it's for a fifty cent sprinkler nozzle. Daily fee, or individually owned public courses can sometimes be a problem with regard to available capital. A wet spring can darn near break them financially.

I would like to stress this comment: we suppliers do recognize this possibility, but ask that you confide in us so that we may help you without getting hurt ourselves. If we know in advance that you will need sixty or ninety days to pay for a greens mower, as an example, we can generally arrange our finances to cover the situation, but please tell us first and early.

I hope that my remarks are representative of the thoughts of the other suppliers to the turf industry who are here today.

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TRENDS FOR TURF MANAGERS - PARKS AND ROADSIDES

Dwight M. Brown, Geo. W. Hill & Co., Inc.
Covington, Kentucky

Turf along our highway and in our parks is generally taken for granted by the motoring public - much like fine turf on our golf courses. Highway turf, for example, is approximately 25 acres per mile, and many interchange areas go as high

as 100 acres each. You can see the size of the maintenance job ahead. We will attempt to touch on a few of the trends in this field of parks and highway.

Seeds

Here in our Midwest we are fortunate in having versatile grasses like the bluegrasses, tall fescues, fine fescues and certain legumes, all of which do maintain themselves quite well once established, and do a reasonable soil erosion control job. For economic reasons we must have grasses like Ky. 31 fescue which can carry on with little or no fertilizer program after the initial seeding application. In states like Pennsylvania crown vetch has been doing a fine job on problem areas. In West Virginia Sericea lespedeza, for example, is aiding Ky. 31 fescue and literally is "finding its niche" in its rough and mountainous areas. Native grasses are doing a fine job in many of our central west and western states.

Seeding Techniques

The greatest changes in turf work in this field have come in seeding techniques.

Application of straw mulch has been handled well and quite effectively by power straw blowers operating from the paving area. Straw, however, in some areas is becoming a problem both because of short supply and freight costs. The new varieties of grain, too, are being bred for more grain and less straw. The outgrowth is, of course, substitutions. Because some of these can be applied by hydraulic methods right along with seed and fertilizer, the cost and price becomes competitive with straw.

After some trial and error wood fibre mulches have emerged, which have proven quite satisfactory. Although straw is, perhaps, still the most resistant to erosion, it does seem to "gully" more while the wood fibre tends more to "rills" which do not cut so deep, nor disrupt the overall appearance of slopes.

Some effective control is being accomplished by an excelsior product, which, like straw, must be applied through a straw blower, or laid down in rolls.

Other specialized materials include a spun glass roping applied by blowing it through a patented air gun under 40 to 60 pounds pressure. This is especially excellent for force work repairing of washes and gullies.

Another new trend is in the use of numerous types of netting both for erosion control itself, as well as a covering for straw mulch.

Equipment

The timing of the prime contractor finishing and the seeding contractor starting is most critical. If not a continuous thing, seedbeds often must be completely reworked. Use of aerifiers in parks, rest areas and recreation areas, where compaction is becoming a problem, should be a very important step forward.

A definite trend, because of enormous areas in highway turf, is toward less mowing. It is accomplished without sacrificing "looks" by "chemical trimming" around guard rails, bridges, etc., and mowing up the slopes only 4 feet or so from ditch lines. Berms, median areas, and areas around interchanges must be mowed for a satisfactory look.

General Beautification

Now with our new highways reaching so many beautiful and potential recreation areas, the "boom" is on. States like West Virginia will follow the already established trend in Indiana, Ohio and more recently Kentucky and others. You will be hearing more about these new machines and techniques. Coined phrases like "glob seeding" and "spattor seeding" will become well known in the field, and will accomplish such things as: pre-spaced tree and wild flower planting on a large scale in parks and strip mining reclamation areas. The use of cut fibre glass to inhibit rodent destruction of seed and small planting stock is contemplated. Many of these new things are being made possible by the manufacture of smaller, more mobile, types of hydraulic seeding and mulching equipment.

Speed and all weather work are key items in turf whether roadsides or parks.

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A PROGRESS REPCRT ON SLIT-SEEDING

H. F. Carroll, Foxcroft Meadows Sod Farm
Glen Ellyn, Illinois

This can only be a progress report as our first experimental machine was not put in the field until May of 1966. Therefore, no finished turf has been harvested from this method of seeding.

Our first seeding unit was built with only the thought of overseeding damaged spots in our turf. The seeding unit was a minature grain drill mounted ahead of the operator of a Model "G" Allis Chalmers tractor.

The seed box was a standard Lawn Beauty spreader 18 inches wide. The ground wheels were removed. The seed shaft was turned by a single floating wheel with a roller chain drive. Seed openings were plugged to give a 2-5/8 inch opener spacing.

The slit openers were seven standard mower sections extending through slots in an 18 inch wide steel skid plate. This skid plate was hinged at the front end and spring loaded at the rear. The slitters extend 3/4 inch below the plate. The sections are staggered in the plate so there is an actual dimension of 5-1/4 inches between any two sections. This was done to relieve any trash conditions, and to prevent tearing out a thin section of soil between slits.

Back of each slitting section was a miniature seed boot extending 1/4 inch below the skid plate. A flexible tube connects each boot to a seed opening in the box. Our first unit had a thin press wheel for each lot, which was later abandoned because we could see no value in pressing seed in an 11-gauge slit.

The first seeding rates were set at approximately 6 seeds per lineal inch of slit. This is the equivalent of 7.2 pounds of Merion blue per acre at the 2-5/8 inch slit spacing.

Our first germination results in overseeding were so good that we immediately built a 6-foot seeder on a 3-point hitch frame. Three 24 inch Lawn Beauty seed hoppers were connected together end to end. The seed shaft was driven from the end

by the floating wheel drive. Four 18-inch skid plates with seven slitters each were used for openers.

On May 30, 1966, we seeded a 16-acre plot of sloping mineral soil from which the sod had been harvested. We did not work the soil before seeding in two directions. Before the seed had germinated a 2-inch rain hit the field. No appreciable washing of soil or seed was noted.

With a solid set irrigation system of .12 inches per hour, we found it required less than an hour per day of pumping to get excellent germination.

On July 3, 1966, another 15-acre sloping mineral field was seeded as the first. Air temperatures this time were from 90°-95°F. during the germination period. It was necessary to cut our watering periods to as little as 8 minutes at a time to hold soil temperatures below air temperatures. Over-watering unworked soil would almost immediately raise soil temperatures 10° above air temperature with consequent seedling damage. It was interesting to note that soil temperatures under a shade box or broadleafed weeds fell as much as 10° below air temperatures. A plot of 15 acres at our Lisle farm seeded at the same time and under similar conditions, but without the careful water management, was a failure. The only seedlings to survive were at the end of the irrigation lines where they received less water.

On August 2, 1966, a sloping mineral plot of 8 acres that had been summer fallowed for a quackgrass problem was seeded with Merion blue. Same seeding rate and same irrigation system was used. A beautiful seeding was secured with .2 inches of water every other day.

On September 1, 1966, we seeded a 30-acre plot of muck soil. Some of this was done with a Viking, some with a Brillion, and some with the slit seeder. Regular 25 pounds per acre rates were used with the conventional seeders except for a few passes of 15 pounds per acre with the Viking. Seven and fourteen pounds per acre were used with the slitter. We consistently got more seedlings per pound of seed from the slit method.

Here are some advantages of the slit seeding method as we observed them:

1. Overseeding in existing turf without working the soil.
2. Less washing on new seeding.
3. Less seed required. We believe as little as 5 lbs. of Merion seed per acre will give a satisfactory turf.
4. Wind does not affect seeder operation.
5. Less water required for germination. Slits held moisture better than top of ground. Germination was much more uniform.
6. We believe seeding time can be extended later in the spring and earlier in the fall. This will ease the work load of attempting to get all seeding done between the conventional period of August 10 to September 15.

Here are some things necessary to improve our experimental machine:

1. Get a better slitting knife. Mower sections, although low cost, have to be replaced too often.
2. Mount each slitter on an individual spring loaded arm with its own depth shoe. The slit depth is critical. Ordinary soil surfaces are not smooth enough for an 18-inch width depth shoe.
3. For muck soils the 3-point hitch frame should be on rubber-tired depth gauge wheels for better control.

Although only one idea affecting sod growing is discussed, it illustrates the intensity of sod growing trends.

RESEARCHERS AND STUDENTS - TRENDS

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

Turf managers can adopt new ideas fast; therefore, research is given prompt consideration. We, at Purdue, are actively working on over twenty ideas affecting your turf programs.

Increasing needs for literature, for generating the favorable climate for idea exchange are being met. Publications are often delayed - since they are less hurried than is the daily schedule.

Rising student numbers - 22 at Purdue now - illustrate their interest. Thirty scholarships were given from the G.C.S.A. this year in the country. Young men are coming into turf and need to be informed in many ways. Certainly the demand is very keen.

Communication is our common problem. You help by attending, by listening, and discussing.

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NURSERYMEN & HOMEOWNERS

James McCarty, Pres., Colonial Gardens
Evansville, Indiana

The speaker stressed the greater knowledge of existing homeowners, the extent of their information through advertising, including TV and magazines. He also stressed the need for the consumer to have wise decisions so that his cooperative work with nurserymen towards securing maximum turf and landscape benefits is realized.

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MECHANIZATION FOR SURVIVAL

Tom Mascaro, President, West Point Products Corporation
West Point, Pennsylvania

(Slides illustrated the evolution of equipment)

Remember the GOOD OLD DAYS? Don't kid yourself - our memories play tricks on us. We only remember the nice things. The "Good Old Days" were miserable-toil and

sweat. Getting up at daybreak, performing back-breaking jobs, going to bed at night dog-tired, only to get up the next day to begin all over again.

To maintain any large turfgrass area in the "Good Old Days" required manpower - lots of it. And, except on the golf course, it is doubtful that the men employed could accomplish much more than necessary mowing, cleanup and weeding. New construction was accomplished by sheer muscle and swet. Ditches were dug with pick and shovel. You walked when you wanted to get somewhere. On the golf course it was not uncommon to see twenty to thirty workmen - and they were all tired at the end of the day. Almost everything was done by hand. Greensmowers were pushed, spikers had two handles on them - for two men. A good scythe-man was hard to get. What was so good about the "Good Old Days?"

What has brought about the tremdous change: mechanization. Mechanization has changed our way of living. It has freed us from the drudgery and toil of hand labor. Unfortunately, turfgrass maintenance has not made the progress enjoyed by the farmer. Budgets across the nation show that labor still uses up between 60% and 75% of the money for maintenance of grass areas.

Why is this true? Why should the turfgrass industry be lagging so far behind in an economy that enjoys the leisure and ease of doing a great deal quickly and easily? We suppose that there are many reasons that will never be answered. However, there are some reasons that are obvious, and, if these were corrected, a great deal of progress could be made.

The first reason is the turfgrass manager himself. By and large he is a quiet, industrious, unassuming fellow who is nice to everyone. He is not by nature a person who likes to argue and battle for every piece of equipment he knows he should have. As a result, he surrounds himself with a bunch of junk machinery. When the chips are down he can't do his job, and the thanks he gets for his effort is that he gets fired. He constantly hears about the need to save money. And he struggles to do it by making his equipment last another year, then another, until finally he winds up with a few pieces of metal carefully wound together with baling wire and glue.

Other contributors to this sad state of affairs are the officials. They, too, are nice guys. They get argued down when it comes to a choice between a nine-gang hydraulic tractor and re-doing the bar, or putting up a new gym, building a pool, etc. They keep backing down when it comes to capital improvements. "Well, let's make things do for another year," is a standard phrase at most committee meetings. Perhaps it takes too much effort to explain to people that this new piece of machinery is not only going to improve the turf but, in the long run, will actually save money. Besides, most people never see the maintenance equipment, but they are tremendously impressed by new recreational facilities, or new furnishings.

What does all this lead up to? Rather, what does all this lead down to? It leads down to demand. If there is no demand, manufacturers will research and develop products for a more demanding market. Having been in this field for some thirty odd years I have heard this compliant consistently. However, as I see it, the biggest problem is that most people do not present enough information to support the need for new and better equipment.

What can be done about it? Well, there are many things a person can do to acquire new and needed equipment. You cannot get new equipment by stomping your feet and demanding it. You have to supply facts. You have to prove the need. You have to show how a particular piece of equipment will save money and improve the use of the turf.

Let me give you an example. Suppose you now have a 30-inch walk-behind mower. The unit, traveling at 3MPH, will cut 6 acres in an 8-hour day. Two such mowers will cut 13 acres of turf in 8 hours. Assuming $ 2.00 per hour for each operator, or $ 32.00 per operation per day, labor costs to cut 13 acres would figure approximately $ 2.46 per acre. Now, let's take a 76-inch Triplex Riding Mower. At 3MPH, it will cut 18 acres in 8 hours. Figuring one machine with one operator, at $ 2.00 per hour, this would come to $ 16.00 per day and would amount to an average cost of only 88¢ per acre - $2.46 per acre against 88¢!!! These are facts, gentlemen. No one in his right mind could even begin to argue against this kind of information.

Now, suppose you need, and should have, a piece of equipment that cannot be measured as precisely as a mower. Let's assume that this piece of equipment improves turf quality but has no visible effect, like mowing. Again you must present facts.

How much is a green worth? A fairway, or a lawn? Eight cents (8¢) a square foot? Ten cents (10¢) a square foot isn't too much if it is in place and growing. A dollar ($1.00) a square foot for a green is cheap. Let's use the 10¢ figure. So,

40 acres fairway at 10¢/sq.ft.	=	$ 175,000.00
3 " tees " 50¢/sq.ft.	=	60,000.00
3 " greens $1.00/sq.ft.	=	120,000.00
50 " of rough, grounds,etc. 5¢	=	110,000.00
First 100 acres just		405,000.00

Others have estimated the value of the turf on an average golf course to be worth around $ 250,000.00. Well maintained turfgrass areas of any kind are similarly valuable. Now, isn't it worth an investment of a thousand dollars or so to protect an investment of a quarter of a million dollars?

There are other facts that you can use to support the need for new and better equipment. The Turf Manager, who is well-equipped, can produce a good healthy turf. Turf in top-notch condition is less costly to maintain. A deep-rooted turf requires less fertilizer. It requires less water; it requires less weed-killers. Good turf saves money. But, you cannot grow good turf without good equipment. Good healthy turf is responsible for a lot of good things. It is easy to walk on, nice to look at. On sports areas it can improve the game and reduce injuries on playfields. It also can help conserve water and soil, prevent erosion, etc.

Mechanization is essential to get the job done - fast and well. Mechanization is essential to you, the turfgrass manager. It means job security. All of you have the knowledge to grow good grass. You must have the proper equipment to do the job. Mechanization for survival means survival of the turf which, in turn, dictates your own survival.

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CUTTING LABOR COSTS IN TURF MANAGEMENT

Tom Mascaro

Not long ago I had an opportunity to hear a panel discussion on population and labor problems. Two professors from the University of Florida brought this rather complex picture into focus. Very simply, they stated the following: "The productive

working age is considered to be between the ages of 25 and 65 years. In this year of 1966, 50% of our population is under 25; 20% of our population is over 65. This leaves 30% to do the work that needs to be done, and there are just not enough people to go around."

The one suggested solution to this problem was mechanization and automation. Machines and systems must be created, not to replace men, but to supplement them. Only in this way can we produce all the things that are needed and wanted in this constantly rising economy.

Suppose we transpose these statistics to cost and labor problems of our golf courses. Let's go back to the thirties. In 1937, labor budgets on golf courses averaged 70% of the total budget. In this year of 1967 the labor still accounts for 70% and even 80% of the budget. In thirty (30) years the labor problem has, if anything, worsened.

Let's compare golf courses to the general field of Agriculture. Here we find that vast improvement has taken place in the last thirty years. Fifty percent (50%) of our population was engaged in food production to feed us in those days. Today, only 7% of our population is required to produce enough food. It is quite obvious that good planning, research, mechanization and a real desire to do a better job has made this possible.

Conversely, golf course operations have not been planning, or researching, or mechanizing to meet our present situation. Labor is obviously in short supply. People are demanding more money and fringe benefits and getting them. We can no longer bury our heads in a sand trap and wish the problem would go away.

What can be done? Well, it's better to start too late than ever. And, the way to start is with a plan. A plan that covers all aspects of the problem. You can make up your own, or use the following as a general guide. Remember, don't cloud your plan with a lot of unrelated problems. Stick to one concept is doing the job that the membership wants done with a minimum of labor and cost. Don't compromise. Cheap labor and improvised equipment wastes money. Your club is not looking for something cheap. They want top quality at a reasonable cost. After you have explored and studied set up a plan of action.

Areas to Explore

1. Your over-all system of operation.
2. Operations that lend themselves to mechanization.
3. Preventative Equipment Maintenance Program.
4. Parts inventory and controls.
5. Reconstruction to reduce maintenance.
6. Redesign of fairways and roughs.
7. Comprehensive study of sand traps.
8. Labor and labor relations.

Overall System of Operations

When you take a cold, hard look at the average system of operations on many golf courses, you find that the sequence of operations and method employed were not developed from the standpoint of efficiency, but rather were developed through trial and error. This does not mean that the whole system of operations is bad, but it does mean that there is plenty of room for improvement. A scientific and

practical approach must be developed to meet the challenge of the sixties with its rising economy, high prices and labor shortages.

In evaluating a system of operations, one must start with cost and time studies, which is seldom mentioned in any turfgrass publications. The first thing you need is a stop watch, which will give you a lot of information. For example, how long does it take to mow a green? If you determine the time that the reel is actually cutting grass, you will find that the total time is only 10 to 11 minutes for an average 6000 sq.ft. green. The rest of the consumed time is used up in getting to the green, preparing the mower, emptying the basket, waiting on golfers, hand spitting, etc.

I want to emphasize here that I am not implying that the man is lazy or slow. What I am implying is that he may be doing the job inefficiently because of the way the job is planned. Does he walk to each green? How far must he walk to empty the basket? How far does his efficiency drop after the second or third green? How much time is he allotted to complete his task? Did you plan the procedure, or did you inherit a system?

In industry we are guided by a rule known as "Parkinson's Law." His law states: "Work expands to fill the available time." If you have an hours time to get dressed you consume the time doing so. If you have only ten minutes to get dressed, you can. Therefore, if it is the custom at your club to allot three hours to a man to mow his greens, then he will use this time to complete his task. What we are really attempting to do is not to force a man to work harder and faster, but we are developing a system which will make him more efficient and, therefore, do more at less cost.

Now, let's convert some of these thoughts directly into costs. We will assume you have saved ten minutes in one of your operations. Ten minutes does not sound like very much, but ten minutes a day equals one hour per week. From April to November, this equals eight months or thirty-two weeks, so 32 hours saved. In round figures, ten minutes a day saved equals one week's wages in a year, and represents a saving of $ 100.00 a year, because you must add to the hourly rate vacation and all benefits the employee receives. Projecting this formula, a crew of ten men wind up with $ 1,000.00 saved. Poor planning, duplication of effort, walking time, equipment down time, lack of knowledge of machine operation, general confusion and many other reasons result in many hours of lost time.

What I have pointed out here, however, does not mean that you can proudly tell your club officials that they should deduct this money from your budget. Every cent that you save is going to be needed for the inevitable increases in wages, including your own salary, supplies, etc. Therefore, I feel that increased efficiency of golf course operations is going to be absolutely necessary just to keep your head above water.

Operations That Lend Themslves to Mechanization

Far too many turf areas are still back in the horse and buggy days. Antiquated equipment, or worse yet, lack of equipment means that the job to be done must be bulled through with expensive hand labor. In this day and age, we cannot afford to dig ditches by hand. WE ARE WASTING MONEY when we mow an area with an eighteen inch hand-pushed rotary mower when the job can be done with a riding triplex. We should not waste a man's time in walking when he can ride. We should use machines that require one man rather than a crew. Operations include aerification, topdressing, dragging, mowing, watering and even supervision can be mechanized today.

Two-way radio systems increase efficiency tremendously, making possible immediate contact with workmen on any part of the golf course. We should initiate and enforce a preventative equipment maintenance program. Much has been said on this subject, but not much has been done about it.

Ford Motor Company has published these figures. Failure to replace a damaged $ 10.00 dry type air filter on a tractor can cause more than $ 150.00 engine damage. Replacing a $ 2.50 hydraulic fluid filter may save $ 25.00 to $ 50.00 in parts and labor later on. A cracked hose between the air filter and carburetor costs just one dollar to replace, but can cause $ 100.00 or more engine damage. In less than a half hour $ 2.00 worth of labor can clean, service and fill a battery that might save a new $ 20.00 battery. Just a few minutes spent each week inflating tires correctly can save $ 10.00 or $ 20.00, or more in yearly excess wear to tires. With a good preventative equipment maintenance program we pick up impressive savings, and reduce down time while repairs are being made.

Parts Inventory and Control

This is another area that saves money in wasted down time. Many supply distributors have spoiled you with their efforts to keep you supplied with parts on a minute's notice. It takes time to get you the part and both you and your supplier are losing money and patience. Why not sit down with your supplier and determine those parts on each machine that are going to wear, then order and stock them in your own parts inventory? Ask your supplier to replenish your parts stock in an orderly fashion as you use the parts.

Reconstruction of Golf Course

Layout is a big area to explore for reduced costs. Many golf courses were designed when labor was cheap. You must learn that you have to spend money to save money. Tees are usually the prime target in reconstruction. Many tees and tee areas cannot be maintained efficiently with modern equipment. Reconstruction of bridges, hard-to-maintain creeks and banks all fit into these areas of exploration for cost savings. Adequate routes and roads to move equipment is modern too! Redesign of fairways and roughs can easily knock off fifteen acres of intensive care turf. Many golf course fairways have become wide bowling alleys.

Constant mowing in straight lines has destroyed the free-flowing design of the architect. Fairways have become wider than they need to be. Stake out each fairway to make it look like its original design. It will be reflected in savings in mowing time, fertilizer, water, and wear and tear of equipment. The maintenance of sand traps is likely the second largest item in your budget. Anything you can do to eliminate unneeded traps,or reconstruct them for easier maintenance, is going to reflect substantial labor savings.

Labor Relations

Labor and labor relations is seldom considered as a cost-saving area, since we usually relate it to higher wages, more benefits and more manpower. Yet, if we look at it logically, we find that labor relations have a profound effect on costs through efficiency in performance and attitude.

A well-adjusted worker, that likes his work, communicates well with you and enjoys working at your club, is an asset to your organization and can be directly re-

lated to cost of operation. The first thing you must offer is a decent living wage with all the expected benefits. But, it doesn't stop there. A good man wants to become part of the act. He is willing to share your problems - if he can share in the praise. Recently a superintendent told me that while he was having lunch in the club house, a member came by and praised him for the fine condition of the course. He said it made him feel good all over, and the raise he had been thinking about didn't seem as important. I asked him if he had gone right out and told his men the same thing. Unquestionably, they would have felt as good as he did about it.

There is virtually nothing that motivates people more than pride. Many of us work for less than we could get somewhere else, or in another line of work, because we are willing to trade dollars for satisfaction. All of us would rather work for less dollars and be happy than to make a lot of money and be miserable. I believe this is especially true of workmen that choose golf course work for a living. In many ways it is a hell of a way to make a living. Rain and mud, stinking hot and freezing cold, bitching members and flying golf balls, tiring work and no one appreciates the work that he has done. The disadvantages of the job must be offset with enough good things to make him want to stay on.

Becoming part of a team is a strong motivating force that will keep him on the job day in and day out. Building the team is your responsibility. Learn to communicate with your men. Bring them into the act. Hold meetings with them. Explain in detail what you are trying to accomplish. Involve them in your short and long-range plans. You will find that it will pay big dividends.

When you sense that a man will not become part of the team, get rid of him. If you can't replace him, you may be surprised to find that your team will take up the slack. Take the money you were paying deadheads and give it to your good men. Analyze it this way. If you have ten men and two are fouling up the works, get rid of them. For round figures, let's say they were making $ 2.00 an hour. That's $ 4.00 an hour you have picked up. If you divide the $ 4.00 among the eight remaining men you can increase their wages $.50 per hour. You can get a lot of mileage with this kind of money. Bring your men into the act. Let them know that you have just so much money to spend on labor to get the job done. Every additional man you hire is robbing their paycheck. Make them conscious of this. The less men to do the job, the more they make. Efficiency will skyrocket. Your men will give you more ideas than you ever dreamed of to cut costs.

Summarizing the points outlined, I have skimmed over some areas that you can study for cost savings. If you apply yourself you will come up with some surprising answers. Golf course operations must become more efficient to keep costs in line. If we don't become more efficient, the costs will become so high that the game will go back to the way it was in the early days -- a rich man's game.

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PUTTING WORKERS ON WHEELS

Tom Sams, Supt., Audubon Country Club
Louisville, Kentucky

At my Club all workers ride whenever possible. Everybody has wheels - to move faster. There's an old saying that a lazy man carries the biggest load. Why does

he carry a big load? Primarily because he wants to get the job done faster. And, in this day and age that's exactly what we're faced with in the turf industry - getting the job done faster. With the labor situation as bad as it is and the ever-increasing leisure time that is being spent on the golf course, I think that within the next ten years that the transition to mechanization and mobility will have to be a must on most recreational facilities such as golf courses.

Being a little on the lazy side, but also with a little foresight, I started the transition to mobility about five years ago by taking a couple of old electric carts and coverting them to gasoline, and by building three low-profile trailers and a few sulkies. Each succeeding year I was able to add to our fleet.

Then on July 7, 1965, our maintenance quarters burned to the ground. The only equipment that we did not lose were our fairway and rough mowers and a few farm implements that were not in the barn. As much as we needed new maintenance quarters, it sure gave me an empty feeling watching the old barn go up in flames. Here it was right in the middle of the season and we had no equipment and no quarters.

The fire was still smouldering when other superintendents from throughout the Louisville area offered to lend me anything I needed in the way of equipment. But, thanks to Jack Dayton & Son and Bunton Seed Company they were able to furnish me with all my needs.

Although not realized at the time, the fire turned out to be a blessing in disguise. Here was a chance to hand-pick all the equipment that I needed to put my men on wheels and this I did.

Also I was able to help design our new maintenance building. The office area is 16' by 22'. The repair room is 20' x 22'. All this could not have been possible without a very progressive Greens Committee. When compiling my equipment list I explained the primary functions of each unit and how it would benefit our operation.

This was one of the reasons I was able to get all that was asked. When making a request to your committee I find that most men are reasonable if they know the "whys" and "wheres", and one way to give them this information is in writing, listing all advantages for your request. The list of equipment includes: 2 trucksters, 4 small tractors (the 7 and 10 horse power varieties), 3 triplex mowers, a power roller (rider), power drag mat, etc. The complete transition to mobility proved most successful the very first year in a number of ways. First, labor costs for 1965 were $ 35,000. In 1966, even after wage increases of 25 to 50¢ an hour were given to all employees, labor costs were slightly less. We operated on four less employees than in previous years and turf conditions were the best we have witnessed.

Before going any further I would like to point out that the transition to mobility requires a lot of adjustments, such as adapting facilities and workers to the new method, having ample storage quarters, an up-to-date work shop with a good supply of parts, and above all a sound preventive maintenance program.

One other point that is worth mentioning, if you are considering putting your men on wheels, is that by improving work conditions you will attract a higher caliber worker, and good workers are hard to find in this day and age. You will also find that the higher caliber worker is much easier to train and keep.

To cite a few examples of how mobility has helped in golf course maintenance at Audubon C.C., in previous years it took two men on the average of five hours each to cut tee tops, using greens mowers. Today one man does the same job in

3-1/2 hours using a Triplex with grass catchers. Then there was the old method of cutting banks and collars. This was done by four men using 20" reel type mowers in a total of 16 man hours. Today one man does the job in seven hours, and I could go on and on.

Tom Mascaro of West Point Products summed up my operation best when he first walked into the new maintenance building and saw my equipment. He said, "You know Tom, you have done what I have been thinking. After further talking with Tom he made the statement that within the next five to ten years all golf course employees will have their own trailer-type vehicle, equipped with a two-way radio. I'm inclined to agree with him. What with the total golf courses nearing the 10,000 figure, and the labor situation getting worse each year, the streamlining of golf course maintenance practices, through mechanization and mobility, will have to be a must.

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TURF HEATING WITH ELECTRIC CABLE

J. R. Barrett, Jr., Dept. of Ag Engineering, & ARS, and
W. H. Daniel, Dept. of Agronomy
Purdue University

Turf heating - adding heat to the rootzone of turfgrass plants to keep the soil from freezing, to keep the turf greener, to promote new root growth and blade extension, and to help melt snow - now has been adequately tested for use in turf management programs in the United States. Basic requirements for installing and managing electric soil warming systems in the North Central states have been determined jointly by Purdue University's Departments of Agronomy and Agricultural Engineering and by the Farm Electrification Research Branch, AERD, ARS, USDA.

The first two major electrically heated turfgrass areas in this country are the playing fields in the Civic Center Busch Memorial Stadium, Saint Louis, and Falcon Stadium, U. S. Air Force Academy, Colorado Springs.

Research presently is oriented toward improving turf in critical-use areas. Response of bermudagrass, Merion bluegrass, Saint Augustine grass, bentgrasses, Kentucky bluegrass and Zoysia to soil warming are now being investigated by interested private, state and federal agronomists, and engineers.

System Design Considerations

Progress reports on work at Purdue University, Lafayette, Indiana, indicate that Kentucky bluegrass sod had increased root growth in winter, an extended growth period in the fall, earlier growth in the spring, and, in the high-wattage areas, growth even throughout the winter. Plastic coverings cut electricity requirements, maintained greater greenness in blades, and boosted growth. However, in the spring, covers must be used judiciously to avoid excessively high temperatures and disease buildup.

The exact design for a particular installation, of course, must depend on area site, the purpose for which the soil is to be warmed, the climate, available

power and grass species used. All system designs and installations should comply with the NEC.

Heating Cable - Both polyvinyl-chloride insulated nylon-jacketed cable (PVC) and mineral-insulated copper-clad cable (MI) are satisfactory.

Installation Parameters - Cables should be buried at least 6 inches for protection from mechanical damage and associated electrical hazards.

Controls - Soil thermostates 1 inch below the soil surface do not give adequate warning of changing weather conditions, although soil temperatures adequately define heat reserves. Air temperature near the ground is the best guide to when heat should be applied. Air thermostats should be shaded but exposed to free air movement.

Power Densities - The amount of heat to be applied depends on weather conditions at a particular location and on the condition desired for the turf area.

To Install and Operate

To improve conditions for an extended fall season, heat application should begin as earth cools, so the system is used to buffer the heat loss. In early spring the system can best be used to warm the soil preceding normal soil temperature buildup. A frost-free, growing turf can be maintained until the close of the fall season, then power either shut off or used in minimum amounts to help the turf repair itself. In spring the turf on the baseball diamond can be thawed, warmed up, and active growth forced four to six weeks before the season opener; the golf green can be in shape before the last snow flies.

Of course, the biggest single consideration in soil warming is the economics of the project, including both installation and operating costs. About 600 kw power capacity is needed to heat a football field at 10 w per square foot - comparable to the amount of power for a field lighting system. In fact, field lighting switchgear can also be used for warming systems. In small areas where less investment and more return per square foot of heated turf is possible, the relation between costs and returns is more favorable.

The system also must be protected from damage during the normal maintenance and repair of the turf area. System damage can result from shoveling or staking.

Agronomic Considerations

Turf heating offers several agronomic benefits which have not been previously mentioned. Rejuvenation of existing turf can be accelerated; new sod or new seedings can be stimulated.

Certain potential difficulties, of course,must be recognized. Bluegrass plants can be overstimulated when temperatures above 50F are maintained at 1 inch depth and thus become susceptible to frost injury in sudden severe cold. When surface temperatures are maintained just above freezing with little air circulation, particularly under snow cover, injury from snow mold is possible.

Investigations will continue on installation and management techniques, on control systems, on responses of various turfgrasses, and on methods of estimating power demands for specific applications under specific climatic conditions. Da'a to supplement findings at Purdue are being taken at USDA installations at Saint Paul, Minne-

sota, and at Beltsville, Maryland.

(Detailed information may be obtained by requesting Report No. F-841 from ASAE, 420 Main Street, St. Joseph, Michigan 49085, or Purdue AES Journal Paper No. 2705).

NATIONAL AND LOCAL BEAUTIFICATION

A. C. Hunt, Grounds Dept., Mead Johnson & Co.,
Evansville, Indiana

It is indeed a pleasure to speak before such a knowledgeable group and one, who through the years, has contributed immensely to the beautification of this great land of ours. As each of us develops his own small cubicle of landscape beauty, whether it be in business and industry, a city scape, a highway, a golf course, or his own private property, each is contributing to the fulfillment of the popular expression today - "Help Keep America Beautiful."

The Problem

Much of this great national community is burying itself with an avalanche of trash and litter, weeds, vermin, open dumps, junkyards, billboard jungles, garbage and rat infested alleys, stinking sewers, and the ominous cry of air pollution, stream pollution and earth pollution is becoming a shout heard 'round the world! The face of America is twisting into a grotesque profile, frowning back at us with an accusing finger.

I was reading the Evansville Sunday Courier and Press the other day and this caption caught my attention "90 Million Pounds Daily - That's Tri-State Garbage!" And, according to that article, this country "spends about 3 billion yearly to dispose of its solid waste, more than any other national expenditure except for schools and roads!" This solid waste includes old automobiles, left-over food, old refrigerators, stoves, etc., etc. And, of course, the problem is aparently compounding itself day by day!

I understand that under the provisions of the Federal Highway Beautification Act more than one million signs, 92% of all billboards along 265,000 miles of federal highways may get the ax. This will, no doubt, cost a wad of money - money spent to see what's behind and beyond the sign!

These are only a few of the problems - the real problem, I think, is the attitude of the people in a community, industry, local government, civic clubs, etc., etc. Maybe the word beautification is too nebulous. It certainly is a term that stimulates different interpretations and opinions. Perhaps the word improvement, or upgrading, might be a better one - these words have been suggested before. The upgrading of an area does not, I think, insure in most cases an improvement over whatever existed before.

Get Organized!

Perhaps the logical sequence for beautification, especially in large operations, is to mop up first, then beautify. Wherever the one stops and the other begins, the entire operation must begin by arousing public interest, through public relations, example and organization of civic-minded people. This year in Evansville

our Beautification Committee, through the Evansville Chamber of Commerce, has reorganized its course of action, represented by a chart showing the breakdown of all areas where upgrading and beautification of a community must be initiated.

We have tried to select people who have shown great civic interest and have attempted to place them as chairmen of the various groups. People who are closely related to the functioning of the subgroups have been located and asked to work in their respective positions of authority and interest to help make the community project successful. By close alliance with these groups and acting as a steering committee it is our hope that each group will choose at least one short- and one long-range objective that will upgrade our community and make it a better place to live.

Through television, radio, newspaper, and other effective means of communication we hope to arouse all members of our community from the deep sleep of what might be complacency and help them awaken to a more pleasant environment in which to work, play and live. We further hope, through the concentrated effort of all our citizens, to dispel, through example, some of the so-called intangible benefits enjoyed by the individual, industry and the community as a whole. And to prove that the motto of our beautification committee can mean what it says, "An Attractive City is a Prosperous City."

The Role of Industry

If we were to make a list of various groups and organizations according to their responsibility to the community, we would probably place industry near the top of the list. Industry can be a source of air pollution, water pollution and soil pollution. It can be a weed infested complex of drab, dirty and outdated buildings. It can have in its backyard, and sometimes in its front yard, piles of old discarded equipment, damaged materials and heaps of useless by-products. It can produce an atmosphere of drudgery for the employee and insult to the people of the community.

On the other hand industry can, with a great deal of pride and fewer dollars than sometimes expected, become a greater asset to the community by building a desirable image in the minds of the people who work for it, who live with it and the people who buy its products.

Not too many years back the expression "company image" germinated and grew into a necessary goal that many companies now accept as policy. There are many things that contribute to the "image" of industry, not one of the least being the visual appearance of their buildings and grounds.

For those of you who would see to it that your community is an attractive one, I might suggest that you begin by

1. Identifying your problems
2. Attach yourself to a stable organization -
   Local government
   Chamber of Commerce
   Civic Club
3. Swell your ranks with people from industry
   government, nurserymen, architects, engineers,
   garden club members, business men, and oh! yes,
   some people interested in turf!
4. Make a plan of action
5. Act.

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Note: In these days of fairway watering and upgrading, the introduction and establishment and protection of the desired grass is a challenge. Representative users of grasses were asked to tell their story - as review for others. -Ed.)

MY EXPERIENCE WITH BENT

Raymond Phillips, Former Supt., Louisville County Club
Louisville, Kentucky

The program at the Louisville County Club did not start out as a fairway program as such. The water pressure at the sixth green was so poor that it was necessary to install a new line. Being as we were going to tap a 6 inch main, I suggested we go through the sixth fairway and install a sprinkling system on our way to the green. After numerous committee meetings, it was decided not only to water No. 6 fairway, but also water the seventh fairway, which was parallel to 6, and to use them as test fairways, thus the beginning.

Late in the fall of 1963, after the dual-line automatic irrigation system was installed, both fairways were sprayed with sodium arsenite, aerified, sliced, dragged with a scotch harrow, fertilized and seeded. The sixth fairway was seeded with bent. Bluegrass was put into No. 7. The following spring they were fertilized again and Pre-san was applied at recommended rates.

Even though neither fairway was perfect, they both were considerably better in appearance and playability than others. In the fall board meeting it was decided to complete the irrigation system and renovate the remaining fairways. By the time the many meetings and paper work were completed, it was too late to do anything in the fall, but the irrigation system was completed early in the spring. This gave us another summer to evaluate the turf on the test fairways and decide what would be seeded in the fall.

The complete watering system was used very little for we did not feel that there was enough good turf on the fairways to justify a regular watering program. On Monday morning, August 16, the golf course was open as usual, but the fairways were closed. Anyone playing golf could hit into the fairways and then move the ball to the side and play from a 12 ft. strip that had been cut around each fairway.

We planned a scortch-earth program and our first operation was to spray all fairways with sodium arsenite at the rate of 24 lbs. per acre. By Wednesday afternoon all fairways were brown - we had a good kill. The next task was to peg and paint the 327 pop-up sprinklers throughout the course. We used a red luminous paint, and during all the activity that followed only three sprinklers were damaged.

The next week was used to prepare a good seedbed. Each fairway was aerified four times with a West Point going in a different direction or angle each time. We used the one-inch open spoon with the springs removed. After each aerification we would drag the fairways with the scotch-harrow and then slice them with the West Point Verti-Groove set at a 2 inch depth. When the seedbed was ready we applied 500 lbs. of 10-10-10 per acre and watered it in.

Following the Labor Day weekend we were ready for seed. Due to the cost of bent seed it was decided to use a combination mixture consisting of 40% Common, 20% Newport and 15% Delta bluegrasses, and 9% Penncross bent, 9% Colonial and 7% Highland bentgrasses. This mixture was seeded at the rate of 100 lbs. per acre, and if you consider there are 7½ million bent seeds and 2½ million bluegrass seeds

per pound, you will see they were seeded in equal amounts per acre. It was felt that with the watering program and the short height of cut, that the bent would predominate. When the seeding was complete each fairway was dragged with the scotch-harrow, sliced with the Verti-Groove set at a shallow depth, and rolled. As soon as the fairways were rolled we applied another application of sodium arsenite at the rate of 14 lbs. per acre. This was done to eliminate any growth that had begun since our first application, and also to increase our arsenic toxicity in the soil.

The automatic watering system was set for 5 minutes every 55 minutes during the daylight hours and activated Friday afternoon, September 10. The next day was cloudy with light drizzle and the system was shut off. Early Sunday morning 2.75 inches of rain fell and I didn't care whether I saw the course or not. Fortunately the aerifying and verti-grooving allowed practically all the rain to be absorbed and there were very few washes. On Tuesday morning you could look across the fairways and see the dew - the grass was up. The next two days we had 2.5 inches more of rain, which did cause trouble. On Monday all areas that had washed were reworked, reseeded, and covered with Famco Mat.

On October 1 we started a regular fairway mowing program with the mowers set at 5/8 inch height of cut. Following a week of mowing, we applied Milorganite at the rate of 800 lbs. per acre, and continued mowing and light watering as needed.

After being closed eleven weeks, the fairways were opened for play the first weekend in November. They had been closed longer than originally planned, but there were two reasons for this. First, we had a little over ten inches of rain since the middle of September, and second, the greens chairman, who had started the program, had since been elected president of the club and he did not want the fairways opened for play until he felt they were ready.

The following spring the fairways were rolled and again fertilized with Milorganite at the rate of 1200 lbs. per acre. The first week in April all fairways, except No. 11, were treated with Dacthal at the rate of 14 pounds active per acre. The eleventh fairway, which consisted of one acre, was put on a Chip-Cal program. The situation looked very good until the 90 and 95° temperature hit us in June. The Poa annua, which was less than 20%, began to go. We made no attempt to syringe or save the Poa - we let it go, and as a result had some thin areas and even some totally bare areas. I say bare areas because both the Dacthal and Chip-Cal did an excellent job of crabgrass control.

In the third week of July all fairways were fertilized with 12-4-8 at the rate of 200 lbs. per acre, and during the first week in August the thin and bare areas were verti-grooved and reseeded. By Labor Day they were looking good again. The second week in October we applied another 400 lbs. of 12-4-8 per acre, plus 600 lbs. of Milorganite per acre.

Due to the long range cost, ease of handling, and the good results with No.11 fairway, it was decided to put all fairways on the Chip-Cal program. This plan was started in October when we applied 200 lbs. per acre. The schedule calls for another 200 lbs. in late March or early April, and another 200 lbs. during the first half of May.

Regardless of what my good friend Jim Holmes says, I feel that with the products and equipment that we have today, linked with good management program and an ample budget, we can have good bent fairways.

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MY EXPERIENCES WITH BERMUDA

Robert V. Mitchell, Supt., Sunset C. Club,
St. Louis, Missouri

In 1950, my career as golf course superintendent started on a nine-hole public golf course owned by the City of Alton, Illinois. I endeavored to rebuild the tees, using U-3 Bermudagrass. This was the only type grass at that time that would withstand the heat of the summer, the traffic of the golfers, and the low-cut demanded by the good players. I noticed, too, that it would perform fairly well with limited funds and attention as compared to bluegrass.

The next eight years my work with U-3 Bermuda was limited to tees, banks, a few collars and the planting of four softball fields - both infield and outfield. During this same time we used some common Bermuda seed on various areas and found it to develop into good turf, but would not withstand the winters. Even the U-3 Bermuda lost ground some winters.

During these same eight years the golfer's constant demand for better, more playable turf meant a closer cut on fairways, which caused the loss of bluegrass. Westwood Country Club was probably the first club to change from bluegrass to Bermuda; St. Louis Country Club was soon to follow. All new country club installations planted U-3 Bermuda on fairways and tees. It was the best grass we had for this turf area - tolerated close mowing, fairly drouth resistant, caused the ball to set up nice and allowed for a well-played golf shot, and wintered reasonably well.

I began my duties at Sunset Country Club, St. Louis, Missouri, in November 1959. Our plan was to improve greens, rebuilding some each year, work on tees,but primarily to "get some decent fairways." You didn't have to wonder why this project was most important after viewing the course. Fairways consisted of a little bent, and some bluegrass, a little common Bermuda, and a lot of goosegrass and crabgrass.

The Greens Committee adopted my suggestions, which consisted of a 5-year venture; planting (by contract) U-3 stolons into slits in the ground on 20 inch centers. With our portable irrigation pipe we could water about 5 acres at a time, and needing to cover the same area again so quickly, I opined that ten acres per year was the maximum amount we could plant. Thus, it would take three years to finish the planting and two years for the third year phnting to cover. The contractor planted our fairways starting in June 1959, and we watered, fertilized to encourage its growth, and sprayed to keep the weeds down. By fall I estimated we had 50% coverage, but the committee did not agree, and needless to say were not happy with the results.

That winter we re-evaluated our program and decided that we would try to stolonize some fairways in 1960, much the same as one would a green or a tee. Thus in 1960 we cut stolons from our own nursery, and planted 5 acres. Our program: spray with sodium arsenite 2 or 3 times in two weeks around the first of June, to kill all vegetation; aerify 10-12 times over so ground was completely loose but would not wash away with a thundershower; cut stolons from nursery; spread with a manure spreader; aerify one time, hoping to cover some stolons with dirt; run over with seed drill to press runners in ground, and at the same time apply 15 lbs. of Bermuda per acre; roll and water. This system worked very well. By leaving pipes on the planted area we could shower the stolons every day from 12 to 1, and make it wet enough so golfers would not walk on the area. In 4-6 weeks we had a very good playing surface. Members could see what we had done and were very happy.

In 1961 we planted another 5 acres, in 1962 we planted 5 acres the second week in June, and the last 5 acres in August. We were cutting our fairways 5 days per week at 1/2 inch, and by September, 1962, they were beautiful. The members were proud of them and in my opinion they were second to none.

I feel the "stolonizing method' is far superior to the "slit-trench method" of planting because -

1. Playable turf faster.
2. Cheaper
3. Less sprayings needed for weeds.
4. Less interference with golfers --

when you consider that it takes two years for the slit-trench method to cover. I might mention that planting common Bermuda seed with the stolons helped give a playable turf faster and had no deterrent effect on the U-3. Most of it froze out the first winter, allowing the U-3 space to grow and recover, and the small amount that did not freeze out makes as good a turf as U-3 Bermuda.

From weeds in 1959 to a beautiful covering of U-3 Bermuda by September, 1962 - 4 years - one year ahead of schedule! Then the very cold winter of 1962-63, with almost no snow cover, took its toll -- all of the clubs lost U-3, and Sunset was no exception. Fortunately we were cognizant of the limitations of U-3 Bermuda and had selected one Bermuda from our No. 10 fairway, hence the name Sunset 10-F, and had developed a nursery of it, and planted some of it on the course. We had started a nursery of Meyer zoysia, and in 1963 started a nursery of Midwest zoysia. Many courses replanted, some seeded, some used Zoysias, some plugged, and some strip-sodded. We tried some of all the above to make our course more playable.

Many courses had evidence of spring dead spot, but we didn't notice any at Sunset until 1964 - 4 years after the affected area's planting date. We tried many different things - various kinds and amounts of fertilizers, various methods of renovation, different grasses, and Mallinckrodt used a fungicide trying to reduce the amount of spring dead spot. In September 1964, I planted 4-inch plugs of Sunset 10-F into centers of 24 dead spots on one fairway. They all lived and filled out the dead spot area in 1965, and are all alive today. This shows promise; in fact, I'm optimistic about this Sunset 10-F Bermuda because through the years it has increased in size, even in competition with U-3, and has never shown any evidence of either winter-killing or spring dead spot. The Zoysias have also shown no damage. This is also true of several other strains of Bermudas from other courses in the area that are part of Mississippi Valley U.S.A. turf program.

I am convinced that Bermuda fairways are the best playing surfaces we have today for golf - convinced also that there must be a better strain than U-3. We are constantly trying to find it, and while looking for it we are continually finding new and better ways to replant the damage from the winters, diseases, and traffic problems of golfers (especially during the winter months). We are trying, also, to find some method of bringing the U-3 we have through the winter in better condition. I have applied varying rates of potash to fairways last fall; am applying Milorganite to one strip each month for the six winter months. Others are trying other things.

Some of us are concerned about Poa annua infestation in Bermuda grasses. Seemed like a few years ago the sun and heat, also close cutting, took care of the Poa for us by June. Now the cold, wet springs we have had the past few years have kept Poa around to July 4. This naturally cuts down on the growing time for Bermudas. Therefore, some of us are trying different pre-emergents to erradicate this

annual pest. However, my tests at Sunset are few and scattered because I am not so sure in my mind, and no one will argue the point, that the extra protection of the Poa coverage during the winter months brings more Bermuda through the winter. Perhaps we will know more this spring, but I'm realistic enough to know that just because something shows promise one year doesn't mean that it will the next, and vice versa.

We know, also, that golfers have changed -- where once they tolerated stoloniferous type planting with watering during the day -- now they don't want to be inconvenienced. Therefore, we have decided to revert to the slit-trench method of planting stolons during 1967. We intend to replant all areas not now covered - they range in size from several hundred to several thousand square feet. These areas will be replanted with Sunset 10-F rather than U-3.

If I have learned one thing in my experience with Bermudas, it is that one cannot be complacent after establishment. A good turf one year may not be that the next. It is obvious to me that good Turf Managers the country over are doing the same thing -- developing new management techniques, seeking new grasses to make their courses the best possible. Unfortunately, some of our methods must be by trial and error. This, we conclude, takes time and careful observations.

I would like to close with this poem written by Ben Burroughs -

"Never Stop Trying"

I regard most highly .... the man who keeps trying
the guy who can smile .... when his high hopes are dying
the man who can weather .... the storms that beat round him
the gent who can whistle ... when bad luck has found him
I look up to him ... who can fight when he's losing
and then forge a winner .... a kind of his choosing
to him who comes back .... when he's lost to another
is really a great man ... and truly a brother
I reach out to help him .... who gives no excuses
but works all the harder .... to quell life's abuses
to him go the laurels .... regardless of outcome
for he deserves credit .... yes, credit and then some
so when you are beat .... be a man, stop your crying
and you'll be the victor .... if you will keep trying.

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FROM POA ANNUA TO BLUEGRASS

Charles H. Tadge, Supt., Mayfield C. C.,
Cleveland, Ohio

Most golf course superintendents are convinced that the elimination of Poa annua is essential for continuous high quality turf maintenance. The questions which arise in addition to how to eliminate the Poa are: how to replace it with desirable turf; how to do this with little interference to the golfer; how is this to be done without spending a fortune; and how to sell the members on the whole idea.

The first step in any major fairway renovation program is selling the program to the Board of Trustees, or the membership itself. Some superintendents may have no trouble selling such a program, but I feel most have the same problems I had. The golfers thought the turf was fine until about July or August when the Poa began to fade. This is the time to sell a fairway renovation program, but you must be quick. If the discussions drag into September or October the fairways are recovering with a new crop of Poa, and the club member can see no need to tear up the turf and spend all that money.

How can you sell such a program in the short period usually allotted by Mother Nature? If a course nearby has successfully completed such a program, you could take committee or board members on an inspection tour. We did not have this opportunity, but probably had something better.

At Miami Valley Golf Club in Dayton we put test plots of pre-emergence materials in one of our worst fairways in 1960. When the fairway Poa annua turf became very poor in the summer of 1964, we had some very good examples of what could be expected from a Poa annua control program. The plots containing arsenicals had shown good results for several years. Most important, these examples were on our own fairways for the entire membership to observe. As an added selling aid, we brought in two outside experts who met with members of the Board to confirm our ideas with their own experiences and observations. The men called upon were Dr. W. H. Daniel of Purdue University, and James L. Holmes, U.S.G.A. Green Section Agronomist.

The next big hurdle was to decide what kind of turfgrass should replace the Poa annua. We decided that bluegrass would best fit our ecological conditions, maintenance budget and the desires of our golf playing members. We knew from the test plots that bluegrass would make a tight turf, which golfers found desirable when mowed at one inch. For several years bentgrass had been seeded into the fairways including the test plots, but the turf was still predominantly bluegrass in these plots and Poa annua otherwise.

So, on August 31, 1964, after vertical slitting, we overseeded the fairways with 68 lbs. bluegrass blend per acre. Seed and fertilizer were incorporated with a chain link fence drag. At the start the fairway turf was about 70% Poa annua, crabgrass and knotweed; the other 30% being bluegrass and bentgrass. Almost no broadleaf weeds were present. As soon as seedlings were up to mowing height, calcium arsenate applications were started. Three applications totaling 4 lbs. per 1,000 sq.ft. were made between October 2 and October 26, 1964. Light watering followed each application.

The following spring a total of 5 lbs. per 1,000 were applied in four applications from April 20 through May 30. The first three applications were not watered in. Where showers did not follow immediately the burning effect on the Poa annua was beneficial. Permanent grasses showed discoloration for about two weeks.

On August 23, 1965, we overseeded again with 68 lbs. bluegrass blend per acre, using same procedure as in 1964. From October 25 through November 29, 1965, three applications totaling 4.8 lbs. calcium arsenate per 1,000 were made. This totals 22 lbs. per 1,000 sq.ft.

It was assumed that 10 to 12 lbs. calcium arsenate per 1,000 would bring us to a toxic level. Evidence of ample toxicity to Poa annua had shown up in the spring of 1965. It was now estimated that 2 to 2.5 lbs. calcium arsenate per 1,000 applied spring and fall would maintain this toxicity.

From April 20 through May 1, 1966, 2.4 lbs. calcium arsenate per 1,000 were applied. On May 20, 1966, we sprayed 0.5 lbs. Banvel-D per acre to kill the small amount of knotweed showing. In August, 1966, the fairways were again overseeded with 63 lbs. bluegrass blend per acre. From October 24 through November 22, 1966, 2.5 lbs. of calcium arsenate per 1,000 sq.ft. were applied. In September, 1966, we estimated Poa annua to be only 10% of our fairway turf. Crabgrass control was good for both seasons. Goosegrass control was fair the first year and good the second year.

Timing for the spring applications of calcium arsenate we feel should be between April 1 and May 10, for control of Poa annua as well as crabgrass. Timing for the fall application should be as soon after seeding as possible, but delayed long enough that seedlings will not be injured. We felt that the month of October best fitted our conditions.

Material used was 85% tri-calcium arsenate in powder form. This was sprayed with a 10 gpm. pump through a boom mounted on the front of a tractor. Solution rate varied from 1 lb. to 1.4 lbs. per gallon of water. Although not serious, some trouble was encountered with screen and nozzle clogging. We felt that the several light spray applications gave us better uniformity of distribution. Also, the arsenic effect on the leaf surface was extended over a longer period. In future years if no seeding were planned, the calcium arsenate might best be applied in late August or early September to get the jump on the Poa annua germination. Watering should follow applications at this time to keep discoloration at a minimum.

Our late August seeding, instead of the customary early September seeding, might have been a key factor in the success of our program. Seed mixture used was 35% Merion, 20% Delta, 20% Newport, 15% Windsor and 10% Common Kentucky bluegrass. Mowing height was held at one inch during the entire program.

Fertility with an arsenic program is very important. Phosphorus must be kept low for the arsenic to show results. In the three years prior to starting the arsenic program the average applied was 4.3 lbs. N, 1.2 lbs. P_2O_5 per 1,000 per season. During the program the average applied was over 6 lbs. N, and 1.2 lbs. P_2O_5 per 1,000. Potash applied was about one-half the nitrogen. Soil tests showed slight acidity with available phosphate in the medium to high range.

Water management is another very important factor in Poa annua control. After our new seedlings were established we did not water until the desirable bluegrass showed stress. Natually by this time the Poa annua was dying rapidly, but this was what we wanted.

This brings up another point in the selling program to the members. Unless the club can afford to resod the fairways, there will be some inconvenience to the golfers. They will have to understand that for one or two seasons the turf is going to be thin as the Poa annua fades out and before the desired turf fills in. The water system will not be used just to see it operate, or to keep the ground soft to walk on. Many of the high handicap golfers will really enjoy the extra distance they get from drives during the summer months.

The areas which have given us the most difficulty were poorly drained. These areas, if known, should be drained prior to the start of an arsenic program. Drainage was installed in several of our worst areas during the fall of 1966. I think there are two factors working against the turf here. The arsenic may act much faster in wet conditions, thus injuring the desirable grasses as well as the Poa annua, and then be dissipated so that the Poa annua can return. Also, during a drouth period these areas may not come under much stress between irrigations,

thereby allowing the Poa annua to hang on.

During our program we also made several fungicide applications using different materials and leaving some fairways untreated for checks. No significant improvements were observed in comparison of materials to the check areas. Disease incidence to date has not been severe enough to cause concern.

In conclusion, I would say that this program worked under conditions existing at the Miami Valley Golf Club in Dayton, Ohio, but if one of two factors were to be changed it might not work at all. I would advise spot testing before jumping into anything full scale. This is exactly what I will be doing in my present position with the Mayfield Country Club.

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USING HERBICIDES

Donald A. Clemans, Supt., Orchard Lake C. C.,
Orchard Lake, Michigan

Before you can intelligently use any herbicide you must be able to recognize the undesirable broadleaf weeds and grasses from the desirable turfgrass species. A reference guide that I use is a booklet entitled, "Weeds of the North Central States" (North Central Publication No. 36 available at any A.E.S. at 75¢ a copy).

Next would come the knowledge of the various methods of applying a material to eliminate the weeds or weedy grasses. Spraying water soluble and water emulsifiable materials is probably the most common method used in applying herbicides. Using a spray boom gives the best uniform distribution of a material as compared to a hand sprayer, plus being able to cover large areas with greater ease and speed.

To use a spray boom you need a large tank to carry the water-herbicide mixture, a pump to deliver the material at a steady rate to the spray nozzles, and a tractor that will travel at a constant speed so that you can apply the material at a constant rate per ground area covered. Probably 25 gallons of mixture per acre should be considered as a minimum amount of mixture, to assure adequate wetting of the leaf of the undesirable plant. A wetting agent and/or a spreader sticker should be used with this small amount of water, since it is less than 1/2 gallon of mixture per 1,000 sq.ft.

Spray pressure should be kept at near 60 psi. Excessive pressure produces very fine droplets that freely drift with the air currents and may be blown for miles. Very small droplets have been knownto drift for miles in a strong wind and may damage plants other than the ones you have intentionally sprayed. A nylon roller pump, run by the power take-off of the tractor, does an excellent job of delivering spray material through a boom spray.

Calibrating your spray rig is of the utmost importance. Do not rely on a table furnished by a nozzle company until it has been verified by an actual test run with a known amount of spray material over a known area. Doing this one test may save you from damaging your desirable turf. Be aware of just what desirable species of grass exists in your turf. A mixture of bluegrass and bent, or bluegrass and creeping fescue will not tolerate the same amount of herbicide that blue-

grass alone will withstand. Be sure your herbicide mixture does not kill your weeds and one of the species of desirable turf as well. If you have a broadleaf weed problem and a weedy grass problem, you may be able to eliminate both with one spray application. But, first check with the herbicide companies to make sure both materials are compatible. Some herbicides work slowly, so be sure to allow enough time to elapse before evaluating your success in eliminating the weed.

Keep a constant watch when spraying with a boom for plugged nozzles, as plugged nozzles give streaked results. Do not stop your forward motion while the boom is spraying, or allow the boom to drip in one spot as concentrations of an herbicide mean dead grass in that spot.

Herbicides can also be used for aquatic weed and algae control. Be constantly aware of the fish in the pond or in the stream in which the pond overflows. Keep the material in the water and don't allow your spray to touch the grass bank as it may mean death to the grass on the pond or stream banks.

Many materials are available in a granulated form that can be spread by various dry spreaders. Be careful of inhaling the dust and be aware of the aforementioned cautions. Herbicides can be used safely and should be used with caution and according to directions.

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WATER AND AIR IN THE SOIL

Dr. Daniel Wiersma, Dept. of Agronomy
Purdue University

It is hoped that a few basic principles can be brought out which will serve as background for the subsequent papers on irrigation. We will limit our definition as the materials which provide the physical medium for plant growth.

Soils are the physical medium for plant growth - turf people may recognize this as the rootzone. Many of you have had experience in the construction of golf greens or football fields of taking materials and mixing them in definite proportion hopefully providing the condition for best turf growth.

Soil is made up of particles varying in size and shape - from the very fine clays to the coarse sands - and they are randomly arranged which form voids or pore spaces. The smaller the particle size the smaller the pores. Thus a soil or soil mix is composed of solid materials and voids. Soils vary - for instance, sands may have only 35% of its total volume as voids, while clays will have more than 50%. Remember, the sands have larger pores than the clays.

Consideration has only been given thus far to the single grain particle arrangement. However, with soils of the finer textures, namely silts and clays, sticky substances or forces frequently hold particles together to form clumps.

Why are we so interested in the arrangement and size of these pores? This is the space in the soil which is occupied by either air or water, both essential to the plant root. The living cells in the plant root must have oxygen from the soil for respiration, and also in the process of respiration give off carbon dioxide. To maintain an oxygen supply, there must be some exchange between the air in

the atmosphere and that in the soil. If the pores are almost filled with water this exchange is slowed to the extent the root cells will suffocate and die. If oxygen is lacking for the roots, the uptake of water and nutrients is slowed down.

Directing our attention briefly to the water in the pores, the water is held to the surfaces of the soil particles by capillary attraction and other forces. The water immediately next to the particle surface is held very tightly and proceeding away from the surface with less and less force. After water has been added to the soil, either by rainfall or irrigation and provided there is good drainage, the water will flow through the soil until the particle force attracting the water will equal the forces of gravity. This is called field capacity.

What is the ideal porosity relationship? Enough small pores to hold water for the plant and enough large pores to provide the aeration. This can be accomplished by a well aggregated soil, that is, the small pores for water retention inside the aggregates and large pores for drainage and aeration. In the case of sands, there is practically no aggregation, and the large particles provide the large pores for aeration. If irrigation is available, the low water holding capacity of sands can be overcome.

To prescribe an ideal soil for water and air would be in the range of 50 percent of the total volume as pore space, and after drainage 50 percent of the total pore space is air and the other 50 water. This could be possible in a well aggregated silt loam soil.

Aggregation as we have been using the term is commonly referred to as soil structure. The structure has several forms which can be described as single grained, granular, blocky, prismatic, massive, or dense and layered.

Approximate Available Moisture Holding Capacity

Soil Texture	Available Water (Inches per foot)	By volume %
Sandy	0.7	6
Sandy loam	1.3	11
Loam	1.8	15
Silt loam	2.2	18
Clay loam	1.9	15
Clay	1.8	15

It is the problem, therefore, of the soil scientists, plant physiologist, the engineer, the turf manager, or whomever is interested in providing and maintaining the optimum soil conditions for growth to understand these delicate relationships of air-water and plants.

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AUTOMATIC IRRIGATION CONTROLS

Robert Rupar, Sales, Rainy Sprinkler Sales,
Peoria, Illinois

The "Control System" of today's typical automatic irrigation installations consists of three components (exclusive of the pump controls) -

1. The Automatic controller, which starts the sprinkling cycle at any pre-determined time.
2. The remote control valves which control the flow of water to the sprinkler head or heads.
3. The control wire or tubing connecting the valves to the controller.

Let's look at what the control system is capable of doing and what this capability means to the Turf Manager.

Because control of the complete watering program is put into the hands of the Turf Manager, not in the hands of inexperienced or incompetent labor, the automatic system is usually more efficient than a manual operation. Putting no more than the right amount of water on at the right time means savings in pumping plant and water costs, and elimination of overwatering, which causes loss of nutrients by deep percolation, choking out of essential air, creation of a disease environment and favors compaction and drainage problems.

Because of today's lack of good available labor, the automatic system has increasing appeal. Although automation does not completely eliminate labor, it does reduce the labor requirement and probably more importantly changes the type of labor required.

Flexibility then becomes a key factor in a good watering program and, of course, this is where the automatic system becomes very attractive. Virtually any type of watering cycle can be programmed from light and frequent to heavy and infrequent watering, or anything inbetween, depending upon rainfall, soil type or temperature, and whether you are irrigating new seeding or established turf. It is, for example, a physical impossibility to water a new fairway seeding on a very light and frequent basis with a manual system (perhaps 10 minutes on and repeat every hour) but quite simple with an automatic system. Push button syringing is also a convenient advantage of the automatic system.

Of course, the system design dictates its flexibility and efficiency. A good designer will take advantage of the automatic capabilities to make the system more economically feasible. For example, a longer watering period can usually be utilized with the automatic system, which means that fewer gallons per minute are required to cover a given area resulting in a lower pump capacity and lesser pumping costs. Pipe sizes can also be reduced for the same reason, and also because the designer can predict more exactly what the flow pattern will be than he can with a manual system.

Before buying an automatic system acquaint yourself with some of the basic design considerations since they dictate the degree of flexibility and the ultimate cost of the system. A few of the major considerations might be:

1. The number of control valves used at each green.
2. The number of fairway heads to run off each control valve.
3. The number of valves to run on each station of the controller.
4. The number of stations to use on each controller.
5. Scattered or centralized controller locations.
6. The number of hours to allow for the watering cycle.
7. The amount of water to apply during the peak moisture requirement weeks.
8. Double or single row fairway coverage.

In summary, automatic irrigation controls can mean a flexible, efficient and reliable irrigation operation, while eliminating many of the objections to the manual system.

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REGULATING IRRIGATION WATER HYDRAULIC & AIR VALVES

Don Wright, Supt., The Camargo Club,
Cincinnati, Ohio

Remote control valves are described as the heart of an irrigation system because they act on command of the controller, to turn the flow of water to the sprinkler head on and off. The way in which they perform their duty varies widely, but for the sake of simplicity they are divided into normally open and the normally closed types, and either the diaphram or piston types. The first description refers to the way in which the valve is controlled and the second group refers to the method in which the valve acts. A normally open valve needs an external force to close it and keep it closed, whereas a normally closed valve needs an external force to open it and keep it open. What specifically is meant by normally open or normally closed is what position the valve will take if attached to a "hot" line with no external connections. If the water flows through the valve it is of the normally open type, and if the valve obstructs the flow of water it is of the normally closed type.

The diaphragm type of valve has a diaphragm which collapses to allow the water to flow around it and on through the valve, and returns it to its original shape to stop the flow of water. The piston type valve allows water to flow or halts it because of the position of the piston in a cylinder, whichbecomes the water passage of the valve.

The normally open type valve is considered the best by the irrigation companies because it has a type of automatic alarm. When the control tubing, which activates it and shuts it down is damaged, the sprinklers come on. This enables the superintendent to immediately realize he has injured a control tube in the system and he can repair the damage done before the turf is damaged. The normally closed type valve, however, shows no signs of injury if its control tubing is damaged and, if the sprinkler cycle is set to run during the night hours, the damage to the system may not be noticed until the turf is damaged. The repair of the system is difficult because there is no indication of where or when the system was damaged.

Until recently the materials used in piston valves were far more susceptible to malfunctions such as seizing and leakage. Because the piston rides up and down on the walls of the cylinders, materials had to be both flexible enough and strong enough to prevent leakage due to wear of the piston edge or cylinder wall. New plastic materials are overcoming the problems of piston type valves. Older conventional materials are not satisfactory and piston valves using these materials should be avoided.

In closing, a word about control tubing. There are basically four (4) types: polyethylene, P.V.C., copper and A.B.S., with the first two being the most commonly used. The use of nylon and rubber control tubing has been attempted, but due to their high cost and difficulty in handling they have not been accepted.

Copper tubing has its drawbacks of economy and maintenance. When copper tubing freezes it expands, and if pin-hole leaks develop due to continual freezing and thawing, the tubing is larger than standard size, and standard fittings cannot be used to patch and repair it. P.V.C. and A.B.S., because of being basically semi-rigid, are difficult to handle and tend to split when they freeze when full of water. Polyethylene has the ability to expand without harm and contract to its original size when the water inside it is subject to freezing and thawing weather.

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SEQUA-MATIC CONTROL VALVES - EVALUATION AND OPERATION

Robert G. Johnson, Illinois Lawn Equipment, Inc.,
Chicago, Illinois

The Sequa-Matic Valve is probably one of the least known methods of controlling water in the irrigation field. I have been working with this Valve, which was designed by the John Bean Company, Division of Food Machinery, San Jose, California, since it was first introduced on the market about eight years ago. At that time I purchased enough for a one-acre solid-set and together with my engineer ran tests on the operation and practical application of this Valve on turfgrass plots at one of our large Chicago-land sod nurseries.

After considerable experimentation, we recognized that mechanically we had a good functioning valve. However, its practical application for our customer's needs in the Midwest was at that time unrecognized. We proceeded to use this system in various places to evaluate the dependability of the fifteen valves involved in our system.

As many of you know, there are many areas of the country where irrigation is absolutely essential for crop growth, and since most of these areas have an ideal climate almost year around, the investment in irrigation is justified. Therefore, we traveled to such an area - California - to investigate large acreage users of this particular system and we were pleased to find that in the first few years of operation the reports indicated that this low-cost, extremely simple method was practical on potatoes, lettuce, beans and other crops that accurate irrigation water control was important. However, we did not find it in use on turfgrass until some years later. It was almost exclusively used in the sod fields in the Denver area.

After careful evaluation of our findings, we felt that the Valve was ready for recommendation by our conservative Company to our customers, who are working in a highly competitive market. After additional cost per acre analysis and comparing it with other methods of sod field solid-set irrigation, we felt there were many advantages in manpower saving to additionally justify its recommendation on our part. Much to our surprise we found we were very competitive in cost per acre with existing 2" solid-set systems on a forty-acre field.

In 1966 a forty-acre system was installed at the Marengo operation of the H & E Sod Nursery. I am pleased to state that the function of the Sequa-Matic Valve was 100% mechanically perfect. The only difficulty being in the master valve that controlled the main line, which has since been overcome.

There are three varieties presently in use of the Sequa-Matic Valve. Sequa-Matic being a patented name of the Shur Rane Division of Food Machinery Corporation. The significant difference between this Valve and all other present day control valves is there are no wires, tubes or any other external signaling or actuating devices necessary. All the Sequa-Matic Valves operate entirely on the signal by the varying of water pressure used to do the irrigating.

The most common and oldest is the aluminum 4 to 15 gallon per minute aluminum above-ground, which operates on a pressure of from 40, minimum, to 80, maximum, per square inch of irrigation water. The Valve consists of an inlet and an outlet with "O" ring seal that accepts a latch assembly from a 1-1/4" pipe. The Valve is normally mounted on a steel base 8" wide x 15" long, with the riser of approximately 6" to 1' coming out the top with the sprinkler at the end of the riser.

Internally you will find a rubber ball approximately 1" in diameter and a live rubber stem connnecting it to a bellows filled with a non-freezable liquid. The bellows is separated by a steel disc, which has a small orifice and a spring holding approximately 20 lbs. of pressure against the fluid on the water side of the orifice.

When water is pumped through the lateral line to the valve and sprinkler, the rubber ball is forced against the outlet side of the valve, thereby directing the flow up the riser and out the sprinkler. After the water pressure, which has to be of 40 lbs. or greater, has been operating for 5 minutes approximately, or more, the bellows have been forced to push the liquid to the other side of the metal plate, through the small orifice, overcoming the spring pressure and stretching the live rubber cord attached to the 1" ball.

The ball will remain against the outlet side of the valve until such time as the water pressure is reduced or shut off. At this point the rubber connector pulls the ball away from the outlet side of the valve, thus sealing off the riser and the sprinkler. As the pressure comes on again after its interruption of from 10 to 20 seconds, the liquid has not had time to again come through the orifice and allowing the ball to cover the outlet. Therefore, the water passes on through the valve to the next valve where exactly the same sequence happens all over again.

The other two models of the Sequa-Matic Valve include a clear plastic valve, which is a model for the under-ground, which incidentally will not crack under freezing conditions. This Valve operates txactly the same way as the previously described valves. However, its operating range is 30 to 70 lbs. per square inch of irrigation water and will handle from 5 to 20 gallons per minute. It is made of Cycolac plastic with a 1" inlet and a 1" outlet pipe connection, and a 3/4" pipe connection sprinkler outlet. We have used this valve successfully on many underground installations. Again, there are no wires or hydraulic lines connected to this valve for operation.

The third valve is new to the line and is called the V-2. It is primarily designed for crop applications under solid-test conditions. It has a length of 2" pipe pressed on one end anywhere from 20 to 40 ft. long, and the other end accepts the standard 2" male coupling. It is, ineffect, two of the smaller valves in series which gives us a capacity of from 10 to 50 gallons per minute through the sprinkler and requires operating pressure from 55 to 80 lbs. per square inch. It can handle a riser to the height of 17 feet for crops such as sugar cane, corn, etc.

These are the three valves presently in use, the application of which varies only with good hydraulic engineering practices and one's needs. The big advantage of the Sequa-Matic Valve, outside of its very low cost for an automatic system, is the fact that a minimum amount of water is required, and the valving and plumbing can be so arranged that watering can be on a twenty-four hour basis, which permits a limited water supply, yet excellent results can be achieved. The underground turf valve, to my knowledge, has not been used in a golf course application to date. This is only because of its more gallonage capacity. However, it has been installed in some large industrial plant applications with very satisfactory results.

To help you understand the operation of this concept, I will illustrate a typical 40-acre sod field installation. There are 968 of the above-ground Sequa-Matic Valves used, each one operating a $7\frac{1}{2}$ gallon per minute single nozzle sprinkler. The sprinklers are spaced 30 feet apart down the lateral and the laterals are spaced 60 feet apart on the main.

Now the reason that I have spent this time building up to this point is to help you understand how a unit can operate without any wire, hydraulic lines or any outside sensing source of any nature. This valve operates entirely on a changing of water pressure that is used to do the irrigating itself. In the case of a typical 40-acre field, we would have 44 laterals - 22 on each side of the main at right angles. There are, therefore, 44 sprinklers watering simultaneously.

On new sod seeding frequent applications, depending on wind and soil condition, are desirable. We would have the timer close valve "A" for a period of 15 to 20 seconds. The individual valves will continue to shut themselves off in sequence, controlled only by main valve at "A" until the system comes to the end of the field. Then, the valve at "A" has to remain closed for a period of 20 minutes to allow all of the Sequa-Matic Valves to reset themselves. At that time, the entire sequence can start over again whenever scheduled.

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RADIO CONTROL OF SPRINKLER IRRIGATION SYSTEMS

A. J. Miller, A. J. Miller, Inc.
Royal Oak, Michigan

Completely automatic control of sprinkler irrigation systems has been a reality for more than thirty years and, during that time, the equipment has become less complicated resulting in much greater reliability and a cost decrease over the years. Emphasis lately has been placed on greater flexibility of operation together with simplifying the installation. Radio control of irrigation systems has sounded to many like the answer and recently a product has been put on the market that accomplishes this.

The basic concept still requires an automatic valve controlling each zone, or on golf courses the conventional valve under every head for fairways. These valves are connected by wire or hydraulic tube to a combination receiver-controller which is usually located between a pair of fairways. Power must run from a source to these controllers which operate the valves. As you can see, the above installation is similar to the conventional automatic. However, many thousands of feet of wire or hydraulic tube are saved by not running all the control lines to a central location such as a maintenance building.

Operation of the system is through a central magnetic tape programmer, located in the maintenance building, which controls the valves by radio, through the satellite receivers adjacent to the fairways. Flexibility of program is almost unlimited since any variety of magnetic tapes may be pre-recorded to handle the variety of watering needs. A by-product of this type installation is that two-way voice communication is available throughout the course.

The Central Radio Programmer can be set to start and stop pumps of other equipment. In addition to the Central Programmer in the maintenance building, a hand held unit, similar to a walkie-talkie, can be carried around the course which can instantly turn on any valve at any time for testing or syringing.

The advantage of the radio control system is that it eliminates much of the wire necessary for a central control location and yet gives the flexibility of remote operation from any spot on the course. As the power required to operate the automatic valves becomes lower through technological advances, then wire size or tube size from the satellites to the valves can be smaller. This will, in turn, reduce the cost of the installation.

As yet no method has been developed to power the valves via radio waves, but this might be available in the future. Sonar, i.e., transmission of the controlling energy through the water in the pipe has been tried, but the energy is dissipated in a short distance and, therefore, not applicable to a golf course.

It would seem that radio control of an irrigation system on an existing course to be converted to automatic would be particularly beneficial, since much of the wire and wire trenching would be eliminated.

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MANUAL VALVES FOR SPRINKLER IRRIGATION

A. J. Miller

Since manual control valves have been used for many years, there are really no new startling developments in this field as far as control of irrigation water is concerned. Generally in the 3" and larger sizes, AWWA approved gate valves should be used. These are designed for underground water main applications and are ideal for irrigation systems. They afford positive shutoff and are generally the lowest priced of good quality gate valves.

In the 2" and smaller size it is important to use a full ported valve, i.e., one that will handle the full flow that you expect in the pipe line. If this valve is to be used for positive shutoff, then it should be of a globe pattern and

and have a cold water or soft seat. All manual valves for underground use should be equipped with a stem nut or forked handle to facilitate use of a key for opening and closing.

Plastic valve boxes that are adjustable in height and with locking covers can be installed over the valve for easy entrance with the key. These boxes should have a magnet in the cover to permit location if grass grows over the top. These same valves should be installed in the pumphouse, they should be of the spring load, non-slam type to prevent shock that might damage the pump and other equipment.

The question always arises as to how many valves should be installed as emergency shutoff valves in a golf course irrigation system. Generally the minimum would be four; however, as many as eight or ten might profitably be used. On a looped system this figure may be higher. A valve should be installed at most all points where laterals leave the main and also on the main, at intervals that would permit shutting down no more than third of the course.

It is imprtant that drain valves be of the globe pattern type, with soft disc for positive shut off, since a small leak here can cause a large wet spot on the course. These, too, should have plastic boxes over them and should be installed on a one-elbow swing joint to take the shock of traffic.

As with your other eqipment, buying a high-quality valve from a good manufacturer is your best assurance of trouble-free operation.

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IRRIGATION FOR SOD GROWING - A REVIEW

A. J. Miller

Sod growing is one of the few turf crops that are grown for profit and therefore, any costs involved in growing the sod can be readily balanced against increased income. Sprinkler irrigation of sod can increase your profits by speeding up sod germination, crop or soil cooling, growth maintenance, prepartion for cutting and nitrogen application. Irrigating sod assures you of a quality product sooner and allows cutting for sale when conditions might otherwise not be ideal and when the price is probably above normal. Our discussion is based on the assumption that you will need a 1/4" per day of water for sod germination and that mature sod will use from 3/4" to 1" of water per week.

There is no such thing as a standard size sod farm, but our irrigation cost estimates are based on 160 acres with water supply at one corner from a pond or stream. To irrigation this 160 acres in 70 to 80 hours will require 800 to 1000 gallons per minute and, of course, to do the job faster will require more water. If water comes from a well it will increase the cost of the capital investment as wells and well pumps are more expensive than surface pumps. We will review the available methods of watering a sod farm, and the costs are based on the above-mentioned 160 acres. Smaller acreage will require a slightly higher investment per acre. The underground pop-up system has been eliminated from our consideration as impractical because of its cost.

Probably the most widely used system is the "hand move" system which requires a main line and six, 80 rod laterals. Fourteen moves requiring 100 man hours of

labor are required to apply 1 inch of water and the cost per acre is approximately $ 110. This system is ideal for sod germination since no damage is done to the ground providing the moves are made when dry. As you can see, labor costs are quite high.

A sophisticated adaptation of this system is the wheel move where the laterals are actually mounted on wheels and propelled across the field by an engine. This cost per acre is approximately $260; however, it cuts the labor by more than half over the "hand move." Forty-two wheels are required for a 1/4 mile lateral and there will be wheel damage to the planting area when moving unless the ground is good and dry.

A boom sprinkler is available mounted on a four-wheel trailer which covers 450 feet in diameter in one setting. This is moved 300 feet by a tractor every two hours and requires sixteen moves and 64 man hours. Four sprinklers are required to cover the 160 acres with 1 inch of water. Cost is about $ 125 per acre and this is an excellent sprinkler for watering in windy conditions. Every 300 feet a ten-foot roadway is required eliminating some production areas.

If you happen to have 160 acres that are square, a self-propelled tower sprinkler might be ideal. This unit requires practically no labot to operate; however, the ground must be r latively flat with no obstructions. Its cost is only about $ 200 per acre installed, but it does not lend itself to small acreages and possibly as much at 10% of the area would be lost to production.

If your ground is cut up into smaller pieces, a smaller, continuous moving, self-propelled sprinkler is available on four wheels. Diameter of coverage is 450 feet and it operates on 660 feet of 4" diameter hose. In one setting it covers 10 acres using a part-circle sprinkler so that the wheels are moving on dry ground. Cost is about $200 per acre. Dragging of the hose over the area might cause damage on new sodding. The sprinkler lends itself to plots as low as 10 acres in side and can be operated by one man.

Probably the ideal system for sod germination would be the solid set where enough lateral lines are purchased to completely cover the area so that no labor is required to set up and move. The individual lateral lines can be manually or automatically operated and frequent light watering can be applied. There is practically no labor to operate this sytem and its cost is about $ 600 per acre. Obviously it presents a real problem for mowing and is usually lifted at the time of first mowing. The boom sprinkler, continuous move sprinkler, and solid set system lend themselves to buried main lines with risers and valves throughout the field as needed. Buried main lines are only slightly higher in cost than portable pipe.

As you can see, any one of the above systems might be used for certain watering jobs, but it doesn't seem that one system alone is ideal for all operations. If funds are available, based on 160 acres of production, it would seem that 80 acres of solid set system, which can be used for sod germination, and two continuous move sprinklers, which are used for sod maintenance, nitrogen application and sod preparation, together with buried main line, would be the most ideal. This cost is about $300 per acre based on 160 acres. As mentioned above, cost per acre increases as the acreage decreases because pump and main lines are still required.

Water applied at the right time is one of the keys in growing any crop and costs are now such that watering equipment will pay for itself in continuous high-quality production.

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SECOND REPORT ON DAILY USE OF AUTOMATIC IRRIGATION

Richard Craig, Former Supt., Losantiville C. C., Cincinnati, Ohio
Now Supt., Firestone C. C., Akron, Ohio

In review of last year's report I stated that Poa annua was being maintained through the summer at Losantiville Country Club in Cincinnati by almost daily irrigation application. The theory and practice was to keep the water level in the soil surface or Poa annua rootzone near field capacity so that -

1. The Poa annua roots would have sufficient soil water to absorb all day long, even in the hot afternoon
2. That there would be sufficient moisture for evaporation from the soil and turf surfaces.

This evaporation of water would, to a degree, cool the Poa annua plant, the plants' micro-climate, and at the same time subsequently increase the relative humidity of the micro-climate of the turf; thus reducing the water loss from the Poa annua through transpiration. In other words, "air-conditioning."

This past summer our irrigation procedures were the same as the year before. However, on four afternoons in mid-July a combination of weather conditions were different than the year before - moderately low humidity, approximately 30%, and on three of these afternoons a moderate breeze that put the Poa in the fairways in a general wilt. I considered this wet wilt because there was moisture still in the soil surface, but the Poa annua roots could not or did not absorb water fast enough to keep up with the plant's water loss through transpiration. Light watering or syringing would stop wilting. However, two of these afternoons came on a Saturday and a Sunday and we lost some grass, approximately 15-20% of our fairway turf, mainly because we were unable to syringe off the fairways fast enough. This was due to the heavy golf on the course, slowing down the small grounds crew who were trying to be considerate and polite to the golfer. There is no definite solution, but our plan for the future was to increase the number of grounds crews on weekends in the months of July and August to five or six men and strive to watch conditions closer - both weather and turf.

One additional thing we did discover was that damaged fairway turf could be overseeded in mid-July with satisfactory results. We started reseeding the spots of damaged Poa annua the very next day after the damage occurred. At first we made our so-called seedbed with just a hand-powered greens spiker - just a spike hole in the dead grass mat and with a cyclone seeder overseeded with a mixture of bent seed. We kept the fairway quite playable for the golfer and we did not open the soil to allow crabgrass to come in. Later we developed a 5-gang spiker, each unit 30 inches wide and pulled it with a Cushman Turf Truckster. In three to four days after seeding, seed sprouts began to appear out of each spike hole and by the end of one month the spot could not be noticed.

Poa annua fairways, I believe, still can be maintained in Cincinnati, but we must be more watchful of conditions and on weekends enough men must be available to handle syringing of fairways if the need arises.

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IMPROVING THE STADIUM FIELD

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and
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Specifications for the Busch Memorial Stadium anticipated only some twenty-five days in February 1966 for the entire installation of the rootzone, sod, etc., in order that the opening date of April 12 could be met. To meet these impractical dates earlier contracts were let for preparing and stockpiling the rootzone, and for developing the sod. Also, the installation was dependent upon availability of the site from contractors.

The owners, Civic Center Redevelopment Corporation, after the initial specifications were written, later made every effort to introduce the most advanced, proven concepts into the building of the field.

Tile Drainage

As outlined in the report in Midwest Turf Conference for 1966, the tile system is parallel, 30 feet apart, at least 3 feet deep, with gravel backfill in the trenches. But, the trenches were not capped with sand, were not filled to overflowing and some subsoil was washed and pushed into the trenches during the wet, muddy shaping of the subgrade during the wintertime construction program.

The tiles were not damaged, rodding proved all tiles undamaged. Later water was run through them to determine actual flow.

Sand Blanket

Specifications called for 3 inches of sand to be spread as a blanket. This would provide free lateral movement into the tile lines. Any water reaching the sand blanket theoretically moved to the tiles and away.

Such did not prove the case. In numerous places water would stand in the sand and not readily and freely move to the tile. This was unexpected and disappointing. The contractor, trying to work in late winter, had difficulty in shaping the subgrade. The sand blanket was uniform at the surface. Later a limited number of holes were made above tile lines to improve the water movement from the sand onto the gravel.

Rootzone

The 9 inch rootzone was made up of 40% corase Mississippi River sand, 30% calcined clay, 20% peat, 10% silty soil. Basically this was a very porous soil; lab experiments showed ample water infiltration. Then, why was the field muddy? It was attributed primarily to the silt soil brought in with the sod. Also, the vertical aerification and calcined clay topdressing anticipated was not carried out because of the immediate and constant use of the field after the sod was laid. Even 10% soil was enough to plug up the rootzone so that water penetration was slow - even below the sod layer.

Because the football practice completely wore out the existing sod, the top

layer of soil, from the old sod, was windrowed with a light grader, and over 300 cubic yards of surface material, including old sod, was removed from the field. Then, 650 cubic yards of calcined clay, sand and peat mixed without soil was spread, tilled into the existing rootzone and regraded. The infield itself was raised 2 to 5 inches. By removing the old sod and not bringing in additional soil, greater porosity should be achieved. Also, tilling plus freezing should help the former rootsone.

Irrigation

Forty-seven sprinklers regulated by eleven electric valves permitted complete automatic watering. Soil sensors were placed in each of the eleven valve areas to determine moisture need. A time-clock regulated time of water application - yet this system was not used during '66 because the field covers were used excessively.

Extra, loose calcined clay was used for topdressing around the valves which would plug up the sprinkler bearings, so the system was not trusted. For example, 3 sprinklers were placed in the crushed brick perimeter - that is where the specs called for them. They should have been in the edge of the sod - somebody had to later move them.

During renovation all sprinklers were checked, re-aligned as needed and the system made operative. The reserve soil sensors were also connected for alternate sensing and for better moisture checking. If the field covers will be used less, then the automatic irrigation can be used more in 1967.

Soil Heating

Fifty long heating cables are divided into four zones to provide electric heating for the football field and perimeter areas. These were placed by contractor and made operative in October, 1966. Specifications called for burial 7 inches deep, but later the grader skimming off the sod found some less than 2 inches deep; in fact, some 30 breaks caused by the sod removal were repaired. The soil warming did keep the ground thawed, did permit wintertime rebuilding and reconstruction, and has permitted the resodding of the field during February 1967. It will be used to force early growth so the stadium will be quite ready for baseball on April 11.

Grasses

Originally a blend of Midwest and Meyer zoysia, plus experimental strains, and a blend of bluegrass varieties, was planted on a sod farm near St. Louis. Even under adversity a fair sod was developed within one year. The sod was damaged by extensive freezing immediately after installation and extensive drying during the alignment of the field lights. Nevertheless, the sod performed satisfactorily during the baseball season. During the football practice season the entire sod was completely worn out, so it was discarded overwinter.

Meyer zoysia was brought in from an Arkansas sod farm. It had been grown on sandy soil, the sod was cut thin, the sod was placed onto frozen ground to reduce traffic damage, then the electricity was turned on to thaw the ground, protect the grass and promote growth.

A heavy overseeding of a blend of bluegrasses was made into the Meyer zoysia immediately after placement to achieve a mixture of varieties.

New Equipment

To improve the field a sprayer, fertilizer spreader, aerifier, topdressing machine, plus other necessary turf maintenance equipment has been purchased. Also, water drills were made which, by using a stream of water, can pierce through the sod, rootzone and sand into the gravel above the tile lines to improve spot drainage. It makes holes approximately one inch in diameter, which are immediately filled with calcined clay to improve drainage.

Summary

This has been an expensive and tedious process. One has to look only at the Astrodome in Houston where turf failed, the Atlanta Stadium where extreme drainage problems exist, the Washington Stadium where resodding has been necessary, to understand that the requirements of a dual-purpose stadium are tedious and demanding. The architects and Civic Center Management have been most cooperative in attempting new ideas to secure the best turf possible. In fact, twenty things have been done to improve and prepare the field for the 1967 season.

Can any turf survive? During 1967 the field is scheduled for 78 baseball games, plus home team practice and necessary warmup sessions. Something new - it is also scheduled for 16 soccer games to be held between baseball games, plus necessary warmup. It is also scheduled for 12 professional football games, plus, beginning September 10, the practice of 40 players and coaches during the practice sessions. This does not include band performances, special events and other uses. Can any turf survive this much wear? Certainly automatic irrigation, soil warming, a blend of warm and cool season grasses, porous rootzone, plus good maintenance equipment can go a long ways.

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IDEAS ABOUT A THIN ROOTZONE

David Ralston, Dept. of Agronomy
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Graduate Student in Turf

One of the most serious problems on both old and new putting greens is compaction. Compaction makes management difficult in that it restricts the movement of water and air into the rootzone. Many of you have experienced the problem of water standing on a green for several hours after a rain. This may be due to the fact that the soil particles are compacted so tightly together that they physically impede the movement of water into and through the rootzone.

When pores are filled with water, air movement in the profile is restricted. As the oxygen supply reaches a low level in the soil, root growth comes to a standstill. It is a common observation on a compacted green to find but few active roots below a depth of 2 inches. Since the roots have a limited volume of soil from which to obtain moisture, frequent irrigation is necessary. Also, this shallow-rooted condition combined with excess moisture makes the grass more vulnerable to disease.

The easiest way to correct compaction is to plow the soil to loosen it. Of course, this is impractical in turf areas. To reduce the potential compaction

limited fines have been proposed. However, in an intimate mix the fines can readily predominate. The general principle to keep in mind is that the more silt and clay sized particles there are in a mixture, the deeper the profile has to be to get the desired drainage. In other words, if soil is used in the mixture, it is necessary to maintain the deeper rootzone so that water can be pulled out of the soil to make room for air which is needed by the roots.

Emphasis in rootzone research has been to develop a mixture in which compaction will not become a limiting factor. In other words, a rootzone mix which could be completely compacted when built and still function properly. One such project here at Purdue has been termed the THIN ROOTZONE. Thin refers to both the depth of the rootzonr mix - 4-6 inches - and depth of shallow tile - about 10 to 12 inches.

The materials used in the thin rootzone include peat, calcined aggregates and sand, but soil is not included. The purpose of the sand is to provide large pores so that water can move into and through the profile rapidly. On the other hand, it is necessary to retain moisture and nutrients for the grass requirements. This is the purpose of the calcined clay and peat. Compaction will also help the sandy rootzone retain more available water for plant needs. The peat has the added advantage of providing resiliency and improving seedling stands.

Construction of the proposed rootzone is relatively fast and economical. Let us take the case of an existing green where it could be improved by renovation. The first step would be to remove the existing sod and contour the needed soil six inches below the desired final grade. Then, narrow trenches could be dug at 10 foot intervals and 3 - 12" deep in the existing soil. One inch or larger rigid plastic pipe would be installed. The pipe should have narrow slits cut at about 3 inch intervals on opposite sides of the pipe to permit water entry. A coping saw can be used to make the slits. It is important that the size of the opening be smaller than the diameter of the sand used so that the sand will not enter the pipe.

After the pipe is in place, the trench is filled to overflowing with coarse sand. Then a 4 to 5 inch layer of medium sand (mortar sand or similar) is spread as uniformly as possible over the entire area. One inch of calcined clay is placed over the sand and then worked into the top half of the sand. Then, one inch of peat, plus fertilizer, is spread over the surface and worked in. It is desirable to intermix thesematerials to improve the storage of water near the surface, plus improving playability.

The rootzone should be compacted by tamping, rolling and/or water settling. Then, the green is ready to be sodded or seeded. Seeding would be recommended unless the sod is grown on a rootzone mix that is similar to that of the thin rootzone. If sod is used it should be cut as thin as possible to minimize the addition of a heavier textured material at the surface of the rootzone. Also,repeat vertical aerifying is used to improve the movement of water into the profile.

What are the possible advantages of the thin rootzone? First of all construction costs are lower. Since the rootzone is only six inches deep, limited materials are needed. Less time is required for construction so there is a savings of labor. Also, this means that the hole will be out of play for a shorter period of time and herein lies the golfer's primary interest.

Good infiltration and percolation are other advantages. The structure resulting from the coarse texture content permits the excess water to promptly move into and through the rootzone where the excess can be removed by the plastic pipe. After the water has drained from the large pores they can be filled with air which is vital for the supply of oxygen for the respiration of the roots. This is usually

the principal reason for renovating a compacted green, that is, to provde more aeration or large pores.

Finally, the variability of using soil is avoided. Soils vary widely in the amount of sand, silt and clay they contain. Thus it is difficult to predict how the addition of any particular soil to a rootzone mix will affect the air and water properties. The only way to be sure is to study the properties of each soil in question. In other words, do not attempt to cut corners by building a thin rootzone with a standard mix of soil, sand and peat or drainage will become a problem.

There are still a good many questions which should be investigated. For example, is the medium sand the most desirable size? Is six inches of mix the optimum depth? And, what special fertilizer or irrigation practices should be developed for the thin rootzone?

So, in conclusion, the objective of the thin rootzone is to remove a maximum amount of water rapidly and yet store an adequate supply in the top few inches for daily grass requirements.

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SUBSURFACE IRRIGATION

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As a person interested in fine turf, it is always a pleasure for me to meet any caliber golfer who shows a sincere interest in the problems faced by the turf manager. Likewise, I believe it is equally desirable for those of us in the golf course turf business to appreciate the problems faced by the golfer - and I think we do, perhaps even more than some may realize.

An example of this may be shown in the irrigation practices used on many greens. I have turned water on greens when, at the very moment I was beginning to irrigate, there was water leaving the rootzone through the drain tiles. To one schooled in turf alone, this was perhaps wasteful of water, labor and time. To one familiar with today's greens and the demands placed upon them, it was entirely necessary to improve the green's resiliency.

The reason is this - we are providing water to the greens for at least two primary reasons. First, we must have enough water present to insure an adequate stand of turf. Secondly, and quite desirable from the golfer's point of view, we water in order that the green will hold the well-hit shot - even some not-hit-so-well.

Looking physically at this for a moment, let us picture ourselves on the hitting end of a 165 yard shot to the green. As the ball is in flight we visualize its properties. First, it has a forward velocity as it flies toward the green. Secondly, it exhibits vorticity, or spin. Thus the ball approaching the green possesses a definite amount of energy, depending upon the way the ball was hit. When we say a green should "hold" we are saying the green should have as one of its properties, the ability to dissipate this energy of impact, thus allowing the ball to come to rest within a reasonable distance from where it first struck the putting surface.

Nearly every green can have this characteristic for a few hours of the day. But, a green that holds at 9 A.M. but not at 3 P.M. can hardly be enjoyed by the tournament golfer. The challenge is to construct a soil profile that will allow for the holding of a golf shot during the driest hours of the day without relinquishing any of the other desirable qualities of the putting surface.

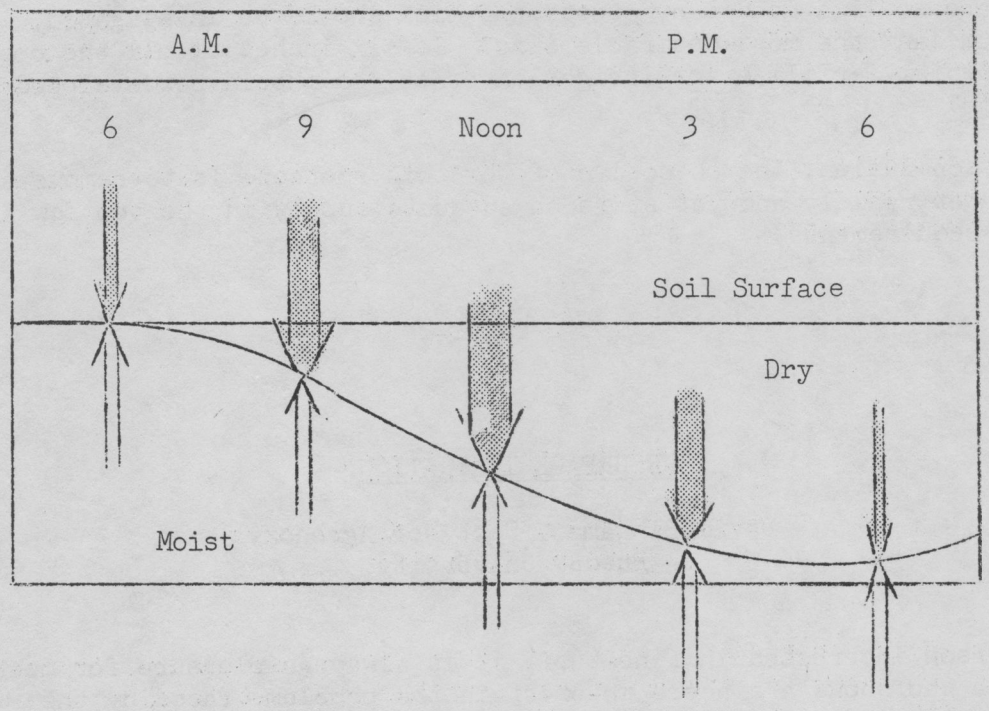

Fig. 1. Expected condition in the surface inch of a putting green where evaporative forces exceed hydraulic conductivity to the surface.

The surface of the putting green is an evaporative site that is exposed to constant energy changes. Across the top in figure 1 we see numbers indicating the time of day, early morning on the left and evening on the right. The shaded arrows are to show the relative intensities of evaporative energy, beginning shortly after sunrise, increasing as the sun approaches a zenith position, and tapering off as the sun moves lower in the sky. Beneath the surface we see a portion of a soil profile. The irrigation, guttation and dew of the previous night has put the surface soil in the wet range by sunrise. Only after the excess surface moisture has evaporated will the surface really begin to heat up. The white arrows represent the soil's upward capillary potential, or the rate at which water can be expected to move by capillarity from a wetter zone to a drier zone against the forces of gravity. As we see, this potential rate of rise is less than our incoming energy could handle. So, the surface dries out, or, as the golfer complains, the green becomes hard.

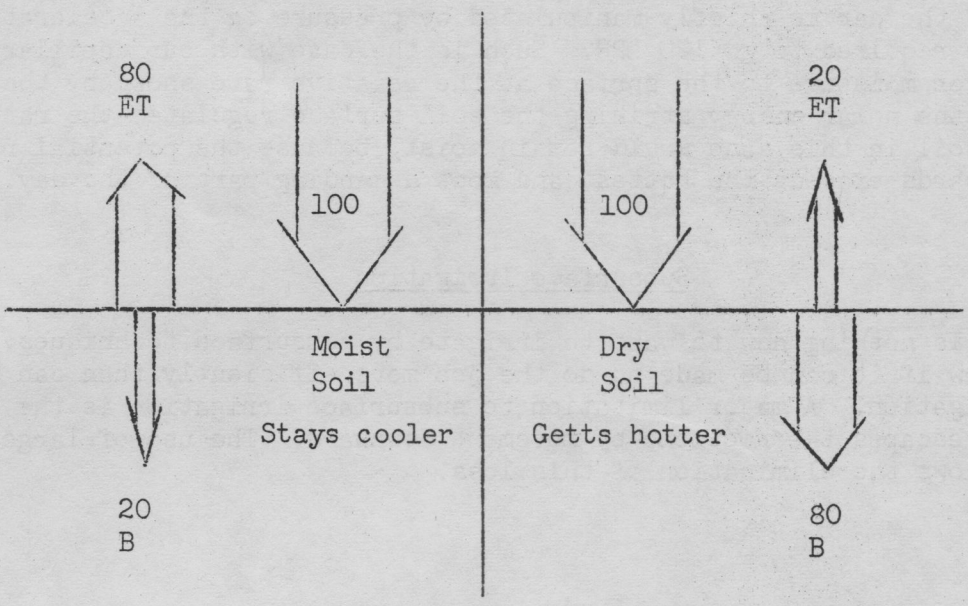

Fig. 2. Energy balance of moist and dry surfaces.

Figure 2 points out the energy balance differences between moist and dry surfaces. Both are subjected to 100 units of heat energy. Water is from 75 to 90 percent efficient in the utilization of this energy. In the moist soil, 80% of the energy is dispelled as evapotranspiration -- and only 20% goes to raising the temperature of the putting surface. However, when the surface is relatively dry, perhaps 20% is utilized in evapotranspiration; then 80% remains to raise the soil surface temperature.

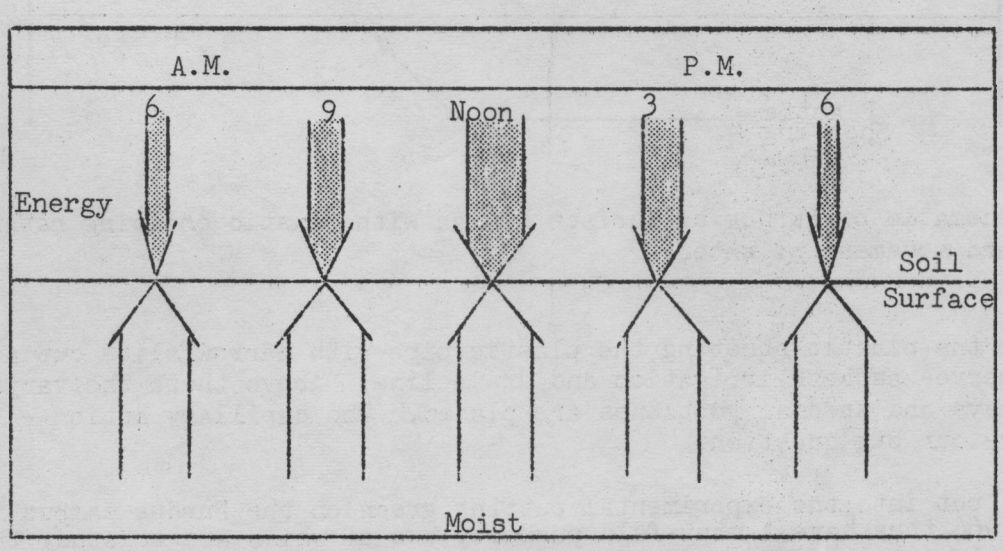

Fig. 3. Status in top inch where hydraulic conductivity exceeds evaporative forces.

Figure 3 is similar to figure 1, but with one major difference - that being the capillary potential of this rootzone is much greater. Keep in mind that the arrows which represent relative capillary potential indicate a dynamic situation. Let me draw an analogy. Your car's speedometer may show 120 MPH on the dash, but

the speed of the car is chiefly manipulated by pressure on the accelerator, so it may never be required to go 120 MPH. Such is the case with our capillary potential. It can deliver moisture to the surface at the relative rate shown by the lower arrows, but the solar energy striking the soil surface regulates the rate of movement. The soil in this case would remain moist, because the potential rate of water movement upwards exceeds the hottest and most demanding part of the day.

Subsurface Irrigation

There is nothing new to want to irrigate by subsurface techniques. There is something new if it can be made to do the job more efficiently than can be done by surface irrigation. A major limitation to subsurface irrigation is the amount of water which escapes the rootzone by movement downward. The use of large plastic sheeting allows the elimination of this loss.

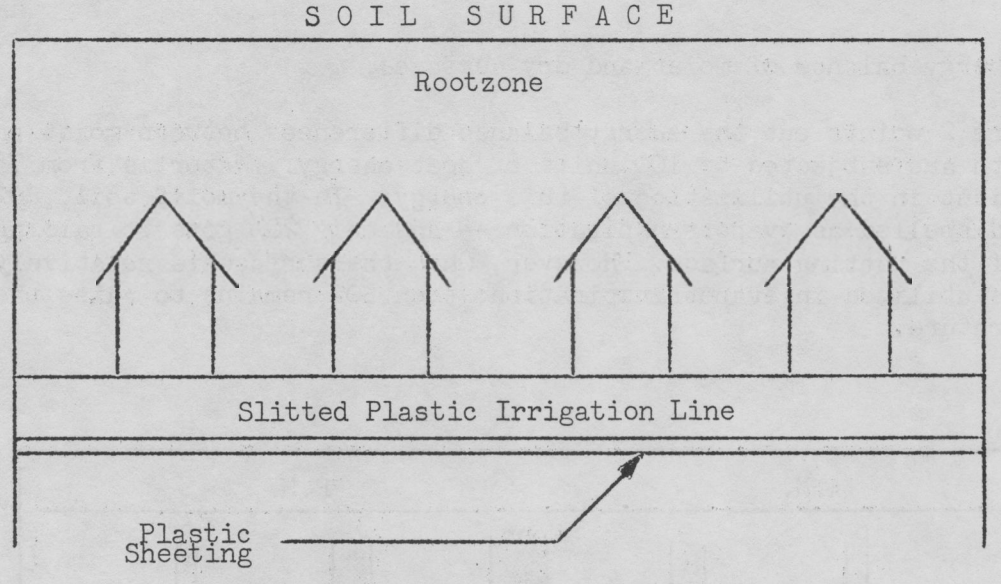

Fig. 4. Schematic of Purdue subsurface design with plastic sheeting retarding downward movement of water.

Above the plastic sheeting the plastic pipe with narrow slits cut at frequent intervals serves as both irrigation and drain line. Above these the varying sands, calcined clays and special rootzones are placed. The capillary action - "wick" - of these are our big question.

Plots put into the experimental putting green on the Purdue campus in the summer of 1966 thus have a many-fold purpose, two of which are to study the movement of moisture to the surface and to further investigate the feasibility of subsurface irrigation. Through subsurface irrigation we may be able to eliminate the word BITE, and the adjectives that often surround it, from the golfer's vocabulary.

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REGULATING IRRIGATION - SUBSURFACE SUPPLY

David Lingaman, Graduate Student in Turf, Dept. of Agronomy
Purdue University

With this type of irrigation there is associated the engineering problems of delivering the proper amount of water to the rootzone at the desired time. The ultimate in efficiency would be to deliver it drop by drop at the instant the drops were required.

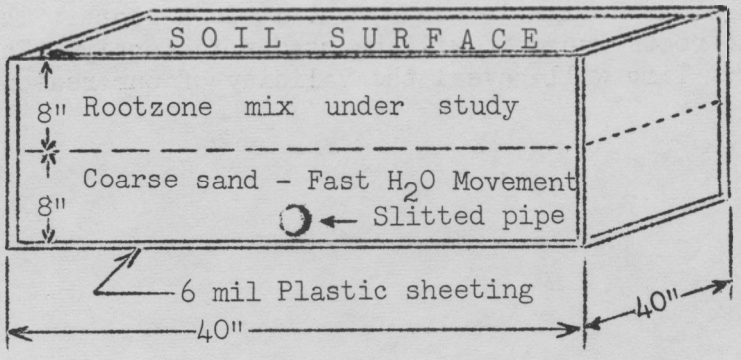
Researchers in various parts of the world have developed several modes of subsurface water delivery. These include industrial engines that force water back through field drain tiles, close spacing of slitted or punched tubing has been field tested by the Ag Engineers in Missouri, and porous cups placed along irrigation lines has been studied in the southeast.

On the Purdue experimental green research plots were constructed last summer. The two primary considerations were the type of top-mix to be used in the green and the effective subsurface delivery and control of water. The soil was removed to a depth of 16 inches below the final desired grade. The resulting subsurface grade was smoothed, wetted and compacted. Then, two layers of 6 mil polyethelene plastic was put on. The edges were brought to the surface at the border of each plot, thus individual water-tight compartments were formed.

At this point rigid plastic pipe was laid in the bottom of each plot directly on the plastic sheeting. This pipe was pre-slit at three inch intervals on opposite sides of the pipe. Each slit was 20/1000 inch across and was cut about one-third through the pipe 90° in arc length. A layer of very coarse sand covered the plastic pipe and extended throughout the lower part of the plot. The particles used were larger than the slits in the pipe to minimize clogging, and the sand permit fast lateral water movement.

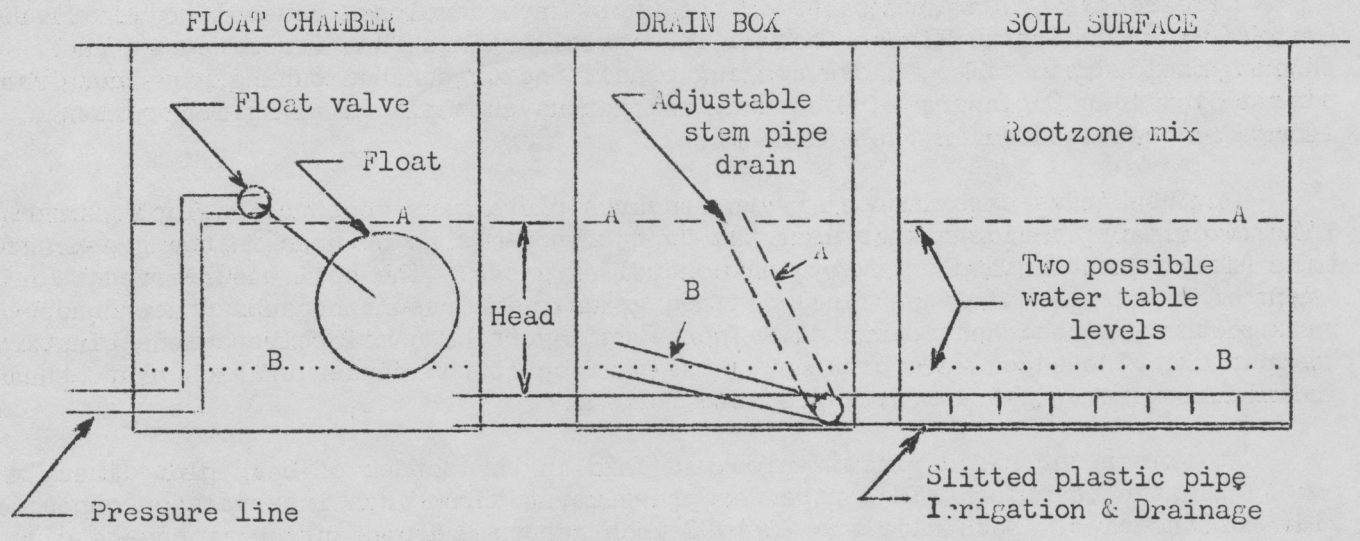
As additional coarse sand was put in, it was settled and compacted to within eight inches of the final surface grade. At this point all of the subsurface irrigated plots were the same. Various top-mixes were then added to the plots and compacted at regular intervals, assuring as complete a compacted rootzone as could be achieved without injury to the plastic line. The plots were then seeded with Penncross creeping bentgrass. With the rootzone mix in the ground it was time to connect the irrigation system. Perhaps the key link between the rootzone phase and the irrigation phase is the slitted plastic. This pipe will serve the dual role of drain line and irrigation line.

Fig. 5. Cross-section of subsurface irrigation plots.



Obviously, water cannot be delivered to the slitted line under very great pressure as the turbulence would disrupt the rootzone. A valve and float chamber were installed to reduce the hydraulic head to desirable proportions and regulate water level.

Fig. 6. Float Chamber Junction and Valve. Fig. 7. Desired free water table height.



The water table height is maintained by the settings of the float chamber level and the swing joint drain opening as shown in Fig. 7. Excess water that enters the rootzone through sprinkling or precipitation is drained by the swing drain level. Thus, a dynamic equilibrium is established, with the datum line being similar for water table level and drainage leve. The capillary properties of the top-mix determines the relative amounts of air and water that exists between the free water level below and the surface of the soil.

Should this system prove feasible the desired uses are numerous. Small turf areas such as malls, sod strips near walkways, trees in arid areas, and other isolated plantings requiring water could be watered at pre-determined intervals with no obstruction to surface activities. If a green needs water at 3 P.M. it gets water at 3 P.M., and the people on the green will not realize the watering is going on.

In conclusion - our design is crude, but it is a start. The objective is to get the water to the roots where it will be used efficiently. The results are several months away. Time will reveal the validity of our reasoning.

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HERBICIDES AND ADDITIVES

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Graduate Student in Turf

Herbicides are, no doubt, one of the most useful tools at our disposal for Efficient and Effective Turf Management. Weed-free turf is a step in the right direction. Just the use of herbicides does not insure good turf or even weed-free turf. Fortunately we do have many herbicides at our disposal that when properly used go a long way in controlling many of our weeds.

We are always looking for ways of increasing herbicidal effectiveness and efficiency. Herein lies the reason for the word "additive" to my discussion. By "additives" we could mean anything that is added to the herbicide -- water, oil, emulsifying agent, stickers, detergents, surfactants, wetting agents, etc., but generally when we speak of additives we are implying materials such as surfactants, wetting agents and, perhaps, spreaders and stickers.

Basically by adding something to the herbicide we hope to get either better control or more selectivity with equal or less amounts of herbicide. Commercial formulations of herbicides are usually applied in systems which contain not only the active chemical, but also various solvents, surfactants, carriers, and other additives.

Early research on the role of surfactants in herbicidal sprays was primarily concerned with their packaging, marketing, handling and application. Many of our herbicides are themselves insoluble in water, requiring some solvent or dispersing agent to be added to keep them in an aqueous solution. Recently much work has gone into the evaluation of the amounts and kinds of surfactants.

A substance which concentrates at a surface is known as a <u>surface active agent</u>, and more recently has become known as a <u>surfactant</u> - any material which facilitates and accentuates the emulsifying, dispersing, spreading, wetting, and other surface-modifying properties of herbicidal formulations. For example, a wetting agent is a compound, which, when added to a spray solution, causes it to contact plant surfaces more thoroughly.

Regardless of the chemical structure, surfactants all have one thing in common - one part of the molecule is soluble in water and another part is not. This property enables them to bind water to oil surfaces. When such solutions come in contact with a solid, say a leaf surface, the liquid-solid contact angle may be lowered, giving better coverage.

Surfactant groups - depending upon their action in solution

1. Non-ionic - do not dissociate and have no charge
2. Ionic - dissociate in solution
    a. Cationic - have a positive charge
    b. Anionic - have a negative charge
3. Amphoteric - Charge depending upon pH of the solution

The non-ionic surfactants are usually themselves less toxic to plants and are more commonly used, and most commercial formulations are blends.

Then, how do you go about selecting the best surfactant for a particular herbicide? You may not have a choice since the commercial formulation will probably have one or more added. We assume the manufacturer has selected the best one. How

about adding additional surfactant? Research and information on this subject is not adequate. However, some reports indicate that the addition of surfactants to commercial Dalapon and Diuron have increased their toxicity to Johnsongrass and crabgrass. Others have found that increased surfactants have decreased toxicity of some herbicides, especially in high volume spraying, presumably due to greater runoff and loss from plant. Then there is always the possibility that surfactants may change the selectivity so that there may be injury to desirable plants.

There is little doubt that if we were using the technical material we would get increased weed control with the addition of a surfactant, and many reports are available showing this. There is also considerable evidence that the selection of a surfactant is also important. For example, one surfactant did not increase uptake of P^{32} in beans, but did increase the response of corn to foliar applied gibberillin. Another surfactant improved phosphorus absorption, but decreased magnesium.

Just how does a surfactant increase the toxicity of a herbicide when added to the spray solution? At least nine different effects have been suggested. The most often sressed and probablh most important factor is the lowering of the surface tension of the solution giving better contact with the leaf and consequently more absorption and translocation. There also is an inter-action between herbicides and surfactants for the best combination. Some work has shown that the minimum contact angle and surface tension occurs at about 0.1 to 0.5% concentration of surfactant, but that the maximum herbicidal activity may occur at ten times this concentration. Phenoxy-type herbicides (2,4-D) generally show maximum activity at about 0.25 to 0.5%; others (Dalapon, Amitrol, Paraquat) show maximum effect around 1.0%.

In summary we can say that surfactants are now an important part of the herbicidal use programs. Most formulations include surfactants for increased herbicidal activity. An herbicide-surfactant combination that will give optimum results on a specific weed problem is a step closer to solving the weed problem and consequently closer to better turf. The research toward my doctorate is researching a group of new tallowate surfactants for effectiveness. It's a difficult assignment.

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TURFGRASS VARIETIES

An abstract of larger paper written for New Jersey by C. R. Funk, R. E. Engel, P. M. Halisky and H. W. Indyk.

The development and use of improved varieties is the most critical need of the turfgrass industry. Many turfgrass management problems would be easier to solve if varieties with greater resistance to diseases, insects, heat, drouth, excessive wear and close-mowing were available. A number of turfgrass breeding projects have been initiated in the United States and Europe. Experimental varieties show considerable promise and a number of superior varieties will be released within the next decade.

Due to differences in climates, soils and the prevalence of disease and insect problems, a specific variety may show superior performance in one area and do poorly elsewhere. Thus it is important for the professional turf grower to keep up to date on their performance.

Kentucky Bluegrass Varieties

Kentucky bluegrass, Poa pratensis, is best adapted to well-limed, fertile, loam soils. Its best season for growth is the cool months of fall and spring with optimum root and rhizome growth occurring at about 60°F. Root growth stops when soil temperatures exceed 90°F. Studies at Beltsville, Maryland, have demonstrated that some root growth will occur throughout the winter if fertility is adequate. Bluegrass shows reduced vigor during hot weather even if moisture is available. With prolonged summer drouths, the grass turns brown and becomes dormant, but recovers and resumes growth with the return of cooler temperatures and favorable soil moisture conditions. Instances of poor recovery from summer drouth are usually associated with poor management practices, such as excessive applications of nitrogen fertilizer and close mowing. This grass responds best to ample fall and light-to-moderate spring fertilization. Excessive nitrogen stimulation of bluegrass in late spring and summer prevents it from going into dormancy in a physiologically hardened condition. Lush growth resulting from high fertility also intensifies damage from the melting-out phase of Helminthosporium vagans.

Apomixis in Kentucky bluegrass is a process whereby a vegetative cell in the ovule develops into the embryo of the seed without fertilization by the male nucleus of the pollen. Seed formed by apomictic reproduction is, therefore, genetically identical to the mother plant. If a plant that produces primarily by apomixis is selected, it will breed true and can be used as the basis for a new variety merely by increasing seed. All of the presently available bluegrass varieties have been developed by this selection method.

Large numbers of new types of Kentucky bluegrass can arise by recombination of characters through sexual reproduction. These new types may have the possibility of maintaining itself through apomixis.

In past years seed was gathered from natural stands extending from Kentucky northwest into Canada. In recent years, seed growers in Washington and Oregon have selected varieties with a high seed production potential such as Newport. As a result, much of the seed currently being sold as Common Kentucky bluegrass is actually seed of one or more of these high seed-producing varieties. It is, therefore, difficult at present to obtain seed produced from natural stands. As a consequence, the state of Kentucky is initiating a program to certify seed that truly represents the natural stands existing in the famous bluegrass regions of that state. This seed will be sold under the variety name of Kenblu.

A considerable quantity of seed labeled as Common is currently being imported from Europe. Manh of these seed lots are contaminated with seed of Poa annua and Poa trivialis. Resistance to disease is a prime consideration in selecting a bluegrass variety for most home lawn situations.

Helminthosporium leafspot and Melting-out

The most damaging disease of bluegrass is caused by various species of the fungus, Helminthosporium. The disease appears as circular to elongate, purplish to brown spots with straw-colored centers occurring on leaf blades and sheaths. The fungus not only defoliates the turf severely, but also causes extensive crown and foot rot termed melting-out.

Helminthosporium vagans causes the most damage in New Jersey, although other species including H. sorokinianum, H. sativum, H. dictyoides, and H. triseptatum are occasionally found during the summer months. H. vagans produces abundant spores

during the cool, wet season from October through April. Moderate disease buildup may occur in the fall, persist through the winter, and subsequently intensify into severe damage in April, May and early June. Significantly, fewer spores are produced from May through September, and if the turf has not been damaged too severely it will start recovery at this time, providing growing conditions are favorable.

The severity of this disease is greatly influenced by certain management practices. Disease injury is considerably greater under close mowing as contrasted to higher mowing. Close mowing tends to deplete the carboyhydrate food reserves, thereby weakening the turfgrass and making it more subject to damage. Plants at low nitrogen have more leafspot lesions in late fall and March or April. However, in May and June, when melting-out is the most severe, turf receiving high rates of nitrogen fertilizer suffers the greatest permanent damage.

Table 1. Percent loss of bluegrass turf from H. vagans and subsequent crabgrass invasion.

	Cutting Height					
	2.5 inches		1.5 inches		1.0 inches	
Lbs. N/1000/yr.	Loss %	Crab %	Loss %	Crab %	Loss %	Crab %
0	5	1	8	2	16	1
3	22	3	24	12	43	18
6	34	7	50	22	63	33

Resistant varieties, higher cutting heights, and avoiding excessive nitrogen fertilization in the late spring are the best means of controlling this disease.

Table 2. Reaction of bluegrass varieties to leafspot and melting-out by Helminthosporium vagans in New Jersey - experimental selections.*

Good Resistance	Moderate susceptibility	High Susceptibility
Merion	Warren's A34	Delta
Fylking	Windsor	S-21
Warren's A20	Campus	Geary
*Anheuser dwarf	Prato	Nu Dwarf
*NJE P-24	Arista	Arboretum
*NJE P-1	Delft	Park
*NJE P-3	Warren's A10	Common
*NJE P-12	Newport	Troy
*NJE P-13	Newport C-1	
*NJE P-16	Cougar	
*NJE P-21	Primo	
*NJE P-27		
*PSU K107		
*PSU K106		
*PSU K5 (47)		
*PSU K104		
*NJE P1e		
*PSU K103		

Stripe Smut

Stripe smut caused by Ustilago striiformis is a widespread disease of bluegrass. Long, narrow, gray or black stripes develop on the leaves. The gray stripes are unruptured sori, the black streaks result when the smut sori rupture and liberate mature spores. Following rupture of the sori, infected leaves curl from the tip downward and become shredded. Since stripe smut infections are systemic, few plants completely recover from the disease. Most new stands of turfgrass are not damaged extensively until they are three or four years old under New Jersey conditions. The disease becomes progressively more severe with age of turf on susceptible varieties. No fungicide spray program has given consistently satisfactory control. Merion Kentucky bluegrass is highly susceptible to this diease. Prato, Arista, Cougar and Newport have been damaged in test plots at Rutgers.

Table 3. Reaction of bluegrass varieties to stripe smut (Ustilago striiformis) in New Jersey under turf maintenance conditions. Experimental*

Good Resistance	Moderate Susceptibility	High Susceptibility
*Anheuser dwarf	Delta	Prato
Park	Common	*NJE P-24
PSU K5 (47)	Newport	*PSU K2 (58)
Delft	Cougar	Merion
Fylking	Arista	*PSU K3 (58)
*NJE P-3		
*NJE P-12		
*NJE P-13		
*NJE P-16		
*NJE P-21		

Windsor has been reported to be susceptible. Resistant varieties offer the best means of controlling this diease. Park and Delft have been fairly resistant to stripe smut, but are susceptible to leafspot. Fylking (0217) and a number of experimental varieties show promise of having good resistance to both stripe smut and leafspot.

Powdery Mildew

Powdery mildew (Erysiphe graminis) frequently infects Kentucky bluegrass growing in shady locations with low light intensity and reduced air circulation. The powdery, white fungus is conspicuous on the surface of leaves and when severe it may completely cover the plant. Merion is very susceptible to powdery mildew. Anheuser dwarf, Newport and Delta have good resistance.

Rusts - (Puccinia and Uromyces spp.)

A number of genera, species and races of rusts may infect Kentucky bluegrass. A variety resistant to one species or race of rust may be completely susceptible to another. Rust gives serious injury in many parts of the United States. It is commonly found in southern and coastal areas of New Jersey, but is rarely found in other sections of the state. Rust is normally damaging primarily under conditions restricting vigorous vegetative growth, such as low fertility and soil moisture stress. An improvement in growing conditions usually brings effective control as

new leaf blades are constantly mowed off before infection develops. A leaf rust caused by Puccinia poae sudeticae is frequently observed in New Jersey. Merion, Anheuser Dwarf and PSU K5(47) have shown resistance to this leaf rust in nursery plantings at New Brunswick. Merion and Anheuser dwarf are highly susceptible to stem rust (Puccinia graminis) whereas Newport, Common, Delta, Park and PSU K5(47) are reported to be moderately resistant to present races.

Growth Habit

Habit of growth and turf-forming properties are very important in choosing a bluegrass variety. Rapid vertical growth, especially during lush growing conditions in spring, requires frequent mowing and removes leaf area so rapidly that a good turf is difficult to attain. Some of the low-growing varieties need high fertility and under such conditions may require as frequet mowing as erest varieties receiving moderate fertility. Varieties like Delft have nearly horizontal leaf blades which will be cut off if normal cutting height is lowered abruptly. Varieties such as Anheuser dwarf have short leaf sheaths and blades at a partly prostrate angle. Cutting height can be lowered on such varieties with less damage. Very dense varieties suffer severe scalping when cutting height is lowered abruptly.

Table 4. Growth habit of varieties. Experimental*

Low-growing with moderately vertical growth		Moderately low-growing	Erect with rapid vertical growth
*Anheuser dwarf	Fylking	Prato	Delta
*NJE P-1	Arista	Campus	Common
*NJE P-3	Windsor	Delft	Geary
*NJE P-12	*PSU K5(47)	Newport	S-21
*NJE P-13	*PSU K106		Troy
*NJE P-16	*PSU K107		Park
*NJE P-21	Merion		
*NJE P-27	Cougar		
*NJE P-24	*PSU K104		
	*NJE P1e		

Density

A dense turf is often preferred and may aid in preventing weed encroachment. On the other hand, density may be associated with abundant thatch formation, a higher fertility requirement, and may give rise to conditions favoring disease development. Density can be greatly influenced by management. High fertility and good growing conditions promote a dense turf. Diseases, insects, phytotoxic chemicals, low fertility, soil acidity, improper mowing, and other abuses result in a thin, sparse turf. Some varieties, such as Merion, produce a large number of tillers at the end of each rhizome and, therefore, produce dense turf under good conditions. Anheuser dwarf produces fewer tillers and forms a less dense turf,but when fertilized properly, density of turf formed by this variety is adequate.

Table 5. Density of varieties grown under favorable turf maintenance conditions, New Jersey. Experimental*.

Dense turf	Moderately dense turf	Below average in turf density
Warren's A 20	Arista	*NJE P-1
*Belturf (S-5)	Delft	*Anheuser dwarf
Warren's A34	Campus	Delta
Fylking	Newport	Park
*PSU K5(47)	Cougar	Common
*PSU K106	*NJE P-3	Troy
*PSU K107	*NJE P-21	
Merion	*NJE P-16	
Prato		
*NJE P-24		
*NJE P1e		
*PSU K104		
*PSU K103		
*NJE P-12		
*NJE P-13		
*NJE P-27		

Color

The ability of grasses to develop a green color early in the spring, as well as maintain color late in the year, is of some interest. Anheuser dwarf, Fylking and PSU K5(47) are dark green varieties that hold color well into cold weather. Ratings taken early in the spring, before the flush of spring growth, show these varieties to have much better color than most other varieties. A few days later, varieties such as Park, Delta and Common initiate a rapid flush of growth and show a bright green color. Merion and Cougar develop green color slowly.

When all of the varieties are growing well, each variety will exhibit its own distinctive shade of green. Anheuser dwarf, PSU K5(47) and Fylking have a very attractive, rich, dark green color throughout the growing season. In the fall, varieties such as Cougar and Merion usually stop growing and lose color sooner than many other varieties. Studies in Michigan have indicated that such varieties have a better chance of winter survival.

Kentucky Bluegrass Varieties

Merion is considered to be the best readily available from commercial sources for use on well-maintained lawns and similar turf areas in New Jersey. This variety has done more to stimulate interest in the turfgrass industry than any other development. Compared with Common, Merion has wider leaves, is lower growing, darker green in color, when properly fertilized, much more resistant to Helminthosporium leafspot and melting-out, and more tolerant of heat, drouth, and close mowing. When properly managed, Merion forms an attractive, dense, vigorous turf, highly resistant to weed invasion and capable of withstanding moderate wear.

Certain weaknesses of Merion are recognized. Older stands are often damaged by stripe smut. It is highly susceptible to powdery mildew and, therefore, it should not be used in heavily shaded areas. Merion is susceptible to stem rust, but this normally is serious only under unfavorable growth conditions. Merion is

occasionally infected with dollar spot (Sclerotinia homoeocarpa) especially on sandy soils of low fertility. On warmer sites with high soil temperatures, Merion is damaged by Fusarium roseum. This disease is associated with turf weakened by high temperatures, excessive nitrogen, thatch accumulation, close mowing and either prolonged drouth or improper watering. Observations at Rutgers indicate that Merion is not damaged any more than most other bluegrass varieties under comparable conditions.

Merion seed is quite small and requires 1 to 3 days longer for germination and emergence than some of the more rapidly germinating varieties. However, the superior vigor, aggressiveness and sod-forming characteristics of Merion usually enable it to surpass other varieties in later stages of establishment. Merion will generally crowd out ryegrass, red fescue, and other bluegrass varieties mixed with it under conditions of adequate fertility and frequent mowing. Healthy, well-maintained Merion turf is seldom invaded seriously by crabgrass or other weeds. Merion frequently requires and will tolerate more fertilizer than Common.

Fylking (0217 as licensed by Jacklin Seed Co.) shows considerable promise. It was developed at Svalof, Sweden, and has been used in Europe for some time. A limited amount of seed was first offered for sale to sod growers in the United Sates in the fall of 1966. Fylking has been tested at Rutgers since 1960 as NJE P-30 and Jacklin's 0217. It is the only commercially available variety that has demonstrated good resistance to both stripe smut, leafspot and melting-out. The variety is similar, but not identical, to PSU K5(47) in disease reaction, seasonal growth pattern and overall appearance. Fylking is reported to be moderately resistant to stem rust. It is moderately susceptible to powdery mildew in New Jersey.

Fylking produces an attractive, dense, low-growing turf of moderately fine texture. It maintains a leafy, high quality turf during seedhead setting time in late spring when many other varieties become very stemmy. The variety establishes rapidly from seed and produces abundant rhizome growth. It appears fairly tolerant of close mowing at 3/4 inch, but does somewhat better at mowing heights of about 1-1/2 inches under New Jersey conditions. Fylking develops an attractive, rich, dark green color in early spring, which is maintained well into late fall and under moderately adverse growing conditions such as low fertility and incipient drouth. It does best when adequately fertilized and well maintained. Fylking has performed very well in mixtures with other bluegrass varieties including Newport, PSU K5(47) and Anheuser dwarf. It has not done well when mixed with Merion.

Newport is a moderately low-growing variety with dark green leaves and fairly good establishment and turf-forming characteristics during the first 2 or 3 years. It has shown some resistance to current races of leaf and stem rust and powdery mildew, but is moderately susceptible to leafspot and stripe smut. A marked yellowing of leaves occurs at times. Turf stands of Newport become very stemmy at seedhead setting time in June. Older plantings of Newport have been heavily invaded by weeds and have shown poor recovery from drouth.

Cougar was selected at Pullman, Washington, from the progeny of an introduction received from Denmark in 1934. It is a moderately low-growing variety similar in texture to Merion. It has been moderately susceptible to leafspot, stripe smut and powdery mildew. It has shown poor color and apperance during late fall, winter and early spring with considerable weed invasion. Cougar bluegrass is a mechanical mixture of three bluegrass selections formerly designated PNW 205, 402 and 602.

Windsor (Plant Patent 2,364 to O.M.Scott Co.) is a moderately low-growing, dark green bluegrass which can produce a rather attractive turf under favorable conditions. It has moderate susceptibility to leafspot, powdery mildew and rust, and

is reported to be susceptible to stripe smut. Windsor has an attractive spring color until it is discolored by leafspot. It has a rich green color in summer and early fall when growing well. Color during late fall is often poor because of orange leaf tips. In New Jersey, Windsor has shown poor persistence and competitive ability in most tests which permits ready invasion of the plots by weeds and other grasses.

Park resulted from a large collection of plants selected from old pastures in 1937 in Minnesota. The fifteen best apomictic strains were composited to form the variety, Park, which was released in 1957. The variety has excellent seeding vigor. It has shown good resistance to stripe smut and stem rust. Some plants are fairly resistant to powdery mildew, whereas others are susceptible. The performance of Park has been very similar to that of Common under turf conditions in New Jersey because of its high susceptibility to leafspot. Park is an erect growing variety with rapid vertical growth. It has yielded well in pasture trials.

Delta originated as a single, apomictic plant selected in Canada. It is reported to be fairly resistant to stem rust and powdery mildew. It has shown moderately good survival and recovery from drouth compared to other erect, leafspot susceptible varieties in New Jersey tests. However, is highly susceptible to H. vagans.

Troy was selected from a lot of seed introduced from Turkey. It is a tall, erect-growing grass highly susceptible to leafspot. It has been used as a pasture grass in the Montana zrea, but performs very poorly as a turfgrass.

Arboretum was an early selection from the Missouri Botanical Garden from collections of plants from old pastures and lawns in Missouri and neighboring states. It is an erect-growing variety highly susceptible to leafspot.

Nu Dwarf (Plant Patent 2,513 Ross H. Rasmussen of Hooper, Nebraska) has good seedling vigor, but has been highly susceptible to leafspot in New Jersey.

Prato was selected by D. J. van der Have from a collection of plants from eastern Holland. (It is licensed to Northrup, King * Co.) It is a moderately low-growing variety, forming a fairly dense turf with moderate susceptibility to leafspot and is quite susceptible to stripe smut.

Delft was developed by Central Bureau in Holland. It is a moderately low-growing variety with rather horizontal leaf blades. Delft is moderately susceptible to leafspot and rust, but appears quite resistant to stripe smut.

Campus was developed by Gebr. van Engelen in Holland. The variety is moderately susceptible to leafspot and rust. It has fairly good turf-forming properties and possesses a shade of dark green color slightly different from the characteristic color of other Kentucky bluegrasses. It maintains this dark green color well into the fall and early winter and greens up very early in the spring. It does not survive or recover from severe heat or drouth as well as the better varieties.

Arista (formerly ZWB 37C or Zwartbere) was developed by Gebr. van Engelen in Holland. It is a low-growing variety with an attractive, rich, dark green color. It is moderately susceptible to leafspot and stripe smut.

Warren's A 10 (Plant Patent 2615) is a dark green variety with moderately fine leaves. It seems to do better at high temperatures than other bluegrass varieties. It is moderately susceptible to Helminthosporium leafspot. A10 is higly sexual and must be propagated vegetatively to reproduce the variety.

Warren's A 20 is a dense variety slightly finer in texture than Merion. It appears to have good resistance to Helminthosporium leafspot. Vegetative propagation probably will be necessary with this variety.

Warren's A34 is a vigorous, dense variety with moderate resistance to leafspot and stripe smut. It has been reported to have better shade tolerance than Merion.

Experimental Varieties

PSU K5(47) is an experimental selection developed at Pennsylvania State University from a single apomictic plant resulting from sexual reproduction of a selection made by Prof. H. B. Musser. It is presently being tested at a number of locations throughout the country and shows considerable promise. It has shown good resistance to leafspot, stripe smut and some races of rust. It is moderately susceptible to powdery mildew. PSU K5 (47) produces an attractive, fairly dense, moderately low-growing turf of moderately fine texture. It has shown very good color in late fall and early spring in tests at Rutgers. Seed yields have been disappointing in the Pacific Northwest.

Pennsylvania State University has a number of other promising varieties in early stages of testing. They include K103, K104, K106 and K107. All show good resistance to leafspot. PSU K106 and PSU K107 are similar to PSU K5(47) in appearance.

Belturf (formerly S-5) was distributed for regional testing in 1964. It was selected at the Plant Industry Station, Beltsville, Maryland, by Drs. Felix V. Juska and A. A. Hansen from an old management experiment. It is a vigorous, dense, semi-prostrate type with excellent rhizome development and good resistance to rust. It appears moderately susceptible to leafspot in early and mid-spring, but recovers satisfactorily by late spring and early summer when many other varieties are being damaged most seriously. It has good rust resistance and appears to show stripe smut resistance. Belturf has an attractive, rich, dark green color and excellent turf-forming properties. It is susceptible to powdery mildew.

Beltsville 117-27(6) was distributed for regional testing in 1964. An irradiation-induced mutant of Merion, it has a dark green color, a prostrate growth habit, good turf-forming properties and good tolerance of leafspot and rust.

Anheuser dwarf was selected in 1952 by Dr. W. H. Daniel of Purdue University. In tests conducted at Rutgers since 1960, it has exhibited a number of outstanding features. It has excellent resistance to leafspot, stripe smut and powdery mildew, a prostrate growth habit with short leaf sheaths, is able to tolerate scalping and fairly close mowing, has a slow rate of vertical growth requiring less frequent mowing, a rich, dark green, attractive color and somewhat better rhizome development than Merion. Anheuser dwarf also has some weaknesses. It is a relatively poor seed producer, seedling germination and emergence is weak, it is susceptible to stem rust, has a wide leaf blade and lacks density. Thus may result in less thatch and fewer problems. It produces adequate density for most purposes if properly fertilized.

Editor's note: A four-line increase including Anheuser has been turned over under contact for increase as Sodco. Hopefully sod grower can get contract seed in 1969.

NJE Pl[illegible]s selected from a golf course fairway near Syracuse, New York. It shows good resistance to leafspot and moderate resistance to stripe smut. Leaf

texture and growth habit are similar to Merion. The variety greens up very early in the spring and is extremely attractive in early and mid-spring. During late spring and early summer, the variety is rather stemmy. It produces high quality turf during the fall season. NJE Ple is partly sexual. It has been successfully used in crosses with PSU K5(47), Anheuser dwarf and Belturf. A number of very promising hybrids have been obtained and are in early stages of testing.

NJE P-24 originated as a single plant selected from PI 258,785 originating in the U.S.S.R. It is similar in growth habit, turf-forming properties and diseases resistance to Merion, but has a much darker, richer green color.

NJE P-1 was selected from an old public park in northern New Jersey. It has considerable similarity to Anheuser dwarf in appearance and disease reaction.

NJE P-27 was selected from an open-pollinated progeny of NJE Ple. It has a high degree of resistance to leafspot and melting-out and a very attractive, rich, dark green color.

NJE P-3, NJE P-21 and NJE P-16 were selected from a progeny of Anheuser dwarf which had been pollinated with PSU K5(47). P-3 and P-21 clearly show characteristics of their PSU K5(47) parent, indicating their hybrid origin. P-16 is an Anheuser dwarf type, but with greater vigor.

NJE P-12 and NJE P-13 were selected from a progeny of PSU K5(47) which had been pollinated with Anheuser. They are both intermediate in appearance to the two parents.

Varietal Mixtures

Currently blending of several selections is preferred. As they are available then mixtures of a number of elite, low-growing, compatible varieties, each with good resistance to leafspot and stripe smut, may be the best way of getting superior Kentucky bluegrass plantings adapted to a wide range of environmental conditions and management practices. Such mixtures should offer considerable insurance against turf failure which may happen when growing any single, apomictic selection.

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TOMORROW'S VARIETIES OF SOD

C. Reed Funk, Rutgers - The State University
New Brunswick, New Jersey

The development and use of Merion Kentucky bluegass has been of tremendous value to the sod industry of the United States. Its relative importance can be compared to the initial impact of hybrid corn on the farmers of the great Midwest. Merion has been the foundation of most of our cultivated sod production. In New Jersey over 90 percent of all cultivated sod produced consists of straight Merion bluegrass, or mixtures containing this variety. Under conditions of moderately close mowing and high fertility, turf of Common Kentucky bluegrass and varieties such as Delta, Park, Geary and Arboretum may show 60 to 100 percent turf loss from Helminthosporium vagans when adjacent stands of Merion are left virtually undamaged.

In one respect, however, the corn farmers are presently much better off than the sod producers. They are not dependent on virtually one variety, but have dozens of excellent hybrids adapted to different soils, climates and uses. These present hybrids yield 20 percent more than those initially used in the 1940's and are superior in disease and insect resistance, stalk quality, lodging resistance and adaptability to mechanical harvest. Yet hybrids are being developed by hundreds of private and public breeders throughout the country. As new problems and needs arise, this trained group of plant breeders has the resources to quickly develop varieties to meet the challenge. They have built up a tremendous body of knowledge in the science of corn breeding, recruited a dedicated and talented group of trained personnel, and accumulated a vast collection of valuable germplasm.

In contrast, the sod industry has been essentially dependent on one improved bluegrass variety to give the consumer a high quality, leafspot resistant turf. He has virtually all of his eggs in one basket. If trouble develops with this variety, if the customer wants to try something different, or if a special use situation calls for something else than Merion, the sod grower has had nothing really outstanding to offer. He is very little better off than he was back in 1947 when Merion was first released.

Fortunately, a number of Universities, seed companies and sod growers have recognized the need for better turfgrass varieties and have initiated breeding programs. We are gradually accumulating the fundamental knowledge necessary to breed Kentucky bluegrass in an efficient manner. The great Swedish geneticist, Arne Müntzing, discovered apomictic reproduction in Kentucky bluegrass in the early 1930's. This discovery was followed by extensive embroyological studies by Fred Tinney and E. L. Nielsen in Wisconsin, Erik Akerberg and Axel Nygren in Sweden, and Franco Grazzi from Italy. Breeding studies by D. C. Smith, E. L. Nielsen and H. L. Ahlgren at Wisconsin, H. K. Hayes and H. L. Thomas at Minnesota, W. M. Meyers at the U. S. Regional Pasture Research Laboratory, Jens Clausen and his co-workers at the Carnegie Institute, H.B. Musser and J. M. Duich at Pennsylvania, and W. L. Brown and W. H. Brittingham working with the U. S. Golf Association Green Section, contributed to our knowledge of bluegrass.

Unfortunately, these studies were not carried far enough to develop really superior varieties, or to finalize an efficient breeding system. Thus, at present, all commercially available bluegrass varieties originated as individual plant selections collected from old turf areas. Many people became skeptical that an effective breeding program could be developed to improve Kentucky bluegrass. A similar situation had developed in the corn breeding programs of the late 1800's and early 1900's. Extensive breeding programs using mass selection ear to row and similar breeding methods showed little progress in increasing the yield potential and many thought that a ceiling had been reached - but, look at the superior corn hybrids of the present.

Apomixis, as it exists in Kentucky bluegrass, is an ideal method of maintaining a superior nybrid genotype. An elite variety such as Merion most likely originated as a chance hybrid in nature. Merion maintains its superior, hybrid genotype because about 97% of its seed is produced through apomixis and is thus genetically identical to the mother plant. Recombining the best characteristics of a number of elite parents through nybridization should be efficient. The plant breeder can bring together the best plants from all over the world and hybridize them. His progress should be much more rapid, especially if he has excellent parental material, an efficient breeding procedure, good evaluation techniques and sufficient financial support to screen large plant populations.

A limited number of good parental plants are now available for hybridization work in Kentucky bluegrass. Breeders, turfgrass agronomists, pathologists and physiologists at Purdue, Beltsville, Michigan State, Minnesota, Penn State, Vermont, Virginia, Rutgers, Warren's Turf Nursery, O. M. Scott, Northrup, King and elsewhere are developing more efficient evaluation techniques. These cooperative efforts should lead to a number of superior varieties of bluegrass within the next decade.

The sod industry needs a number of good bluegrass varieties. Bluegrass is used as a long-lived perennial turfgrass under an extremely wide range of environmental and use situations. These range from shade to full sun, show-place to family-use lawns, nearly year around athletic field use to roadsides, to say nothing of variable climates, exposures, soils and maintenance practices. Specialized bluegrass varieties to tolerate shade on home lawns, traffic on parks and playgrounds, heat and drouth on hot souther exposures, close-mowing on the golf course and low maintenance on our roadsides are needed.

The use of new, superior bluegrasses will have a highly stimulating effect on the entire turfgrass industry. People with superior, well-adapted varieties are well rewarded for their efforts in liming, fertilizing and other improved management practices. They are proud of their lawns and happy to spend the effort and money needed for sod, seed, lime, fertilizer and equipment with the knowledge that such money is well invested. People with an inferior or unadapted variety which responds poorly to their efforts in improved management soon become discouraged.

New varieties will become available. They should be adequately tested before being put into widespread use.

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TURFGRASS IMPROVEMENT THROUGH BREEDING AND SELECTION

Terry Riordan, Gradute Student in Turf,
Purdue University

The work being done here at Purdue has a two-fold purpose. One, we are looking for a vigorous, medium-growing selection for roadsides. The second purpose is to find a low-growing, semi-dense, disease-resistant selection for turf areas, such as golf courses and home lawns.

Certain basic rules for breeding and selection have been followed to make the bluegrass program more efficient. First, a large amount of diverse germ plasm has been obtained in several different ways. Local and foreign field collections are being used: 16-B, Chicago Golf Club; Nugget, cold tolerant from Alaska; and Northport, from Europe. Selections from other institutions were obtained, and well-known and widely-used varieties, such as Merion bluegrass, are included. Other sources of diverse germ plasm would be the artificial mutigens, such as radiation and chemicals, which are known to increase variability.

A second basic principle would be the need to understand and know the plant so that large numbers of perennial plants can be maintained and evaluated efficiently. The cytological differences (chromosome number and embryogenisis) must be studied, and also whether the plant is apomictic or cross-fertile. This better

allows a breeding program to be established. Another example of increased knowledge would be in the greenhouse where early selection allows the research time to be used on the better plants.

Another rule would be that there must be a selection pressure, or a survival of the fittest plants. This will lead to an increase in the frequency of superior genotypes in the plant series, and thus provide better material for plant selection. The following is a list of selection differentials which we are using here at Purdue: differences in mowing heights, insect and disease infestations, shade, nutrient level, and seed production capabilities.

A fourth and final rule is that we must have time to do the research. Dr. Daniel has stated that it will be at least 1970 before the current selections of Anheuser dwarf, 16BB56, RI-10, and AQ6 will be released in limited quantities. It will probably be 1975 before results of my work are available to you. This is because of the volume of testing, the small quantity of seed, and also the time required for acceptance by the public.

This work at Purdue has been carried on since 1951. At that time a few apomictic selections were studied, but it soon was realized that variation was the real key to success. Dr. Daniel has kept the program flexible, and thus, the program has the needed diversification to allow selection of different type bluegrasses for different uses.

Including this year's planting, over 10,000 spaced plants have been observed within the past three years. In the fall of 1966 solid seed plantings includes 300 plots. Selections obtained from Pannsylvania, Michigan, Minnesota, New Jersey, Sweden and Europe are included.

After one month seedlings were selected out of plot material for individual transplant into four-inch pots for greenhouse increase overwinter. This will be the material for the present 1967 space planting. This coming spring and summer observations will be continued on space plants, sprig plants and plots. Vegetative and seed increases of outstanding individuals will also be made.

At the present time bluegrasses are being selected using I.B.M. cards and a card sorter (I.B.M. 83). This allows the seventy-two thousand bits of data to be analyzed at six hundred pieces per minute. Hopefully, this I.B.M. process will better allow selection of that new bluegrass or bluegrasses. At the present time 3700 of the original 3900 plants have been discarded. This leaves 5% of the total population to be used for further work in the selection of that new variety of the future.

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DEVELOPING A NEW SOD FARM

Donald W. Morrill, Shamrock Turf Nurseries, Inc.
Hanna, Indiana

The views on developing a new sod farm, which I will discuss, are based on my experience in the Chicago market area after working to develop three different sod farms in the last ten years. I am going to outline the three main points which I consider to be MUST'S in developing a sod farm. They are: management, site and

market and resources. I have tried to list these in their order of importance to me.

First and foremost I think a person must honestly analyze himself before entering such a business. Under owner or operator requirements I would list the following:

1. A love for this type of business (to the extent that you can live with it 24 hours a day when necessary). Remember that this is a manufacturing business - nor farming. You can't just plant it and forget it - not even for a minute. There are always problems coming up - nature changes, labor, marketing, trucking, etc. Loving the sod game will get you through the rough spots without losing your mind.

2. Be capable of assuming the responsibilities of running a business. As I said this is not just growing grass - this is a business with all the complications this brings.

3. Experience in sod is essential. I worked for another sod grower for five years and this is the minimum experience I would recommend.

4. Sales and marketing experience is also invaluable. Mine was selling for Swift & Company, but any selling or related experience will be profitable to you later.

5. You must have management abilities - being able to work within a budget, making the best use of men, money, land and equipment, weighing investment against return, analyzing consumer credit, determing credit risks, etc.

A turf farm manager must be a people motivator and have the abilities to get his personnel to do what he wants them to do, the way he wants them to do it. This is extremely hard for a small business man, who is production-minded, but teaching and training is what we need to do -- not just order jobs done without ever explaining why.

But, assuming you meet all these qualifications, let's move onto the site and market. Today 96% of the U. S. population live in cities - only 4% in rural areas. This means we must locate near the heavily populated areas or cities; personally I would not want to locate in any area that did not have a minimum population of 500,000 within a 50 mile radius. One reason is that the distance from the market is a direct ratio to the number of loads you can haul per day, and also is a yardstick to how many trucks are required - this is an important consideration. Also, and equally important I feel is avoiding areas over-populated with existing or expanding sod farms, such as Detroit, Chicago or Milwaukee.

Thirdly, let's assume you are entering the sod business to sell sod (and not as a real estate speculator) so you will not want to sit right on the edge of a large city. Some of the reasons why I would stay away from this are rising property taxes, changing zoning laws, complicated water problems (contamination and availability), etc.

Fourth, let's put our model sod farm on a state highway. It makes it easily accessible the year round, it's good advertising, and in most areas it will exempt you from the frost laws that might tie up secondary roads during early spring harvesting.

Fifth, let's make sure our site had adequate, clean water. Do not under-rate water as a necessity. First check the average annual precipitation. Make sure you

have an adequate supply during your growing seasion. I would hate to figure on irrigating more than one-half of my requirements. Other sources for water (with which to irrigate) are ponds, streams, rivers and wells, but you should check water table depths and whether or not you can get water in volume. From my own experience I would not even consider a farm without putting down a test well first. In my area we need a minimum of 1000 gallons per minute for every 160 acres.

Sixth, consider the drainage of the site in question - this is almost as important as water itself. Make sure you can get rid of your excess water before it has time to do any extensive damage. One of the major growers reported $ 450,000 flood damage not too many years ago. There are several ways to drain land - natural drainage, field tile, ditches, or pumps, to mention those with which I am familiar.

Last on my list of site requirements is soil types. Sod can be grown on almost any type of soil and in most cases successfully. I will only recommend that you try to get a soil that is relatively free of stones. There are three soil types that I am familiar with and I will only discuss these and mention my personal reactions on each type.

Clay Type Soil

Advantages	Disadvantages
Doesn't blow	Slow for root development
May dormant seed	Sod, when wet, is heavy
Good water-holding capacity	Subject to cracking during drouth
Holds plant food better	Hard to work
Can load trucks in the field	Water penetration is slow when dry

Sandy Loam Type Soil

Easy to work	Blows
Doesn't crack	Doesn't hold fertilizer
Enables good root development	Doesn't hold water well
Absorbs water easily	More susceptible to disease
Can load trucks in the field	

Muck or Peat-type Soil

Sod grows like crazy	Blows
Good water-holding capacity	Can't load in field
Holds plant food well	Subject to flood conditions
Sales appeal	
Lightweight sod	

Lastly, in discussing resources let me tell you what Bob Warren told me several years ago. They had just sold their first yard of sod off a particular 200 acre plot and he figured this yard of sod cost about $ 250,000 over and above their capital investment (land and equipment). Add to that your first two years living expenses while you're waiting to market yard No. 1 and you might come close to your monetary need. Of course, if your acreage is smaller, the cost is less overall but more per acre.

With some of this money you must buy equipment, which I consider a necessary evil. Because cur business is seasonal the dollar invested in equipment is at the bottom as far as its return compares with other expenses. Steel mills work 24 hours a day, seven days a week just to make their equipment pay. I just cannot get excited over owning a lot of equipment, especially if I can lease it cheaper and write it off as expense. We do own all the equipment we feel we need to function properly, but we do still take off the plow to put on the disc. Proper servicing of your machinery can double its life, and I'm a great believer in this. And, don't get me wrong, we mechanize whenever and wherever we can profitably. By the way, we hire all our trucking out.

Still another way to spend that money you're investing is in good men - ones that you can train to do your kind of job. I've found it is wise to hire good men for good money and expect them to live up to an honest day's pay. Most of my men have shifted into their own niches automatically and those that haven't do not stay. With diversified duties each man can share responsibility and yet be part of a team effort. Statistics-wise: for about 360 acres I have five full time men (with hosp. furnished and income protection furnished), and we use about 15 seasonal employees. For migrant workers we furnish modern housing, stoves, refrigerator, hot water, showers, laundry rooms with washers (pay rate $ 1.45 to $ 2.00 per hour).

In conclusion, what makes a good sod farm? GOOD LOCATION - within 50 miles of several large cities, on a state highway, flat, square, well-drained, with water supply (and I would add, on muck). SPECIAL EQUIPMENT - wheel move irrigation is our answer to proper watering, time-saving, labor-saving, and gets the job done right. Mechanized harvesting is a must for survival. We have cut, rolled and loaded mechanically for three years, and whenever we find a better way we'll switch to that. GOOD PRODUCT - don't knock it! Nothing sells like a good product - it's worth more time, more money, more effort. I hope I never get too big to give my customer the most for his money (and by the way, I'm not the cheapest around and I don't ever intend to be).

I thank God for the opportunity to be a sod grower and for His help in bringing me along this far. Thank you for the time you took to listen to me.

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SOD CERTIFICATION

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

The purpose of this talk is to summarize for those here from the Midwest some of the current concepts included within certification of sod of several states where this is being attempted. As expected, the five major subdivisions of certification standards are followed. These include: application eligibility, land requirements, specifications, field standards and specific requirements.

The purpose of certification as quoted from Nebraska is "To maintain and make available to the public through certification, high quality sod of superior types of turfgrasses so grown and distributed as to insure genetic identity and purity, with a high degree of freedom from weeds, insects, diseases and other pests."

You will notice that certification is a tool to identify high quality sod from superior types of turfgrasses. To accomplish this the superior types must be identified - usually by the Agricultural Experiment Station, then accepted by the certification group, such as a crop improvement association. Obviously there must be application forms, there must be inspections, there must be proof in order to qualify the final product as certified.

What is Proof?

Land requirements are basic to all certification programs whether vegetative or seed planted, and regardless of crop grown. One specification quotes - "field will be considered for certified sod production only if during the preceding three years it had grown the same variety established from foundation, registered or certified seed." Another specifies - "on land which had not produced for the previous two years." Another - "unless one year of clean, cultivated crops were produced." Another - "unless a six months fallow is followed immediately by planting." Another - "once the soil was treated by a recommended soil fumigant, or accepted herbicide program."

How Do you Prove This?

One specifies - "Inspected twice prior to planting at approximately six weeks interval." Another - "Inspected four times prior to planting." Another - "Left undisturbed for two weeks before inspection to determine - - - -."

What Is Contamination?

One specifies - "Must be reasonably free of contamination of other turgrass species, crops and weeds." Another - "Presence of unacceptable weeds and undesirable perennial grasses." Another - "To identify any other perennial grasses, or strains of noxious and objectionable weeds." Another - "Field inspection will be made not only to determine the identity of other crop plants, weedy plants or percentage of turf species in the mixture."

Generally in the Midwest bentgrass, quackgrass, nimblewill are considered vegetative contaminants which may exist in a field and create variable color and texture when transferred with the sod. South of here Bermuda, or any creeping vegetative grass and nutgrass could be considered major contaminants. Of less consequence, but at times of critical value, may be contamination of bunch-type grasses, including tall fescue, orchardgrass, bromegrass which as clumps would disfigure the perennial sod. Of special importance Poa annua, because of its profuse seedhead formation, presents a special problem as a contaminant in sod fields for it may increase its population through seeding after sod placement.

Inspections During Growing

Specific inspections should be made just prior to harvest to ascertain sod quality and to assure reputation of the broad sod certification program. Severe damage resulting from insects, diseases, etc., which may weaken the sod, should restrict sale of the sod until repaired. Of special significance, because of sod moving, transfer of insects either restricted or unrestricted by regulations should be minimized by effective insect control programs. Of some consequence is the potential of nematode distribution. However, this has not yet received much attention.

Generally certification will also make inspections during the growing periods to upgrade the production program and to exchange information.

Tagging and Labeling

Upon certification then a labeling requirement must be met - "All stocks, when sold as certified, shall have a proper label properly affixed to the invoice. The certification label which is attached serves as evidence of genetic identity and purity." The responsibility or obligation rests with the grower or subsequent handler.

Basically, therefore, the certification programs now active in Maryland, Pennsylvania, Nebraska, New Jersey for bluegrass sod are effective means for education and promotion. They will definitely require a closer cooperation of the grower, the merchandiser, inspection service and the Experiment Station. All this correlation must cost. My personal estimate of this cost is approximately 10%. Certainly the service should be as self-supporting as possible, thus application fees, tag charges, field records all become a part of a tedious process. Travel for inspection followup on complaints all require time and knowledgeable personnel.

For these reasons sod certification will proceed rather slowly. It may serve as a useful tool during the coming periods. It should become more important as we get special varieties which will require a premium in the market. The sod growers have been progressive and aggressive in the development of their business and production programs. The new national sod association should be a further adjunct to improve sod programs.

The attempt of this has been to summarize in general terms the purpose, requirements, inspections and program common to many certification specifications.Note: (With about 100 people in the room, including an estimate 30 growers, most agreed that in the Midwest certification was not yet desired.-Editor)

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ARTIFICIAL TURF

W. H. Daniel

Basically turf provides these features -

1. Color of surface - usually a contrast. Think of the baseball field. Usually it is green.

2. Mud reduction. Turf permits playing on muddier soils with more finesse. Also, turf permits playing on a drier field with satisfactory results.

3. Resiliency and playability. By reducing evaporation and providing a mechanical cover turf increases the softness and protection to players.

4. Traction improvement. Good sod is strong. It supports the player as contact is made - providing safety against unusual slippage.

5. Finally replacement of wear. New growing points, new seed germinating, new leaves may repair damage rather quickly.

If artificial turf is used it must also have side strength or traction resilience, a leaf character to reduce skid burns, color retention, permit excess moisture removal and permit cleaning. There are the additional problems of anchoring the edges, moving of the material, storage during non-use and rearranging for various purposes.

The artificial turf will require a porous media. In order to regulate moisture for conditioning there will be the need for automatic irrigation. In order to lengthen the season soil warming will be needed and, of course some grooming will be necessary. Thus the question is not one of simpler maintenance, or simply operation. It is basically a question of increased frequency of use which artificial turf might permit, or conversely the limitations of living turf to replace wear occurring on the site under extreme schedules.

Just think - a stadium with 70 plus baseball, 16 plus soccer, 12 plus football, plus practice sessions of baseball, warmup sessions for soccer and practice sessions for football is asking quite a bit of any turf.

Finally, artificial turf must be well engineered. Not all grass leaves are the same height - there are shorter leaves and longer leaves in effect. This increases the intricacy of manufacturing as well as the cost. And, damaged areas need replacement.

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EFFECTIVE BUSINESS COMMUNICATION

Prof. Glenn Griffin, English Dept.,
Purdue University

Have you looked at your letters and memos lately? Are they ---

Courteous

Clear

Complete

Concise

Correct

Credible?

1. If your letters are courteous --
   They are sincere.
   They show positive rather than negative thinking.
   They reflect man's dignity - of both the sender and the recipient.

2. If you letters are clear --
   They are written with the reader in mind -- the "You" attitude.
   They are planned before the first word is said or written.
   They are free of businessese -- the talk of an inner circle. (It's like a foreign language to the person outside the circle).
   They are free of double meanings and contradictory statements.

3. If your letters are complete --
   They answer pertinent questions of time, place, amount, procedure.
   They give reasons for unusual procedures.

4. If your letters are concise --
   They are keyed to simple words.
   They are free of rambling sentences.
   They save time -- yours, your secretary's, the recipient's.

5. If your letters are correct --
   They are written according to conventional, acceptable usage.
   They are made correct by two people -- you and your secretary.
   They are carefully proofread.

6. If your letters are credible --
   They are free of exaggerations.
   They fit the situation. (Form letters not adapted to particular cases often miss their mark).
   They are free of expressions put in to "make somebody feel good" or to rationalize a company action.
   "You are one of our best customers" is a worn-out gimmick.
   "Our entire organization wishes you well" includes people who don't know or care about the situation.
   "You leave us no alternative but to---" lacks conviction; it's ordinarily not true.

Letters are exchange of ideas among PEOPLE. They are not just symbols on paper. Make yours fresh and personable.

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HORTICULTURE OCCUPATIONS PROGRAMS

Avery Gray, Dept. of Public Instruction,
Indianapolis, Indiana

Turf Management is the focal point of one of the job clusters in the broad field of Horticulture which has stimulated the development of a new horizon of teaching and learning experiences. The over-all program is understandably broader in scope to allow some degree of choice for students. The central thought for the Vocational Horticulture Program becomes "A New Horizon of Occupational Opportunity in Horticulture."

Although an integral part of Vocational Education in Agriculture, Horticulture may be the only phase offered in some urban and suburban schools. Both young men and women will find challenging opportunities in Horticulture. The main objective for any vocational program is to develop, within individuals, those competencies needed for successful employment in a given occupation or cluster of

occupations. It is important to remember that such a program has considerable "spin-off" effect which tends to enrich the total school curriculum. Even elementary students and teachers may become involved in the development of aesthetic values as a part of the practical experience program carried out by upper-classmen in Vocational Horticulture Programs.

The program is highly flexible in both length and content; consequently, it can be custom designed to meet the needs of students in almost any community or school system. In general, extensive use of community resources and businesses is suggested. However, the program is such that all of the practical experience could be on the school land laboratory, or, on the other hand, practical experience may be gained by working on golf courses, sod farms, garden centers, or other similar businesses.

THE COURSE OF STUDY

A State Horticulture Consultant Committee of 20 has developed a flexible guide which any given school may use. This guide is so designed that the length of each instructional area is flexible and some areas may be omitted, depending on the nature of the community and the needs of the students.

Specific teaching materials have been prepared to serve as a teacher-guide in the preparation of each lesson. An extensive list of references, teaching aids, materials, supplies and sources of additional help are available. Only the broad areas of instruction are listed for your information here:

Exploring Occupational Opportunities in Horticulture
Identifying Horticultural Plants
Propagating Horticultural Plants
Growing Horticultural Plants
Using Soil and Other Growing Media
Recognizing and Controlling Plant Pests
Constructing and Using Growing Structures
Horticultural Salesmanship
Establishing and Caring for Lawns and Turf
Operating and Maintaining Small Power Equipment
Use and Care of Ornamentals and Landscape Structure
Human Relations in Horticulture

Practical Experience Programs

Every individual must have the opportunity for meaningful personnal experiences of a practical nature to develop competencies important to success. However, the development of desirable work habits and attitudes cannot be overlooked. Such learning experiences should be carefully planned and carried out with the assistance and supervision of the instructor.

The location of practical experience activities can be varied. The value of certain home-centered activities should not be overlooked. School-centered activities on land laboratories, lawns and greenhouses are especially useful at selected stages in the program. Certainly the program should utilize occupational training opportunities in the community where actual on-the-job experience can be attained. Much of the course of study can be taught through the production of specific crops in the greenhouse and on school land. The types of crops include flowers, vegetables, fruit, turf and nursery stock.

Facilities and Equipment

A detailed guide has been prepared. Included are classroom, mechanics, greenhouse and land laboratory recommendations. Several Hoosier schools are starting their program in plastic covered greenhouses with the expectation that glass houses may be needed in the future.

The entire school property can conceivably become a learning laboratory. Shrubs and other plantings can be sprayed, pruned, propagated and transplanted. Essentially the same is true of turf areas as well. However, it would be certain death to the educational value of Vocational Horticulture if the students enrolled become cheap or unpaid labor for the school grounds.

Specific areas should be set aside for the use of the horticultural students to lay out two to six acres of plots for the production of nursery stock, vegetables, flowers and turf. The space available and its use should be flexible depending on the community and the needs of the students enrolled.

Help Needed

Are you willing to help insure success? The true test of this innovation depends on its acceptance by the businessmen in the horticulture industry. Several states are developing similar programs. Will you encourage local school corporations to consider initiating a Vocational Horticulture Occupations Program? Will you advise and help teachers develop this program? Will you provide on-the-job training? Will you employ graduates from such programs at premium rates? Can you afford not to?

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CHALLENGE AROUND THE WORLD

Dr. R. C. Pickett, Dept. of Agronomy
Purdue University

What does the world population increase mean to you and me? We have all heard of the fight for additional food to keep up. The idea I would like to get at today is - how does the stage of development of a country affect those who come into cities? All around the world cities in under-developed countries are growing very fast. The ability of a country to feed its people, clothe them and house them does affect our happiness. How does it affect your turf business? Well, you'll have to draw some of your own conclusions.

During my trip around the world I lived in India in 1963 for 1964. Last fall I revisted many of these areas, plus some new areas in Africa. I'm going to South America for an eight weeks visit to research stations.

Let's start the discussion in Sinaga in West Africa. In a bazaar, or market place, you have a great many green leafy vegetables for nutrition. Yet, the primary crop is ground nuts or peanuts and the malnutrition is amazing. In spite of the ability to grow crops many of the countries in Africa and Asia and other places in the world do not have enough for their populace. One of the things I get the

biggest kick out of are the interesting people you meet. Lagos, Nigeria, is one of the cities growing faster than any place else. Our challenge is - "Can we make these cities a decent place to live."

You in the turf industry are certainly engaged in the matter of attractiveness of homes and recreational areas. I can assure you that many cities are not engaged in the turf industry. I'm not saying they don't need it, understand. Now we can see these things all too clearly in other people's culture, can't we? The question is, "Can we turn around and look at our own culture and see what's holding us back?" Compare! This is a city of a million people here in small city/central Nigeria. But, right outside of this city, the jungle is just as it was centures ago, millenniums ago. In villages where most people live there is little landscaping or recreational area. There are work areas, however, where they boil the palm oil and prepare fresh pork for consumption.

Bill Meyers, who is associated with the Rockefeller Foundation, is concerned with improved crop production in these tropical areas. Well, some of the great crops they grow are wrong, and I submit that this affects you and me. For example, casaba is a starch crop, which has only about 1.5 percent protein. Throughout the tropics people eating this are under-nourished, which seriously affects some of the cropping practices. Some of these ideas sound pretty good just offhand, putting one crop of millet out and letting another crop (sorghum) come up.

Lack of water is one of the things holding up development through most of the world. Leaf diseases can come as can insects. Many people are engaged in growing animals. The horns on these cattle would sell for souvenirs in Texas, but seriously they are growing millions of these in the northern part of Nigeria - but they march off all the meat as they walk to the market.

If we are going to gather together in civilization, people must get along with each other - we have to have harmony and communion with each other. When I was in Nigeria tribal warfare broke out and there were road blocks outside of every major city we came to. I did not like it at first, but somebody explained that probably it was the best way of keeping explosives out and keeping the riots down. However, the day after we left Lagos Airport, the mob joined the army and slaughtered off several thousand of the opposing tribesmen.

In order to understand this development process, we need to understand that 80 percent of the people in the world live on subsistence agriculture. This is just a Moslem village in Northern Nigeria. And yet, it was this same group of people out of this village and some additional places that got together with their army and killed off the opposing tribes.

The University of Ebodin in Nigeria, which the English started in 1948, is proceeding, with a good deal of American help, but the Nigerian people are using it very well. A Ph.D. from the States, now a teacher, makes enough money to have his own vehicle at the Modabelle University in Southern Nigeria. A Ph.D. from Purdue, Rueben Olembo, is teaching at Uganda, over in East Africa. Again one sees a little turf area around some of the better developed institutions, but this is not their main point of concern, which must be existence - the basic health of the people. In much of Africa food is certainly the prime concern.

But, they are also concerned with education and some of the accoutrements that go with it. Micare University College is an excellent institution. The East African Research Organization is concerned with agricultural improvement, including forestry. A Ph.D. from Purdue of a couple of years ago will soon take over as Research Director. The bazaars are quite interesting places with a variety of goods. So are the Moslims in prayer at the ancient wall city of Connel. Many wonderful

bodies of water, as Lake Victoria, make beautiful lakes; yet are practically useless. You think - boy! we could sure have recreational areas, boating, fishing and so on, but one of the reasons is the snail-born diseases which affect people. It is a technical problem to be licked to even use their basic land resources or water resources in many areas of the world.

It's fascinating to see East African game reserves. If game parks are properly preserved as civilization is built up around them, it could be one of the fine spots in all the world. Climate in places like this, in high elevations of the tropics, is absolutely beautiful. I got telephoto pictures of many game animals - it is a thrill to visit such areas. It is almost like Disneyland when you see the elephants and giraffes; a lioness with her fresh kill, with her mate dragging a partially eaten leg around.

The tropics are one of the most challenging locations. The real people living in this game preserve area are the high-flight tribesmen, who are just cattle herders. They are a little healthier than those people eating that casaba and yam, because they eat a blood pudding from the jugular vein from the cattle they herd. But, these people still lack health and well being to properly utilize the resources from the wonderful area in which they live. They build an enclosure of thornbushes and live in mud huts and herd their cattle in at night. This shows how many of the areas adjoining the game park are being cleared and being used for housing and subsistence agriculture. Finally, one of the problems slowing development might be typified by this group of Indians in East Africa. They were brought in as railroad workers and now are a minority group.

Challenges Around The World are obvious! How can you and I as Americans help individuals?

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