NORTHWEST TURFGRASS ASSOCIATION

Proceedings Of The 28th Northwest Turfgrass Conference

September 24-27, 1974
Sun River Lodge
Sun River, Oregon

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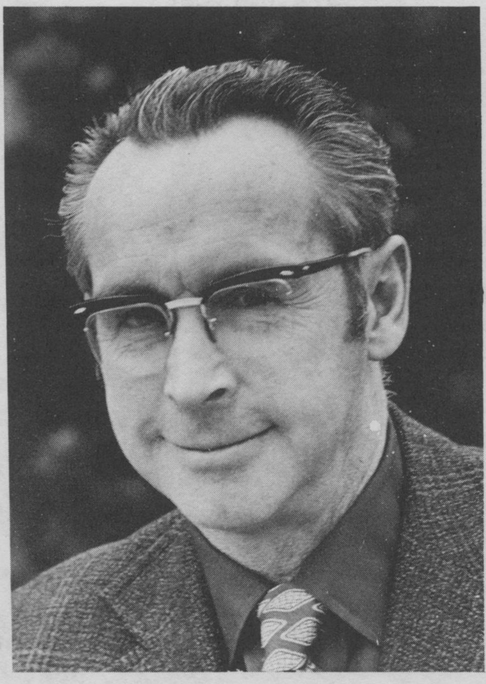
PRESIDENT'S MESSAGE



Welcome to Sun River and to the 28th Annual Northwest Turfgrass Conference. Certainly there is no finer setting for a Conference. Your Program Chairman is Richard Fluter who has worked closely with Dr. Roy Goss to give you a good, solid turfgrass program. We hope you will leave some of your ideas with us as well as receiving ideas from our program speakers. Mrs. June Schwabauer has a fine program lined up for the ladies. Our thanks to June.

I feel the highlight of this year was our Turfgrass Field Day. Dr. Roy Goss, Dr. Charles Gould and Dr. Stan Brauen have as fine a turfgrass research program at Puyallup as you will find anywhere.

I would like to thank the fellow Directors of this Association for their help this past year. We have had great cooperation from each one. Our membership has shown much interest in our Association with many helping in the area of membership this past year. I would hope that you would add to the success of the Conference by leaving your ideas with one of the Directors as to what you would like to see on the program in the future. I am sure you will receive consideration for ideas that you have to offer. This is your Association. Please be active and take part in all of its function.

Thank you for the opportunity of serving as President this past year. I hope your stay at Sun River is a good one.

NORTHWEST TURFGRASS ASSOCIATION

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AN ALTERNATIVE METHOD OF GREENS MANAGEMENT[1]

John H. Madison[2]
William B. Davis[3]
Jack L. Paul[4]

We propose a system of frequent, light topdressing as a management practice that favors quality putting turf on greens.

Much material of this paper had been formally presented in one paper (1) and set forth briefly in another (2). Here we discuss our proposal extensively and informally so the reader can understand our goals and the approach to achieving them.

In the late '50's Madison had creeping bentgrass plots which had become thatchbound through a program of heavy feeding and watering. The grass was unhealthy, the plots did not accept water well, and the turf did not respond to nitrogen. The turf problems did not respond to use of fungicides nor wetting agents. Coring resulted in some improvement. Of operations tried, only topdressing restored the grass to vigorous, healthy growth.

At about the same time some Dano method compost was piled next to another bentgrass plot. The evening winds blew small amounts of compost across a corner of the turf plot.

Over 15 months, the grade of the plot was increased from 0" about 6' away from the compost pile to over 2" next to the pile. That part of the turf topdressed by the wind

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[1] To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

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was beautiful the year around until late in the second summer when, during a hot spell, there was heavy loss of grass associated with rapid breakdown of the organic topdressing. The pattern of kill resembled what is often described as "scald".

On the basis of these observations we became interested in topdressing and initiated some trials. We topdressed monthly with topdressing containing several different amounts of organic matter from different sources. We found that large amounts of light, loose materials such as peat or sawdust resulted in a loose thatch and unplayable turf. Denser materials such as granulated bark produced a better surface but were not as good as plain sand in creating a firm, true surface. Whenever we used 25-50% organic matter, disease problems occurred during hot weather.

Subsequently we ran tests in which all elements of a putting green management program were separated and used individually on bentgrass plots. The first season these showed that a fungicidal preventative spray produced the most thatch and an excellent turf. The high rating of the fungicide treated plots was exceeded in mid-summer when plots receiving insecticide surpassed it. Any use of herbicides reduced turf quality. Coring aided greatly in thatch breakdown. Cored plots were better than the control. Plots receiving a regular sand topdressing showed good quality, but the plots were not outstanding. Not at first. But as time went on, the topdressed plots rated higher and higher until by the end of the second summer topdressing was the best and most consistent single treatment we had.

The above gives the background of experience from which we began to develop our present concepts.

In the late '60's we had many discussions about greens, about superintendents, about golfers, about turf management, and about what lay in the future. The amount of play had been rising steadily and was continuing to rise. The problem of traffic was being met by coring to relieve compaction and feeding heavily with nitrogen to keep the grass growing and repairing itself. Two things in particular were wrong with this program. We were overdoing the nitrogen so that disease, insect, and nematode pests were being encouraged. Second, coring was encouraging weed problems and use of herbicides was debilitating the bentgrass and appeared to be increasing bentgrass disease susceptibility.

By going to sand greens we had helped overcome the compaction problem, but no one knew what was going to happen to the infiltration rate of sand greens with time. Some greens had been sealed by use of products carried on a vermiculite carrier. In Kansas, Keene reported wind blown silt additions of up to 1/2" per year. It seemed as if we might have to keep on coring sand greens to keep up their permeability and to help keep thatch under control.

On the basis of our experience with topdressing, we favored the alternative of keeping the sand surface renewed by frequent, light topdressing. Topdressing would also control thatch and would make coring unnecessary. Without coring or similar operations which create a seedbed for weeds, we should be able to bring weeds under control. Stopping herbicide use would improve grass vigor. A difficulty was the superintendent and his program. Most superintendents are geared to a heavy aeration-topdressing program two to three times a year. They regard topdressing as a major job. Some apply so much coarse sand that the golfer is unhappy for two weeks after, and for two or three weeks the coarse sand grains knock the edge off of the mowers. This makes topdressing a greater problem. Our attempts to get superintendents to change this kind of program have met little success in the past.

After 10 years of promotion we were getting some superintendents to stop topdressing with gravelly sand and to start using medium sand. Perhaps we could use that impetus for change, work topdressing into a total program and substitute topdressing for something the superintendent was already doing. The more we examined this idea the better it looked.

On paper our program took this form. We kept mowing and irrigation as is. All other programs were combined into one or eliminated. This should provide an appeal of economy of operation. Fertilizing, topdressing, insect control, weed control, disease control, liming, etc. were combined into a single operation; vertical mowing and coring were eliminated. Chemicals and sand were combined for dry application every three to four weeks. If properly chosen for size, materials used should wash out of sight with a light irrigation. Thus a daily golfer should be able to putt a green within half an hour after topdressing without being aware that the activity had taken place. There should be no residue to affect mower sharpness.

The weed control part of the program looked especially good to us. We didn't want to use an herbicide because of attendant injury, and it looked as if we wouldn't need to. By eliminating coring and by reducing and using great care in vertical mowing, we stop preparing a seedbed for weeds. Most weed seeds need light to germinate. By continually burying them we reduce germination and emergence. If, in addition, we add bentgrass seeds to the topdressing, we will have turf filling in and competing wherever grass is thin. Bentgrass will germinate earlier in the fall than *Poa annua* and earlier in the spring than crabgrass so it will be up and competing before they begin to germinate.

Not only would we bury seeds, we would also bury disease inoculum. There seemed a good chance our program would reduce disease problems. Disease control would also be helped by elimination of the thatch layer.

Any program has bugs. We needed trials to find the bugs. Also we had a major unknown. We wanted to add enough sand to continually bury the thatch. But we didn't want to add so much that we destroyed the mat or cushion that protects the turf from injury by traffic. Could we bury the thatch and still keep the mat?

We began a research program using an experimental green of 'Penncross' bentgrass. The U.S.G.A. assisted our start with funds, and the TARP program is providing continuing support.

In designing our topdressing we proceeded as follows: First, we selected a sand of suitable particle size. This is essential to any program that is to succeed. The sand must be less than 1 mm in size. This means that all the sand should pass a #18 screen (Tyler #16, New U.S. std #1). Don't try this program if you can't get a sand of this size. To be effective the sand must drop down into the thatch so the golfer doesn't see the sand and so the mowers don't cut it.

To this sand we added appropriate amounts of all important mineral nutrient elements, not on the basis of demonstrated need for grass growing in our green mix, but rather on the basis of assurance that our results would not be affected by a hidden deficiency. For our nitrogen source we used a mixture containing ammonium ions, nitrate ions, and organic N (from Milorganite). This was taken from careful research done at Rhode Island by Bell and De France (3) and represents the optimum balance between the three sources for bentgrass growth. We are aware that any N source can be used, but we used the Rhode Island results so we would have a recognized source that would not introduce nitrogen source as a variable in the experiment.

In the appropriate season we added an insecticide (Diazinon or Sevin) and/or a fungicide (thiram, Dexon, captan, Koban or Daconil 2728). These were added to the topdressing as wettable powders. We also used 1-2 oz. of 'Penncross' seed per 1000 ft^2. During the first year of our experiment we used only one variable, frequency of topdressing. We applied as little sand as possible, about 1/28th inch, and adjusted the amount of addends so all treatments got the same amount of chemicals during the year.

When we applied topdressing every week, grass growth was depressed and during the slow growth of autumn we almost smothered the grass. At two week intervals we were still adding too much sand. We buried both the thatch and the mat. When a ball was pitched to those parts of the experimental green, there was no cushion to absorb the shock, and the grass was killed. Traffic rapidly abraded the grass around the holes.

When we topdressed at 4 week intervals the sand just buried the thatch but left an adequate cushion. However, the grass was low on nitrogen the last week of the four. When the interval was much greater than 4 weeks, we built alternate layers of sand and thatch, and this we wanted to avoid. Roots do not penetrate these layers very well, and soil-water relationships are impared by the layer cake condition.

As a result of these observations, for our second season, we used a standard topdressing interval of 3 weeks with 1/28th inch of sand added at each topdressing and a check. Variables were the use or non-use of insecticides and fungicides.

During this, our third summer of treatments, we are using only two treatments. One is our check which is standard management with topdressing 4 times a year combined with hole punching, and fertilizer applied monthly with sprays as needed. The other is the topdressing program again using the 3 week interval with seed and all fertilizer and pesticide chemicals in the topdressing. This summer we are just looking for failures to show in the program. We don't expect them, but we are alert and watching.

We consider that our program to date is a success. These are the results we have seen.

WEEDS

Weeds have almost disappeared from the green though they are abundant around the green, though wind blows in seed, and though *Poa annua* was present and seeding when the program was started. When we have injury that destroys grass, weeds come in at once, but they are soon crowded out. We do not know how much of our bentgrass seed is germinating or whether any of it is becoming established.

DISEASE

In the summer we get *Pythium* on the apron around the experimental area, but it hasn't become serious on the green. Before beginning the program we had *Fusarium* patch in the winter. *Fusarium* patch occurred in shaded areas in proportion to the amount of shade. The first winter after treatments began there was no *Fusarium* patch. In late fall of the second year we added extra applications of N to produce a cosmetic green for a special open house. *Fusarium* patch appeared a month later, again following the patterns of shade. There was some significant reduction of disease in the treatments where a fungicide had been added to the topdressing. At this time we haven't the data to draw conclusions about the effect of frequent topdressing on disease.

INSECTS

Caterpillars are a problem but are readily controlled with insecticides in the topdressing. Without thatch to burrow in during the day the caterpillars are more vulnerable to birds, and birds can mar the green with their beaks while pecking out caterpillars.

FREQUENCY

The three to four week interval appears appropriate at Davis during the growing season. Three weeks is adapted to our N program, and to go four weeks we would want to use a longer lasting N source. From November to February growth is slow and there is little growth of stolons so there is no need for topdressing. We continue to fertilize but at less frequent intervals. In different areas of the country it is likely that the program would have to be adjusted to make the total application of sand proportionate to the total growth. Also, if more or less N is used, then more or less sand would be needed to just keep the thatch covered. 'Seaside' may require less sand than our 'Penncross' bentgrass.

THATCH AND GRADE

When topdressing is properly done, grains of sand just separate the organic residues and no thatch layer forms. Air and water movement continues unimpeded through the sand channels. There is build-up of uniform sand and organic matter without layers.

Change in grade is not a problem. Of 20 applications per year that we schedule, we actually use topdressing only

14 times. Because of lack of stolon growth during winter, we apply only the seed and chemicals. When growth is slow, we have cut our application of sand to 1-1/2 ft^3 per 1000 ft^2 of green. Our build-up is only slightly over 1/2" per year. This is hardly more than the annual build-up of thatch and sand under a usual program in this area. In northern tier states 6 to 8 applications of sand per year may be sufficient to keep up with stolon growth, and grade changes are even less. Grade changes occur regularly and are neither noticed nor commented on. When cutting a cup in a California green that has been down for 30 years, one no longer cuts down to parent material, but I have never heard this change commented on.

FERTILITY

Our program is set down below. It provides a good level of nitrogen without the excess that gives a high cosmetic green color, but invites trouble. Less nitrogen might be desirable on 'seaside' bentgrass, and less would be wanted in areas of high overcast. The program contains most minerals that would be needed, and it should be reduced to allow for minerals that are supplied by irrigation water and soil. We don't wish to have excess salt in our drainage waters. Some California sands contain sufficient potassium to meet most of the needs; a few have adequate phosphorus. Irrigation water may contain adequate amounts of calcium and magnesium. As we had large amounts of iron in the sand and appreciable iron in the Milorganite, applications of iron chelate in the topdressing were probably unnecessary. We still get a favorable response from foliar applications of iron sulfate, but that is usual. We included zinc as there is evidence of occasional need in California. It is probable that a need could be as well met by use of zinc sulfate as by the more expensive chelate.

Material	per 1000 ft^2	per $100m^2$
Sand -1.0mm to +0.05 mm (-#18 + #200 screen)	3 cu ft	90 liters
*Nitrogen source to provide N	3/4 lb	350 grams
K_2SO_4	5 - 6 oz	150-175 g
Dolomitic lime on acid soils	2 1/2 - 3 1/2 oz	75-100 g
or		
above pH 6.5, gypsum	2 - 3 oz	50 - 75 g
plus Epsom salts	1 1/2 oz	45 g
Zinc chelate (or mixed minor element chelates)	1/2 oz	10 - 15 g
Iron chelate	1/2 oz	10 - 15 g
*Phosphorus source to provide P	1 - 1 1/2 oz	30 - 40 g
Bentgrass seed	1/2 oz	10 - 15 g

*In our study the N and P were provided by:

Ammonium sulfate	210 g
Ammonium nitrate	500 g
Milorganite	2200 g

Fungicides and insecticides were used from the following list at the rates given for 1000 ft^2:

Thiram	85 g
Dexon	110 g
Daconil 2787	56 g
Captan W50	85 g
Diazinon W50	56 g
Sevin 10%	570 g

MIXING

Mixing was done in a cement mixer. The sand was damp enough to prevent segregation of materials. Pesticides were added last with the operator wearing a dust mask and gloves. Once the pesticides are mixed with the sand, there is a problem of safety in handling and disposal of the topdressing material.

Mixing can be a problem. If mixing is troublesome and involves equipment purchase, it is probably best not done in the beginning. The program can be given a preliminary trial for a year or two--applying the ingredients separately. If the program proves to be what you want, then you can consider whether it is more economical to combine all operations or to continue to separate topdressing from fertilizing and spraying. Once several courses in the same area are using the program, custom mixing may prove more economical.

SPREADING

The need is to apply a light, even application. One commercial topdressing machine uses a vibratory action. This will spread both damp and wet sand at a low rate, but the damp sand spreads only if the machine is run fast to get intense vibration. This machine also tends to cause segregation. We have had fertilizer rise from the mix and then go on last at a heavy rate that caused burning. We have not yet used the belt type of topdressing machine. One fertilizer spreader, made by Gandy, has a special agitator so it can spread damp sand.

Evenness of application may depend on the moisture level of the topdressing. At some moisture levels with some sand, one may have only to turn on the irrigation to wash the sand down. Under other conditions brooming the sand may be needed to even out the application.

INFILTRATION

When topdressing is started on a soil with low infiltration, infiltration remains low. If infiltration rates are high, they will drop to the rate sustained by the topdressing sand.

WHAT DOES THE SYSTEM OFFER ME?

The system presented here produces a healthy, vigorous turf of excellent golfing quality. Joe Carlson, golf coach at UCD, says: "I get excited when we are going to play Franklin Canyon, or Davis Muni. I know exactly how my ball is going to behave on those greens. I have complete control, and the action of the ball is completely predictable whether I am pitching to the green or putting." These are courses that are using a fine sand topdressing with greater frequency in an effort to go in the direction we are suggesting.

The reason for the excellent control is that there is no thatch layer and the surface is firm and true.

We believe our system of frequent topdressing offers a desirable method for *Poa annua* control. Crowding the *Poa* with vigorous bentgrass, burying the seed of *Poa*, and ceasing to prepare a seed bed provides control that is more desirable than any use of herbicides we know of. Herbicides we have tested are all damaging to bentgrass in some way or another.

Elimination of coring removes an operation that requires an expensive machine, quite a bit of labor, and some upset to the golfer. Verticutting may also be eliminated.

As a uniform soil profile is built up, depth of rooting tends to increase and sudden water stress is less common. Of course, water stress can always occur when a dry breeze rises on a sunny day.

Compaction is no longer a problem. The sand used has good infiltration rates and reasonable aeration characteristics even when densely compacted.

DISADVANTAGES

First, a new method of operation involves change. If you have a good operation that goes like clockwork and there are no serious problems on the greens, there is no reason to change just for the sake of change.

Second, it may be troublesome finding the right sand, learning how to mix it, learning how to spread it, providing storage for it, and otherwise working it into your program.

Third, a firmer green with no thatch may feel strange to the duffers and they may not know how to play it at first. Result - complaints (but also compliments from the golfers).

Fourth, there are no sudden spectacular results from all of the effort you have to put in getting this program started. Within several months the green should firm up. Within a year there should be a noticeable decrease in the amount of *Poa annua*, but it is apt to be two years or more before enough new soil is built up so the benefits of a deeper root system are noticed. If you are looking for spectacular results, you may be disappointed. This is a longterm system of management.

HOW DO I GET STARTED?

Management using a system of frequent topdressing will require making new judgments. One should become familiar with the operation before applying it extensively, and we suggest initial experience on the practice putting green. To be thoroughly fair, the initial test should leave half or at least a third of the practice green under the regular management so both you and the course members can feel the difference underfoot and watch the difference in the way the ball rolls.

The first step is to locate a suited sand source. Without the right sand, the authors do not recommend the program. One superintendent has solved this problem by using sand from a deposit on his course. He has a local sand company wash it and screen out fines that pass through a #100 screen. He then screens off the +18 material himself and ends up with an excellent sand.

We suggest that the second step is to begin applying the light sand topdressing every 3-4 weeks during the growing season. Find the techniques and equipment that will permit you to apply in the neighborhood of 1/32 of an inch of sand and not more than 1/16th of an inch. These techniques should allow you to apply either dry or damp sand. If the sand must be dry to go through your equipment, you will have to find storage space to spread out and dry sand, and this is seldom economically practical.

The first application or two of sand should go on with a heavy coring treatment to cultivate the interface and create a transition zone into the present profile. By the time you have 3 or 4 applications of sand down, you should be able to make some initial evaluations of playability. As you get experience and can make an even application at the low rate, you can then add seed and fertilizer to the topdressing.

Once seed and fertilizer is in the sand, the mixture should be used. Seed will probably deteriorate rapidly in storage and there can well be ammonia loss from mixed fertilizer if the sand is at all damp. We have not tested these. Begin using seed in the topdressing at least a month before the season for *Poa annua* germination. Then when *Poa* germinates, bent is already filling in the thin areas. During the next six months you should have some idea of the possibilities for *Poa* control. After the initial cultivation of the interface you must, of course, not use a coring machine on the test area, and disease and insects should not be allowed to open up bare areas.

You are now essentially in operation and at any time can make a decision to add pesticides in the topdressing. If your physical plant allows an economical mixing operation, then a single periodic topdressing with all chemicals in the topdressing will give you a simple, economical operation. If mixing involves hauling and shuffling, and moving, and loading and unloading, and storing, and reloading, etc. then it may be more economical to just add a monthly topdressing as one more operation on top of the fertilizing and spraying.

Once a couple of inches of topdressing and thatch mixture has been built up, you can begin to test your experimental area with a little water stress. You may find you can go an added day between irrigations or that you can economize with a light sprinkle on one day, with regular irrigation on the alternate day.

Once you have found the best method of operation for you, you should find that a light, frequent topdressing 15-20 times a year requires no more effort than the present major campaign which is mounted 2 or 3 times a year and which involves several man crews engaged in the coring, sanding, dragging, vertical mowing, and mower sharpening, and involves you in answering complaints, and in struggling with *Poa.* A program of frequent, light topdressing seems to us a simple way to have championship greens where a controlled shot is still under control after it hits the green.

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SAND PLAYFIELDS[1]

Irving S. Rodley[2]

I am a civil and structural engineer and make no claims to any technical expertise in agronomy or horticulture. I can tell you, though, that I have acquired enough knowledge to get into trouble. If someone had told me that I was going to become involved in a new type of paving laid on a sub-base contrary to my discipline and training, I would have replied, "not a chance."

For some years prior to becoming a Park Engineer I coached a boy's soccer team. I wasn't in this endeavor very long when I took notice of playfields. Somehow or another all fields were a muddy mess. I can still see a soccer ball floating in a puddle and being blown about by the wind. Who, I wondered, constructed these fields; what the qualifications were of the people involved? I soon found out. In school projects the area designated as a playfield was the place for the contractor to dispose of excavation for footings and basements. Parks, in a sense, were not much better. Both had one thing in common--no money--no thought; and who could get very excited about a football season that lasted only until November? I also found no one qualified to install a field. Sieve analysis of soils was what engineers did on road projects, or did with sand and gravel for making concrete. What kind of grass to plant? Opinions varied in direct proportion to seed stores, coaches and home gardeners. Grass was supposed to have two characteristics: one, that it could take a beating, and two, that it could stand wear. I don't pretend to have known all the answers and solutions; however, I did know there were others who didn't know what they were talking about.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

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My 14-year-olds went on to win the State Soccer Championship and I quit coaching while I was ahead. My interest in playfields gradually died and finally forgotten.

In Seattle the people passed a large bond issue in 1968 and part of this issue included funds for new park acquisition and rehabilitation of old parks. Three years ago I took on the job of Park Engineer; it's a crummy job, by the way. I don't have the time and staff to do much design work; the vast majority of our projects are designed by consultants. My role is basically construction and the enforcement of contracts, plans and specifications.

When West Seattle Stadium came on board for improvement my forgotten interest in playfields was re-awakened. I also remembered the shame that I felt as a Seattle citizen when I watched a South American soccer team play on a cow pasture such as the stadium was then. I just felt that a city of half a million people surely could afford at least one good facility. One that we could be proud of, one with real grass; not with fake grass such as the Memorial Stadium. You can bet that I took a personal interest in this project.

Actually, construction of a good playfield is simple; it has problems true enough, but it isn't hard. The objective has to be understood, it takes attention. The workmen have to be interested, and the maintenance men that follow have to love that field and give it fierce, loving care. Ordinarily most of our work is done by private contractors; in this case my construction foreman just asked to do this job. Just a few weeks prior to this project we had extreme difficulty with a contractor who put in another field. This was the lever we needed and our superiors gave us a go ahead. It was decided that in-house forces would do all the work except sod laying and paving.

I have prepared sketches showing schematically the drainage plan and cross sections. I haven't shown the irrigation system, even though it is very important, as you all know. The pitrun layer had a maximum aggregate size of 4 inches. This was kept to a minimum, but when I think back on it, this may be a mistake. The bulk of this pitrun passed the 1-1/2 inch sieve, and no more than 2% passed the 200 sieve.

The gradation was very open, a requirement for free drainage. This open gradation and lack of fines causes construction problems. It is very difficult for a wheeled grader to spread and it won't compact. Delivery of the sand layer over this base course is also very difficult, particularly when you try to tailgate. There has to be a solution, and I believe that it is possible to design a gradation that will be open for drainage and still compact, or at least stay reasonably in place under wheeled traffic. Perhaps if we had increased the amount of 4 inch aggregate so that they would bear on each other and the voids filled with smaller sizes would be a solution. I made a sketch showing what I mean. The cost may be prohibitive, I don't know. At any rate, for those of you who are about to put in a field, and haven't done this before, you have been forewarned. It is a serious problem and slows construction.

The sand layer is our park standard playfield mix and consists of 50% sand and 50% steer manure and sawdust mixture. The minimum sand size passed the #270 sieve and this is kept to 10% or less. Of course, this is rototilled lightly into the pitrun base to avoid a clear line of demarcation. We then applied dolomite and 38% urea.

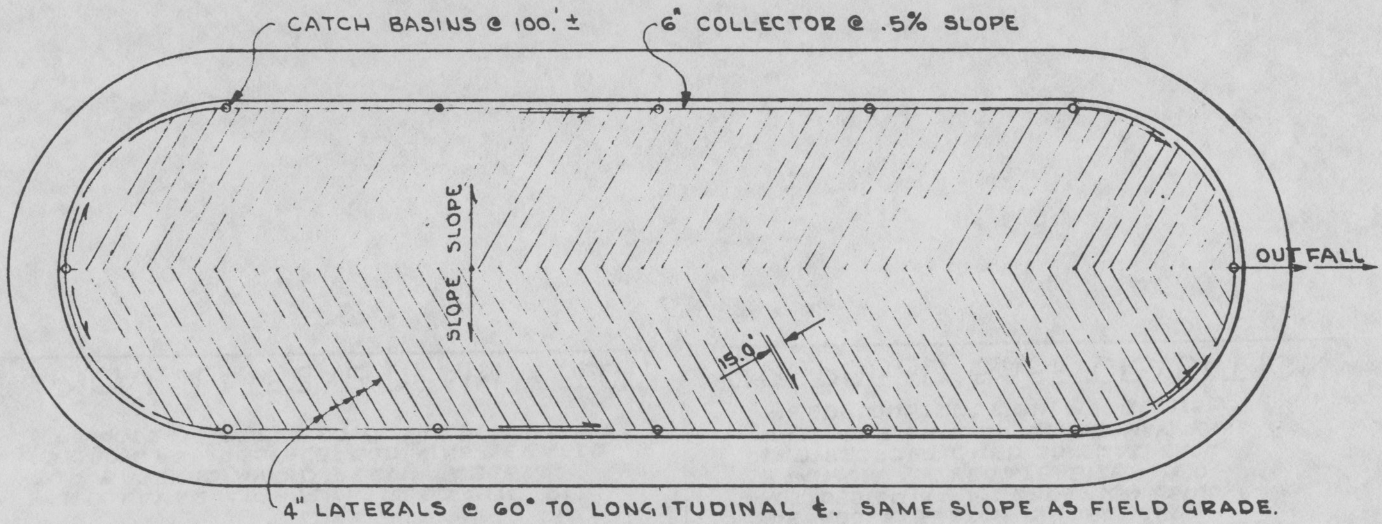
You will remember that I said that we were not going to lay the sod. This plan took a turn. When we went out for bid, we learned to our chagrin, that an indifferent contractor with whom we had previous experience with was the low bidder. We had tight specifications and construction procedures based upon experience with other sod laying projects. This contractor was of the type that required watching; if he went to urinate, the inspector went with him just to keep him in sight. I tried to award the bid to the second low bidder, but ran into trouble. It's too bad that our various governments have succumbed to the theory that government is best run by inexperienced brilliant young men. The fellow who had all this authority insisted that we take the low bid. Here was a fellow that could only distinguish a dandelion from a rose by the thorns and had all this power. We decided to reject all bids and to lay sod by in-house forces. I bring this episode up to illustrate my remark that everybody has to be interested and seriously wants to do a good job. If you don't get this, you have nothing. You will note in the slides that will follow that we have a set procedure and

I would suggest that you follow a similar one. After the sod was laid, we applied 10-20-20 fertilizer, turned on the sprinklers, and we were in business. Incidentally, for those of you who are wondering, the sod is a mixture of 60% Merion bluegrass and 40% Manhattan ryegrass. I don't know who determined the mix, but it seems to be a good one.

As you can imagine, when the kids saw that bright green grass, out came the football. Luckily we were in the school year and the kids didn't show up as long as park personnel was around. We timed the irrigation system to come on in spurts, and it coincided with their timing. This eliminated a lot of damage, not entirely, but a lot.

This is not the end of the story; more has to be done. Any grass field can be tromped to death no matter how well constructed and maintained. The traffic has to be controlled and maintenance schedules have to be established and kept. In the case of West Seattle Stadium, we have a man assigned permanently, and he's fierce. He loves that field like it were his own home. We have a roving crew that periodically mows, aerates and fertilizes. We are in a budget crunch as well as any other city, and we're not perfect yet, but we are striving.

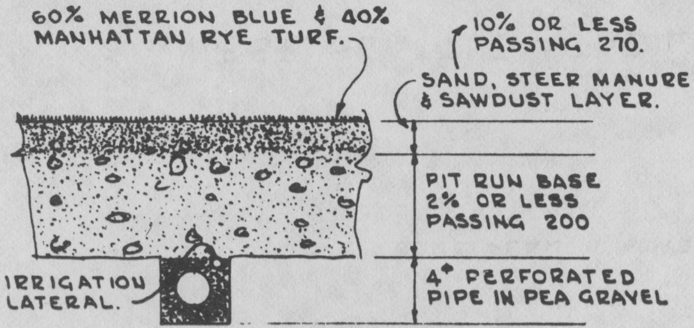
In addition to maintenance schedules, we also try to limit a field such as this to games only. Our plan is to have a few of these fields scattered over the city where games only will be played. Each of these facilities will have satellite fields that will be used for practice. We are experimenting with a sand-cinder field that will be used for soccer and baseball only. If this is successful, we plan to establish a few of these also. They are more easily maintained, require no irrigation, fertilization, and what have you. We may not be successful, but at least we have a plan.



THE ABOVE PLAN IS SCHEMATIC ONLY.

NORTHWEST TURF CONFERENCE
SUN RIVER, ORE.
SAND PLAYFIELDS – BODLEY

WEST SEATTLE STADIUM DRAINAGE SYSTEM



SAND LAYER LIGHTLY TILLED INTO PIT RUN BASE TO AVOID PERCH TABLE. AS SOON AS POSSIBLE SOD WAS AERATED & PLUGGED TO BREAK DOWN THE PERCH TABLE.

TYPICAL LATERAL DRAIN X SECT.

THE ABOVE SKETCH IS IDEALIZED, BUT DESIGNING A GRADATION USING MAXIMUM AGGREGATE SIZE = 1/3 D AND PROPORTIONED SO THAT EACH WILL BEAR ON EACH OTHER MAY SOLVE FIELD CONSTRUCTION PROBLEMS.

PROPOSED BASE GRADATION

NORTHWEST TURF CONFERENCE
SUN RIVER, ORE.

SAND PLAYFIELDS - RODLEY

PARKS HAVE TURF MANAGEMENT[1] PROBLEMS TOO!

Albert D. Angove[2]

I suppose the title of this talk is rather self-explanatory. However, if that were the case, I wouldn't be here. Certainly parks need turfgrass management. Then why are so few managed? I know that most of you have been around parks and asked yourself: "Why can't the grass be in better shape?" or "How come no fertilizer?" or "Who waters this area?".

These questions and some personal observations are what I would like to address myself to this afternoon.

I think the first thing to explore is the age of most of the turfgrass in parks. In most cases, urban park systems were started in the twneties when grass varieties were primarily bentgrasses and used primarily for golf courses. The parks got some kind of lawn seed with plenty of clover. Since there were fewer people, things such as compaction, fertilization, and aerification were not needed. Now some park directors are being forced to live with this same grass in this era of population explosion and increased leisure time. The problem, however, is not simple. For years, park budgets for turfgrass maintenance has been neglected. The park directors of the country have been no better. In fact, up until recently, most park directors have been involved in recreation rather than turf management.

History is a very good learning tool. As I've previously stated, most urban park grass is mixed varieties and mowing and watering was the maintenance. The primary recreation was picnicing and this was not organized by the government, but by individuals, lodges, and community clubs.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Park Director, Spokane County Parks, Spokane, WA.

In the 50's the people demanded some formal recreation in the parks, so the government got into the recreation business. Mind you, that with the increased park activity, mowing and watering were the sum total of park maintenance techniques. As we have grown into the 70's, the park usage has gone out of sight!

In our country, for example, since 1970, the park usage increase has been over 150%. This fact, I believe, is not uncommon among park departments. The point to this historical review is that there are a lot of park departments that still only water and mow.

The real challenge as I see it, is two fold:

1. To effectively manage the old type of grass to get the maximum greenness and wear factor.

2. To provide new parks with proper management, seed types and introduce soil balance to effect "good management".

For too long, park people have been solely recreation minded. Turfgrass management is both a necessity and a tool to provide the park directors additional funds to further these programs. The better the turf areas look, the easier it is to get a budget to keep them that way.

What about old turf areas? How can they be effectively rejuvinated?

First, I believe in the three laws of turf management:

1. Aerification
2. Fertilization
3. Irrigation

For those who have old park turf, the solutions for improving management are basic:

1. Determine grass or grass types
2. Determine soil type and nutrient level

3. Get together with a local professional - this could be your golf course superintendent, agricultural extension agent, grass seed representative or fertilizer representative, and go over possible management practices.

These would include aerification schedules, plug depth, slicing schedule, compaction test, overseeding, fertilizer programs, etc... For those who have old turf that needs some attention besides watering and mowing, there is no excuse not to be on a good informed turf management program. I know I've used my superintendent's expertise in turf management solutions.

New parks are a different problem. Your problems are certainly less because you have control over the grass seed and some control over the soil conditions; you may only need to add some material such as sand. As far as disease goes, the primary fungus problem is fairy ring.

SLIDE SHOW

In closing, I would like to say that those in the park business need to look for all available help and education they can find in turfgrass management. Go to the Superintendents' meetings. Get acquainted with your agriculture representatives. Most of all - be a good, concerned turf manager. It will pay off!

DRAINAGE PRINCIPLES AND PRACTICES[1] ON GOLF COURSES

R. H. Brooks[2]

Managers and operators of golf courses are often faced with the task of getting water into or out of the soil as rapidly as possible. In general, water is supplied to the soil to promote plant growth. However, water supplied to the soil by rainfall usually cannot be controlled and excess water may accumulate in or on the soil creating an unstable or difficult playing surface. The task of providing facilities and conditions for rapid removal of water from the soil requires an understanding of the basic principles and practices of drainage.

This article will attempt to review drainage principles and suggest practices that will improve golf course conditions after excessive irrigations or rainfall.

PRINCIPLES

Soil Properties and Water Retention

The term drainage implies water removal from the soil either from its surface or from the pores of the soil below the surface. The discussion presented herein will be centered around subsurface drainage. The principles associated with subsurface drainage are much less understood than those for surface drainage. Since subsurface drainage water movement occurs below the soil surface and it cannot be readily observed, some conceptual model is often helpful in visualizing the flow in order to solve problem situations.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Associate Professor, Department of Agricultural Engineering, Oregon State University, Corvallis, Oregon.

Irrigation and drainage implies the flow of two fluids in the soil: air and water. When water enters a soil, air must leave and when water leaves, air must enter. The rate of movement of these two fluids, depends, to a large extent, upon the properties of the media through which it moves.

A great deal can be learned about the hydraulic properties of soils that are important in the construction of greens and in the placement of drains by subjecting a sample of material to a water retention curve analysis. The curve is best understood by remembering that when water and air coexist in small spaces such as in the pores of a soil, there is a tendency for the pressure of the water to be reduced below the pressure of the air in the soil. This occurs because of the physical nature of water and solids. In other words, the smaller the pore space, the lower the pressure of the water. If the air pressure is at atmospheric pressure, the pressure of the water is below the pressure of the atmosphere. This pressure is called "suction", "capillary pressure", "Matrix potential" and a number of other similar terms.

A water retention curve gives the pressure of the water in the soil at various water contents. A typical water retention curve is shown in Figure 1 for two soil materials. The curve shows capillary pressure head related to water content. The pressure of the water in the soil is represented by the term capillary pressure head because it has great physical significance. It is exactly equivalent to the distance or elevation above a water table in a soil-water-air system after drainage ceases. For example, if a column of soil material is completely saturated and then allowed to drain until no further drainage occurs, the water content from the bottom of the soil column to the top will vary according to the curve shown in Figure 1(a) if indeed the soil is of the type shown.

The shape of the curve indicates the nature of the soil material and in a qualitative manner its drainage characteristics. If the curve exhibits an abrupt change in water content for small changes in the capillary pressure, as shown in Figure 1(b), the soil material has a narrow range of pore sizes and therfore retains a relatively small amount of water after drainage. That is, the area under the curve is related to the amount of water retained after drainage.

Porous materials that have a narrow range of pore sizes usually consist of only sands and or silts. On the other hand, porous materials that consist of all three primary particles, sand, silt and clay, where there is sufficient clay to produce aggregation of particles, will be characterized usually by curve (b) shown in Figure 1. The effect is to produce a wide range of pore sizes and a large amount of water retained in the soil after drainage. This gradual change in water content for small changes in capillary pressure always characterizes soils having a wide range of pore sizes. This wide range of pore sizes cannot be synthesized by selecting sand particles having a wide range of sizes. It is only achieved under conditions of aggregation when significant amounts of clay are present in the soil material. Certain types of clay and weathering conditions produce stable aggregates that generally have very favorable drainage characteristics. Many forest soils in the Northwest are highly aggregated and very stable at high water contents. Other types of clay produce unstable aggregates and, when loads or forces are applied to the soil, instability (compaction) results over a range of soil-water contents.

Another characteristic of the water retention curves in Figure 1 is that part of the curve labeled (A) or (B), called the capillary fringe. This characteristic indicates that all soils (after drainage ceases) remain saturated for a distance [(A) or (B)] above the water table. This distance may vary from a few inches to several feet, depending upon the sizes of the largest pore in the soil. The smaller the pores, the greater the distance. Pores that result from aggregation are usually large, whereas, pores created by sands may be small or large depending upon the sizes of sand particles.

Water retention curves such as those which are shown in Figure 1, are very useful in the selection of sands for construction of greens. If more than one soil is encountered in a profile or if several layers of soil materials are used in green construction, the water distribution in the profile after drainage may be determined by superimposing water retention curves for each soil material by using the water table as the common origin. For example, assume the two soil materials (a) and (b) shown in Figure 1, exist as distinct layers in a shallow profile. If layers (a) and (b) are each 40 cm thick, then the water distribution curve after drainage is shown in Figure 2 for (a) overlying (b) and vice versa.

Obviously, from a drainage viewpoint, the profile with layer (b) on top of layer (a) is superior to the inverse arrangement.

It would be difficult to predict these distribution curves by a superficial examination of the two soils involved. However, with the aide of the two water retention curves, the distribution is easily estimated. One must remember that such distribution curves occur only at complete equilibrium which seldom occur in nature. The non-equilibrium profiles will have higher water contents, but the shapes of the curves will be similar. Even though equilibrium seldom exists, the concept presented above is nevertheless valuable for predicting water contents of layered and nonlayered profiles.

Permeability and Water Movement

The concept of permeability incorporates, among others, the two properties of the soil mentioned in connection with Figure 1. The single most important property affecting permeability is the height of the capillary fringe. Permeability is that property of the soil that determines how readily water moves through the soil, other things being equal.

The higher the capillary fringe, the lower the permeability. There are some sophisticated methods for predicting the permeability of the soil from the water retention curves, however, these methods are beyond the scope of this paper.

In the simplist of terms, the rate at which a soil profile will drain depends directly upon its permeability and inversely upon the distance to the water table or the subsurface drain. In order to visualize how water moves toward drains or downward through a profile, it will be assumed that the pressure of the water is nearly the same everywhere. Therefore, it can be assumed that water moves from points of higher elevations to points of lower elevations. However, the greater the distance the water must travel in going from one elevation to another, the lower the rate of travel. For example, assume that a soil profile consists of uniform soil material with a drain placed in the profile as shown in Figure 3. If after a heavy rain, the profile is saturated to the surface, water will move from the soil surface toward the drain because the drain is at a lower elevation. The rate at which it moves to the drain, however, depends upon how far the water is away from the drain. A water particle half-way between drains at the soil surface will move ten times slower than the water particle over the drain because the distance is ten times greater than for the water particle over the drain. The result is that soil drains much faster near the drain creating an arched water table between drains shown by the dotted line in Figure 3. If the drains are too far apart, the water midway between the drains is not influenced by either drain and moves very slowly or not at all. In other words, the closer the drains, the more rapid the lowering of the water table.

Since permeability also affects rate of water table lowering, spacing of drains can also be expressed in terms of permeability. Soils having a high permeability may have drains spaced further apart than soils with low permeability. Expressing this concept in slightly different terminology: the radius of influence of the drain is greater for soils with a high permeability than for soils with a low permeability. This latter statement of fact is more general and applies to other types of drainage systems.

DRAINAGE PRACTICES

Selection of System

With the above as background information, it may be possible now to select the type of drainage system which will correct a given situation. Inadequate drainage will result usually from a combination of poor profile conditions such as soil layering and/or topography. On relatively flat slopes, soil layering may be the principle cause of inadequate drainage. The problem can be alleviated by use of a relief drainage system. That is, a system of equally spaced drains all connected to a collector line or main line. The rate at which the water table is "relieved" or lowered depends upon how closely the drains are spaced and upon the soil permeability

The ratio of depth to spacing of relief drains should be about one to ten, or one to eight, i.e., if drains are placed 1.5 feet deep, the spacing should be from 12 to 15 feet apart. Drains should be placed in the most permeable soil materials.

Abrupt changes in topography combined with soil layering may be also the cause of inadequate drainage. This situation exists as a seepage area. The seepage area is caused usually by water flowing laterally down a slope below the soil surface. When the slope of the soil surface flattens to a smaller slope, a seepage area may result. The situation is shown schematically in Figure 4.

To correct this problem area, an interceptor drain should be placed in the vicinity of the upstream edge of the seep. The drain will intercept the lateral flow of water and eliminate the seepage area downstream from the drain.

It is essential to place the drain in the aquifer where the water is being carried. The lateral movement is usually caused by some restricting layer lying parallel or nearly parallelling the soil surface. The drain should be placed near this restricting layer as shown in Figure 4.

Drainage Water Disposal

A drainage system is no better than its collector or mainline which disposes of the water collected from the laterals. If a mainline becomes plugged or is submerged with water, the laterals will not perform their designed function. The selection of a suitable outlet is very important. Gravity outlets may be an open ditch or a natural stream channel. The outlet elevation should be the lowest point in the entire drainage system.

How fast the water moves through the subsurface tubes depends in a large measure upon the installed slope of the tubes. Usually a slope of one inch per hundred horizontal feet will be adequate.

Due to the topography and outlet conditions, it may be necessary to use small slopes for the laterals and a sump for the outlet. The outlet of the drainage system terminating in the sump may be protected against submergence by pumping the water to a surface ditch.

This type of outlet is sometimes more economical than gravity outlets if the distance to the gravity outlet is large. A schematic of the pumped outlet is shown in Figure 5.

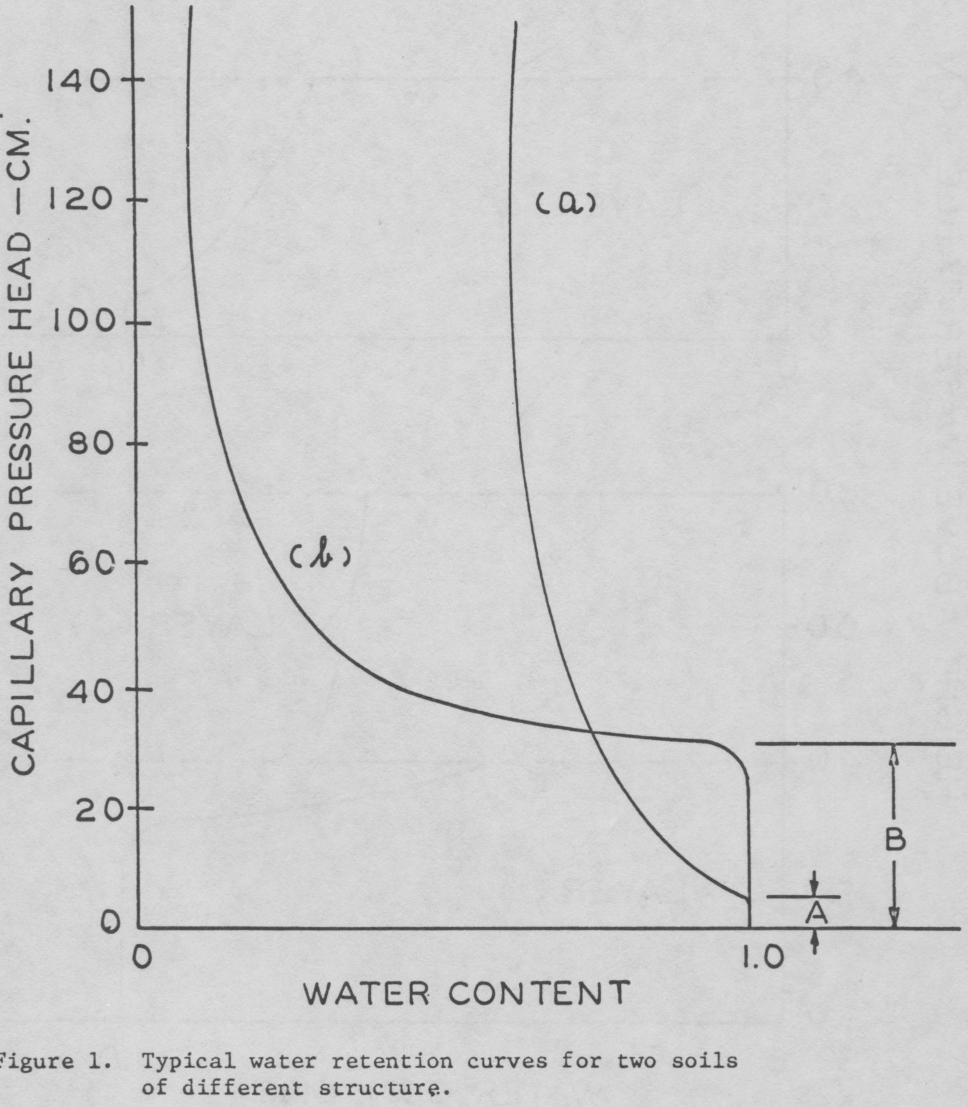


Figure 1. Typical water retention curves for two soils of different structure.

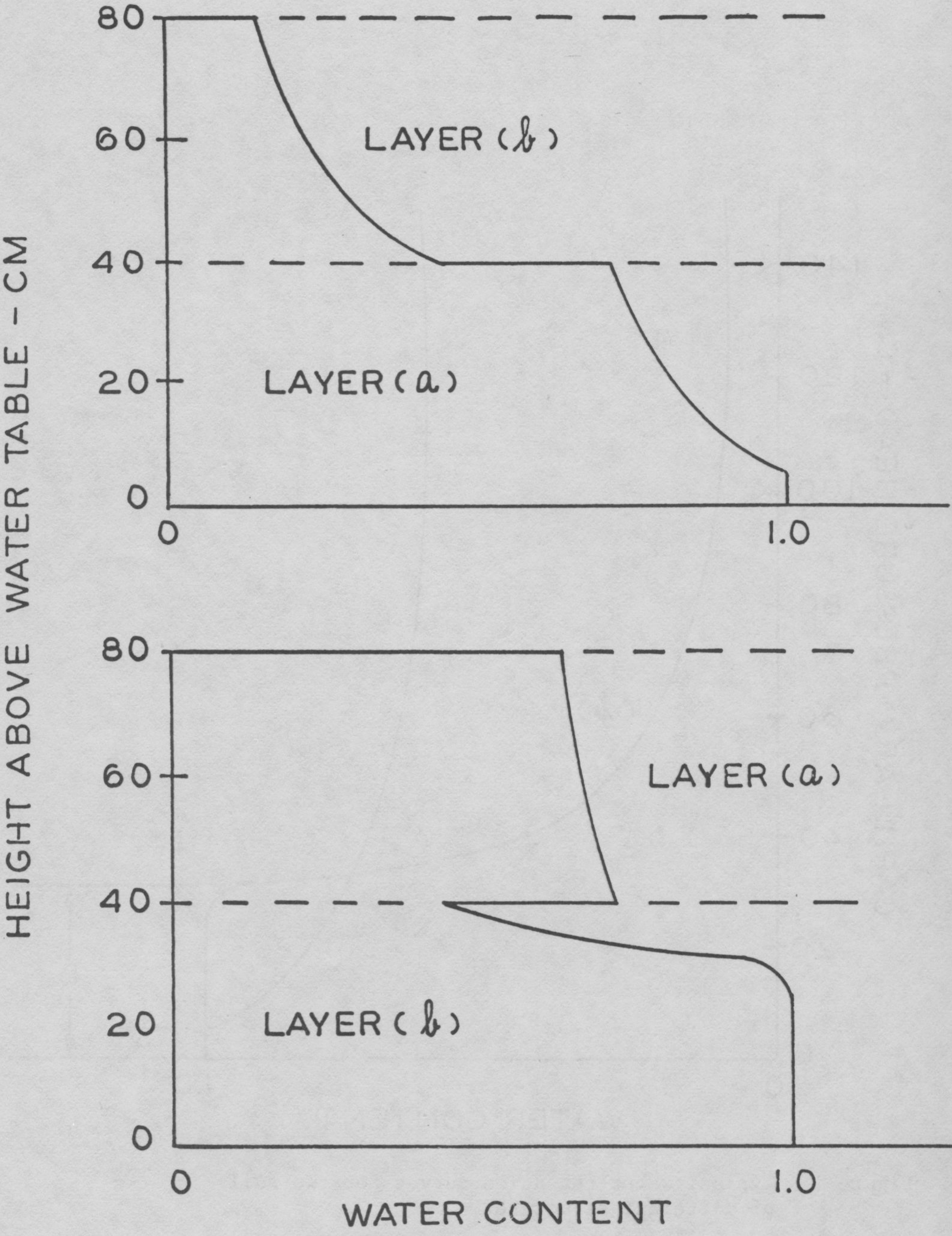


Figure 2. The water content distribution curve for two layered soil profile. The water retention characteristics of the layers are shown in Figure 1.

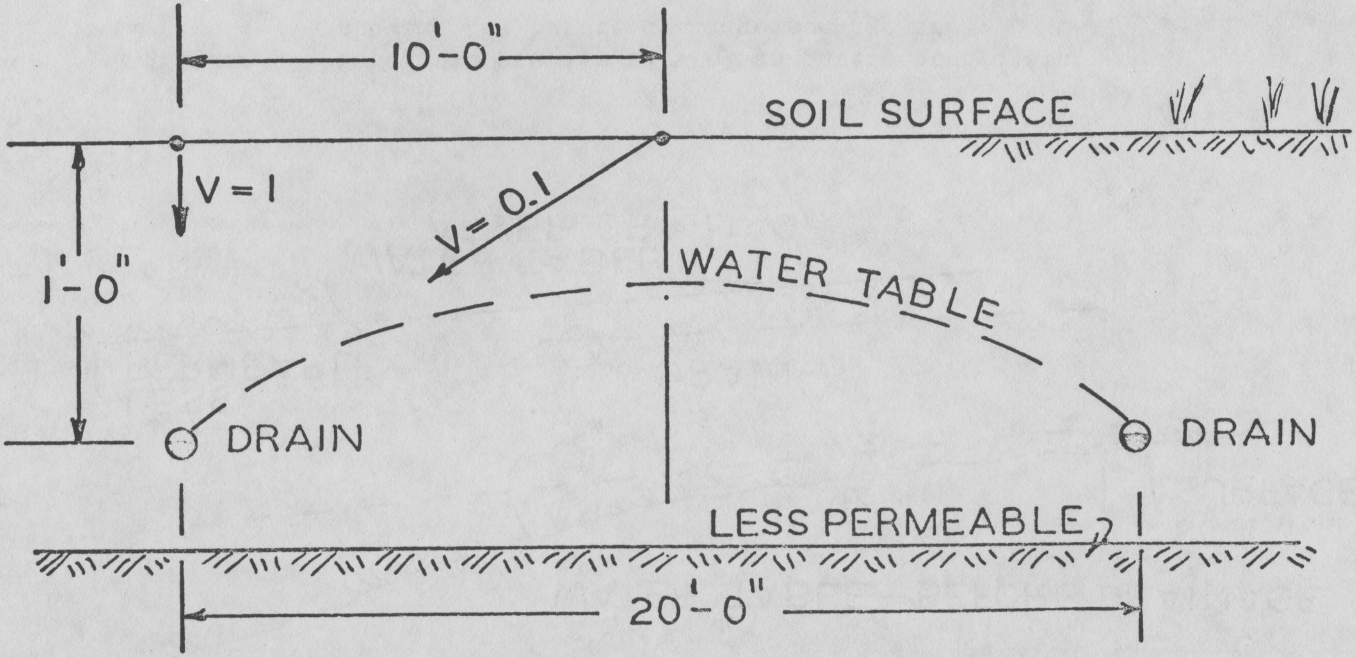


Figure 3. Typical water table shape for a system of relief drains.

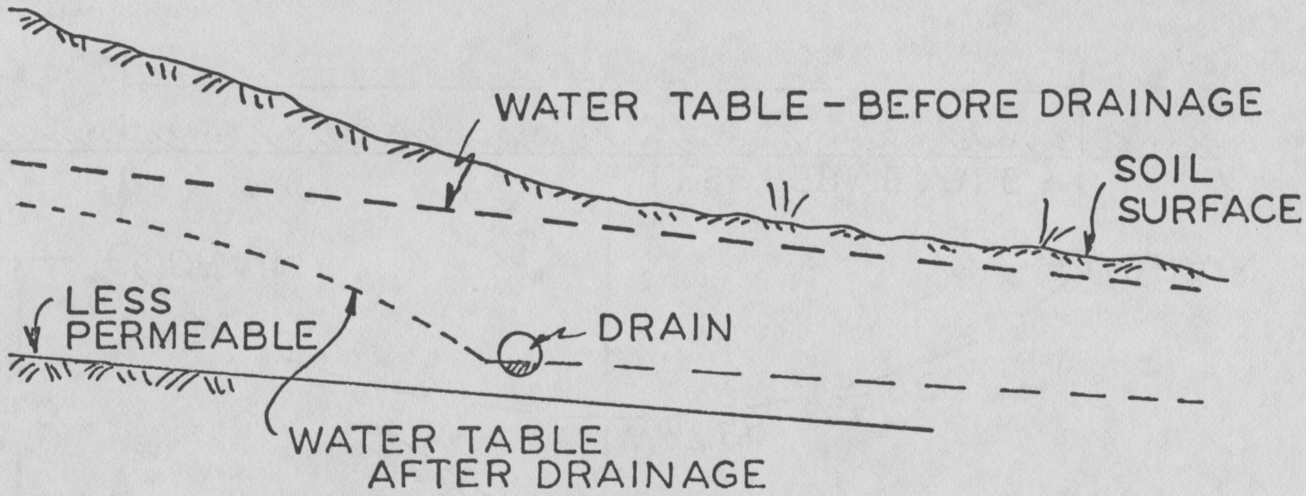


Figure 4. Schematic profile view of an interceptor drain showing the before-drainage seepage area.

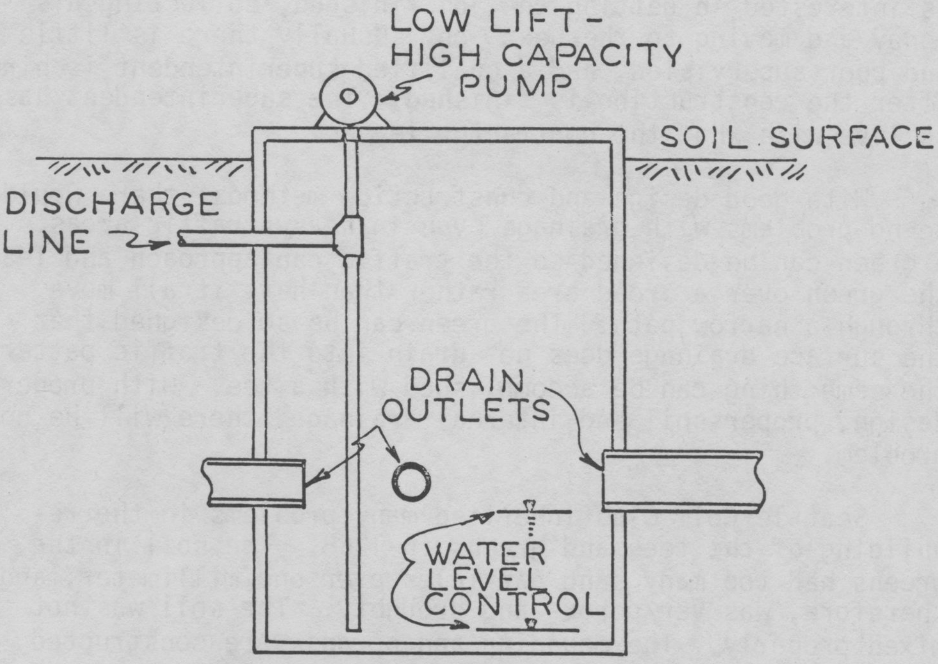


Figure 5. Sump-pump outlet system for disposal of drainage water.

CORRECTING DRAINAGE IN TROUBLE SPOTS[1] ON GOLF COURSES

Milt Bauman[2]

There are many reasons for poor drainage on golf courses, some of which are pockets with no internal drainage, impervious soils, poor design, and traffic.

Most golf courses are built by contract. The contractor is interested in getting the job finished, collecting his money and moving to the next job. Usually there is little and poor supervision, and a qualified superintendent is hired after the construction is finished. The superintendent has to live with what the contractor leaves.

With good design and construction methods, there would be no problems with drainage even in heavy traffic areas. A green can be designed so the traffic can approach and leave the green over a broad area rather than have it all move through a narrow path. The green can be so designed that the surface drainage does not drain into the traffic pattern. The same thing can be accomplished with a tee. With proper design, proper soil and internal drainage, there will be no problem.

Seattle Golf Club inherited many problems in the rebuilding of the tees and greens in 1968. The soil in the greens had too many sand particles over one millimeter, and therefore, was veryporous and droughty. The soil was not mixed properly. The mounding and aprons were constructed

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1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Superintendent, Seattle Golf Club, Seattle, Washington.

from an impervious soil. The surface drainage from the greens all drained to the front and into the traffic pattern. There was a pocket that wouldn't drain in front of every green. Most of the tees were built in the same manner with an inch or two of sand mix on top of muck soil.

We will always have a problem in front of the greens during the winter as all of the surface drainage from the greens falls into the traffic pattern, and there are many times when we can't move the water out as fast as it flows on the surface. However, by rebuilding we corrected most of the problem in front of the greens and tees in the following manner.

We removed the soil from the problem area to a depth of 18 to 24 inches, but all to a minimum of 18 inches deep. We then dug drainage ditches in this base 8 to 12 inches deep and backfilled with drain gravel. The tile lines were spaced no farther than 20 feet apart and no closer than 15 feet apart. We then backfilled the total area with pit sand. The sand that is used should be of the following particle size: There should be no more than 15% under 1/4 millimeter particle size; no more than 5% under 1/8 millimeter particle size; no more than 10% over 1 millimeter particle size. The bulk of the sand should be between 1/4 and 1/2 millimeter in particle size.

This sand should be backfilled and leveled, then fertilizer should be applied at the following rates: 50 lbs. of dolomitic lime; 25 lbs. single super phosphate; 20 lbs. of potash; 25 lbs. urea-formaldehyde or slow release nitrogen per 1,000 ft^2. This should be raked into the top 2 or 3 inches of the surface. The surface should then be smoothed and seeded or sodded.

Obviously, if it is a tee or an apron to a green, it will have to be put into play as quickly as possible, so it will probably be sodded. The sod should be grown on sand; but since very little is, the next best thing is to cut the sod as thin as possible. After the sod knits, aerification will help establish a root system and water movement in the soil.

DRAINAGE PROBLEMS IN TURFGRASS AREAS[1] —CAUSE AND CORRECTIONS

Richard W. Malpass[2]

A well known, and very old adage states "When all else fails, read the directions". And, if I were writing directions for the purchase of a farm, the building of a subdivision, construction of a highway, a park, a golf course, or a multitude of other projects; the problem of drainage would be considered first and foremost.

My brothers and I were among the first to utilize large, open drain ditches constructed by dragline or carry-all on our farms in the upper Willamette Valley. This work was done in conjunction with the Soil Conservation Service and their engineers. Subsequently, I was on the Board of Directors of an irrigation district and of a large drainage district utilizing open drains and canals. Later, with the Agricultural Stabilization Service of the USDA, I worked with many areas developing drainage projects.

In the years I have lived in western Oregon and western Washington, I have seen the results of improper engineering or of the complete ignoring of potential drainage problems. The result has been flooded subdivisions, sections of highway washed out, farms flooded, unusable areas of parks, or golf courses, or schoolyards, abandoned homes---you no doubt have seen them all.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Superintendent, Riverside Golf and Country Club, Portland, Oregon.

Just a few of the questions you might ask yourself when beginning or considering a project would be:

What drainage problems exist?
Will they adversely affect the project I have in mind?
Can it be corrected?
If so, can the problem be economically solved?
What steps will have to be taken to insure the continued proper functioning of the drainage system?

In the late 1950's and early 60's a group of us purchased over 400 acres of land northwest of Eugene, Oregon, in the upper Willamette Valley. It was our intention to construct a golf course and, eventually, subdivide land about the course. One of the first considerations was to determine if the land could be drained, what the cost would be, and if the drainage system, as proposed, would effectively drain the area. When we were satisfied that these questions could be satisfactorily resolved, we began our project. In doing so, we utilized the services of the Soil Conservation Service and the Extension Service of the USDA. Much of this area has a very slight fall to the north and west, actually only about 1 foot per 1000. Consequently, it was necessary to build fairly large drainage channels to move the water across and away from the property. Large bulldozers and carry-alls were utilized. With the exception of major flooding by the Willamette River which spread a shallow sheet of water over much of the lower areas of the golf course in 1964, it has escaped the major flooding formerly occurring. Heavy rains will cause temporary ponding of water in some areas, but it soon moves out.

In 1970, we moved to Portland, Oregon where we became responsible for the care of a golf course, Riverside Golf and Country Club, lying behind dikes near the Columbia River. This course was completely wiped out by the floods of 1948. Seepage water from the river as well as the moisture falling upon the course must be removed in order to keep it playable. Over the years, quite a bit of tile had been laid, much of which was not properly functioning. There were also three inadequate sump pumps which attempted to remove excess waters from the course. A major construction plan involving the rebuilding of the drainage system as well as construction of new tees throughout the course was proposed. We examined the plans and noted that the drainage proposed was not much more than a copy of the existing system which was not properly functioning. We called in Soil Conservation engineers and representatives of a pump manufacturing company. A drainage plan was developed which appeared practicable and we were authorized by the club officials to proceed. Initially, 5 miles of drain tile were laid on grade, two lakes with a surface area of approximately two acres were constructed, and nine tees constructed utilizing much of the spoil from the lakes. A large pump was installed to remove the drain water from the course. This water was accumulated at one of the new lakes at a central location on the golf course. The pump was engineered to remove anything short of a major flooding of the course. It is capable of removing 4250 gallons of water per minute. Under normal operation, during the winter months, it will run about two hours, then rest for an hour or so, depending upon runoff. Since it only has to lift the water about 5 feet, it utilizes a 40 HP motor and is quite economical to operate. Under conditions of heavier-than-normal rainfall, we have known it to operate almost constantly for several days at a time removing over 6,000,000 gallons of water per day. The water is pumped through a 12" plastic pipeline 600 feet to a slough. Multnomah County Drainage District #1 then pumps the water up about 10 feet into another slough from which it is then pumped over 25 feet dikes back into the river. Portland International Airport property borders us to the north and east and is 39 feet above sea level. We are lower than the airport, so probably have some areas on the course near sea level, or below.

Since the initial construction of the new drainage system, we have added another one and one-half miles of drainage lines. Most problem areas have been properly drained. This past winter, with heavier-than-normal rains, saw the course playable at all times. We are now proposing a tee-to-green cart path system in order to allow year around play with golf cars utilizing the new paths during inclement weather.

Proper engineering, utilizing agencies available nearly everywhere, using their recommendations, proper construction, and a desire to achieve the utmost utilization of a recreation area have resulted in a golf course facility of which the members may well be proud.

USEFUL FIELD METHODS FOR DIAGNOSING TURFGRASS PROBLEMS[1]

William H. Bengeyfield[2]

Whether you are a landscape, park, school, cemetery, highway or golf turfgrass superintendent--there is one thing about being called in on an emergency; you are finally going to be heard! People reluctant to pay attention in the past will now be your most ardent listener.

In my work with the USGA Green Section, we will receive a dozen or so real emergency calls each year. In almost every case, the problem is "man made" not grass made. The grass plant responds to the management it receives and, when it gets into trouble, the problem can usually be traced to an omission or comission by man. When we are not thinking clearly, we are truly our own and the grass plant's worst enemy.

What should you look for when called in on a turfgrass emergency? What kind of checklist will lead to the cause of the problem and then to the remedy? Probably the greatest diagnosticians in the world are found in the medical profession and we can follow much of their routine. Certain tests can be performed. Experience counts a lot and by deduction, usually a process of elimination, you can discover the facts and prescribe corrective steps.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Western Director, USGA Green Section, Garden Grove, California.

There are two useful tools and, once you get used to them, they will be invaluable; a good soil probe tube and a husky pruning knife. The soil probe can give you information on:

1. Soil moisture content; smell and color
2. Depth of rooting
3. Depth of root activity
4. Soil texture
5. Soil layering
6. Degree of thatch
7. Degree of compaction.

A pruning knife is suggested because it is husky and can stand the gaff. Use it to cut pie-shaped wedges from the sod and these will reveal:

1. Degree of sod toughness, density
2. Thickness and condition of thatch
3. Possible insect activity
4. Degree of moisture in upper surface
5. Aerification needs and past accomplishments
6. Soil Layering
7. Compaction.

When first approaching a problem area, try to gain a general, overall view or 'feel' of the situation. Is the problem confined to an isolated spot or is it spread over several acres? Is it on high or low ground? Is it in the shade or sun? Is there a pattern of any kind? What clues can be found?

One of your first steps will be in determining if the right grass has been planted in the right location. We all know bermudagrass does not do as well in the shade as it does in the sun. But do we <u>all</u> know zoysia will do well in the shade along with the velvet bentgrasses, *Poa trivialis* and the fine-leaf fescues? We must know our grasses. Shade, sun, height of cut, irrigation and fertilizer needs, salt tolerance, pH, etc. In a word, "Is the right grass being grown in the right place and is it being given the right management?"

Soil tests or tissue tests are invaluable aids for turfgrass managers. Actually, it is the interpretation of the tests that really counts. Identical soil samples may be sent to two different laboratories and when the results are received, they appear to be totally dissimilar. However, when interpretations are made by someone familiar with the specific chemical tests and crops involved, the final recommendations will be quite similar. Remember, when taking soil tests for turfgrass areas, a 2-inch depth is recommended for the random samplings.

Soil samples should also be checked for soluble salts and sodium when you find bare areas or turf with weak, poor growth and color even though other management practices appear to be generally good. "E.C." or Electrical Conductivity readings can frequently be obtained. The reading is recorded in Milli-mhos per centimeter and the scale may be interpreted as follows:

Less than .75 milli-mhos per centimeter - low salts
.75 to 1.5 milli-mhos per centimeter - medium salts
1.5 to 3.0 milli-mhos per centimeter - high salts
More than 3.0 milli-mhos per centimeter - very high salts.

Turfgrass nutritional problems can sometimes be determined by observing weak, sparse and unthrifty appearance. Is the clipping removal rate 'normal'? When was the last fertilizer application made? Were other chemicals applied and if so, what was the date and rate of application?

One of the more frequent nutritional problems we find is a general yellowing or chlorotic condition of the turf. This can be produced by any number of different factors including:

1. Plant stress due to any reason
2. Overly wet soils
3. Very high phosphorus levels
4. Very high pH levels
5. Heavy thatch accumulation.

One of the most frequent causes of turfgrass yellowing is iron or magnesium chlorosis. This may be easily checked with an application of 2 to 3 ounces of ferrous iron sulfate or magnesium sulfate in no more than 5 gallons of water per 1000 square feet. Do not water in since this is intended to be a leaf feeding. If iron or magnesium is deficient an immediate greening (within several hour's time) will usually result.

Of course, turfgrass problems are frequently the result of disease or insect activity. Knowing the symptoms and knowing what to look for can be of immeasurable help. Many of the chemical companies have published excellent colored photos of turfgrass diseases and insect damage. If you are suspicious of disease, check on past weather conditions and particularly humidities and temperatures. Check to see if there is good air drainage across the problemed area. If you suspect insects, look for the telltale signs of cutworms, sod webworms, soil grubs and frit flies. These are our most common insect problems.

Irrigation and drainage problems are frequently at the seat of the majority of turfgrass problems in the West. By a great margin, overirrigation problems predominate. The soil probe tube will immediately tell you how wet the soil is below and, if it has been wet for long, a characteristic odor can be detected. In many cases, the soil will have a blue or dark color. One of the best field tests for over-irrigation is to remove a soil core and squeeze the upper 1-inch area in an attempt to raise water. If you can develop free water by squeezing the turf 5 to 6 hours after it has been irrigated, you can safely conclude that too much water has been applied in the past.

Tree roots can also cause serious turfgrass and irrigation problems. Generally it is the saml1, feeder-type tree roots growing within the grass root zone that directly compete for soil moisture. In all cases, tree roots will win this competition. Cut a sod plug with your knife to a depth of 2 or 3 inches. Break it open and see if small, fibrous tree roots are present. Of course, shade and air drainage are also problems of the irrigation and drainage picture.

Finally, when visiting a turfgrass problem area, look for mechanical signs of damage. Certain wear patterns may be visible either caused by man or machinery. Grass mowing equipment frequently is not properly sharpened and causes a damage of its own. Inquire what the turf manager's program has been in the recent past and what has been applied. If chemicals have been applied in spray form, frequently a 'spray pattern' may be detected. Similarly, certain patterns can be found from the application of dry materials.

By checking out the above points, you will narrow the field of possibilities and draw closer to solving any turfgrass problem. In closing, I'm reminded of a statement attributed to Professor Lawrence Dickenson at the University of Massachusetts Turfgrass Management Course. Professor Dickenson was one of the early sages in the turfgrass industry and he said:

> "As turfgrass managers, we must help the little grass plant to grow. We must never make it grow."

TRENDS AND NEW IDEAS IN THE GOLF BUSINESS[1]

Jerrold H. Claussen[2]

Golf has been the subject of many fine tales, fact and fiction. For example, a veteran golf course superintendent once complained to his Green Chairman: "If it wasn't for all those so-and-so golfers, we could have a fine course."

We might call that losing your perspective. In business, it is easy to forget why we are here and who is paying the bill. But golfers who play for fun or money seldom consider the business end of producing the equipment and running the golf shop and maintaining the grass.

Despite the game's tradition, it is also a gigantic industry. The statistics are staggering: almost 11,000 golf facilities, 13.5 million golfers, 260 million rounds played in 1973, $495 million spent on maintaining the courses, $3.4 billion in physical plant investment.

The business is changing, just like everything else around us. We see signs everywhere. Here are some of the major trends in golf course development and operation that look significant:

FIGHTING SLOW PLAY

A strong movement is spreading to find a remedy for slow play that has been choking our busiest courses for years.

The National Golf Foundation made slow play a high priority about six years ago with a humorous promotion campaign using "Speedy" and "Mrs. Speedy" golfer, depicted by rabbits.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Rocky Mountain Consultant, National Golf Foundation, Denver, Colorado.

A starting time system to utilize all of the golf course for more hours, with maximum time for playing each 9, was sent to every course. The attempt was commendable, but the results not very noticeable. Then, one by one, golf industry leaders and major publications started trumpeting the need for speedier play. Finally the idea is catching on. Even PGA tour officials have been tough as they threaten and occasionally levy penalties on slow players.

Earlier this season Golf Digest gave the campaign first priority with an article called: "It's Time to Get Tough with Slow Play." Six specific, firm suggestions were made, including three rule changes. There were 10 helpful tips for club officials on managing for faster play.

Many public course operators have picked up these ideas. Most now have 150-yard markers for faster club selection, start 9-hole players from No. 10 tee when open, use rangers, teach rules and etiquette to beginning classes. More are using realistic spacing of starting time to avoid jamups, reminder signs in the pro shop, on the course, and even on the scorecards suggesting how much it should take to play each hole, 9 and 18.

An example of a sign is on the 7th tee of Brookhaven Country Club, a 54-hole club near Dallas, Texas: "Par for playing time to this tee should be 1 hour and 33 minutes. How is your score today? Everyone enjoys the game more when play moves on time. We appreciate your help. Thanks...Your Board of Directors."

Now if everyone would just stop pretending to be Lee Trevino circling his putts on every green....

A MORE EXPENSIVE GAME

Golf has been called the "Game of a Lifetime". It may be open to almost anyone of any age, but at what price? Inflation is hurting the business.

Private membership clubs have been trying desperately to keep ahead of cost increases. Many are raising dues, imposing house minimum charges, assessing members for losses, raising prices for food, beverage and other services, and/or seeking more outside party business.

Increases in the minimum wage, higher costs for food and other purveyor's services, plus rising taxes, have forced those increases. We have seen monthly dues go from $70 to $90 at one club, $38.50 to $45 at another, and the imposition of a $20 per month house minimum charge at another, in the Denver area.

Middle-income families who have access to less expensive tennis and swim clubs are no longer lining up to join some suburban country clubs. The so-called "status" means much less to our mixed, mobile, more open society than in previous times.

Even the cost of playing golf is soaring. Municipal courses that once charged $2 to $3 for 18 holes or all day, now charge $4 to $5. Season tickets at these courses are up to $125, $150 or more per person. Privately-owned daily fee courses report green fees up to $7 or $8 for 18 on weekends. And if the typical club member pays dues of $876, $73 per month, as the last Harris-Kerr-Forster survey tells us, and plays even 30 rounds of golf per season, that's almost $30 per round, not counting the cost of golf car or caddie, lunch, bets, and a couple golf balls dunked in the lake.

MORE MUNICIPAL COURSES

Municipal golf has too long been the poor cousin of the golf business, except in how many people it served. But no longer.

A combination of factors -- urban population pressures, public interest in open space and ecology, increasing development costs, Federal support through the BOR grant program, lots of national publicity about the need for public courses and how they can be built -- contributed to this trend.

The results are encouraging. Last year 38 new regulation municipal courses and 58 municipal projects in all opened for play. Both the 38 new courses, and the ratio of 21% to all new regulation courses, were new records. Another 45 municipal projects, or more than 15% of the 290 reported, started construction. Utah led the nation, with two new public-owned 18's, two 9's and two 9-hole additions to existing courses.

Local government can and does use many methods to create public golf facilities. Johnson County, Kansas, in suburban Kansas City, purchased a former private club last year. The City of Plano, Texas, leased land to a partnership of former PGA tour players to build and operate a public course subject to city regulations. The City of Arvada, part of suburban Denver, Colorado, purchased a bankrupt daily fee course on leased land, will also buy the land, and lease the business to a private operator for 25 years.

EXECUTIVE COURSE CONCEPT SPREADS

The name no longer fits the category, because the short, intermediate course has caught on among all types of golfers. Not boring like most par-3's, it's also not long, difficult and time-consuming like many regulation-size layouts. Families, women, seniors and even the rushed executive are finding the new, well-designed intermediate course a happy golf experience.

At the end of 1973 NGF counted 552 of these courses in the United States, including 328 clubs having only an executive course. More than 60% were 9 holes, many of these additions to regulation golf courses. About 70% were daily fee, indicating how popular they are with the public and profitable to their owners. The resort-retirement areas of California and Florida led in numbers. Forty-one states reported at least one.

The trend is continuing. Thirty of the intermediates opened in 1973, compared with 18 in 1972. Another 28 were reported under construction, almost double the 17 of 1972. For the first six months of this year, 12 more opened and 11 more were started. The dozen openings represented 16%, a new high, of all new openings for that period.

The golfers not only like them, so do developers, whether a private club, real estate combine, or a municipality. The short courses use less land, are usually less expensive to build and maintain, faster to play, and can produce more revenue.

In Oregon, the only four new courses opened for play in 1973 were intermediate-length, daily fee 9's, connected with residential communities. One at Charbonneau near Wilsonville will have 27 holes, three executive 9's. Oakway Golf Club at Eugene was once a regulation daily fee 18, but remodeled, reopened in 1974 as an executive 18, and made a profit by development of excess land.

GOLF ATTRACTS BIG CORPORATIONS

It has seldom been a cheap venture to enter the golf business. Now land costs near population centers have soared to $5,000, $8,000 and more per acre. Design and construction standards are higher than ever. Construction and material costs are escalating fast. Big capital is needed to buy land, build course and clubhouse, equip and hold on for two, three or more seasons of operating loss until the business gets established.

Not that the golf business isn't profitable over the long term. In recent years surveys have shown that in most years up to 50% of private clubs run in the red. But other surveys consistently report that 90% and more of daily fee and municipal courses make money. So with costs rising, and potential for a good profit in operation and appreciation, enter the large corporation.

Nearly half of courses opened in 1973 and now under construction are part of large real estate developments. Nearly 500 such projects have opened in the past four years, 142 in 1973 alone. Some of those are part of conglomerate chains -- Diamondhead Corp., McCulloch Oil, Great Western Cities, Golf Host West, National Golf Courses, Inc., and Rockresorts, Inc.

Most of these groups had little or no previous golf course development or management experience. They simply hired knowledge. Their primary goal in almost every case is to sell real estate. But despite lavish advertising and promotion campaign, the golf courses are often sterile, the service impersonal, the cost astronomical.

Also among the new corporate ownerships are the Japanese, who have purchased or are developing several clubs in Hawaii and California as investments and homes-away-from-home for traveling businessmen. Japanese interests own at least 10 courses on American soil, including Mesa Verde Country Club, Costa Mesa, California; Canyon Hotel and Country Club, Palm Springs, California; and Incline Village Golf Club and Ski Resort, Lake Tahoe, Nevada.

COURSE DESIGN: A PARADOX

There are more first-class, well-designed, well-maintained golf courses in play today than ever before. Probably 75 active individuals offer good credentials as golf course architects. The American Society of Golf Course Architects, the elite of the profession, has more than 60 members.

So why are we still seeing so many bland, dull courses with a mass-produced look? Why so many small tees, bad drainage, inadequate pumping systems? For one thing, only about one-third of the 300+ new facilities opening each year are designed by professional golf architects. The rest are products of well-meaning private owners, local golf pros, citizen committees and other pretenders. The results in most cases are disasters for golfers and superintendents who must maintain them later.

Why won't ownerships hire the best and build right the first time? NGF's Facility Development Consultants are often frustrated by this problem. Most ownerships -- real estate developers, city councils, citizen committees -- don't know what a really good golf course looks like, how it is put together, played or maintained. Budget often is restrictive, too. So they buy cheap -- and regret it later.

At the same time, there is a hefty resource of knowledge in print about what goes into modern golf course design and construction. The best of our 12,000 courses and 160,000 golf holes have been publicized so that anyone can learn the principles. But golf architecture remains more art than science, and great artists are always in short supply.

GOLF CARS MULTIPLY

Along with more golfers playing more rounds of golf, fewer of them want to walk anymore. The result is more rounds of golf are being played out of those three and four wheel buggies we call golf cars.

In 1973 NGF estimated that 345,000 golf cars were being used on about 90% of the courses. That's more than twice as many as the 160,000 counted five years ago.

Like most trends, the growing popularity of riding has no single cause. But these are contributing factors:

* A decline in caddie programs, mostly because few clubs and their pros make an effort to attract them;

* The money-making ability of golf car rentals, to both the club and the pro;

* Improved design and maintenance service for the top-line cars, including attractive lease-purchase programs through local distributors;

* An ego thing the American male has about driving, matching his attachment to his personal automobile, coupled with laziness.

The result has been helpful extra dollars made by many clubs -- especially resort and semi-private types -- which might be struggling otherwise. One Denver daily fee operator reported he grossed about $90,000 from golf car rentals in 1973. One out of every five of his customers rode to play.

But what of the cost? New clubhouses with full basements for storage of cars, or separate steel buildings for that purpose, require major capital investments. Where traffic is concentrated, asphalt paths cost $2-$4 per running foot to build, plus repairs later. There are other costs, like turf damage, liability insurance, cleanup. But no matter, because many golfers want to ride, are willing to pay for it, and the demand is increasing.

WOMEN SHARE THE CHORES

Slowly but surely the equality of women has affected the golf business. Maybe most men golfers would like to restrict them to Ladies Day one morning a week. But they keep the clubhouse busy, do a good share of buying in the pro shops, and now are sharing in operations, too.

Women club managers are no longer unique, like Joyce Jackson at Cypress Creek Golf Club, Orlando, Florida, and Bernice Terrell, at Covington Country Club, Louisiana. There are perhaps 200 or so women teaching professionals at larger clubs and resorts. A few are running the whole golf shop business, such as former assistant Ann Gavin at Triple A Golf Club, a daily fee 9 in St. Louis, Missouri, and Barbara Myers, Georgetown Country Club, South Carolina.

The big breakthrough in women's employment has been in golf course maintenance. After a few courageous superintendents let down the sex barrier, like Norman Graft at Stansbury Park Country Club, Magna, Utah, who hired an all-woman crew two years ago, others have tried it and liked it. In the last two seasons we've seen girls on maintenance crews all over the map.

Every superintendent with female crew members reports the same good results; they are hard workers, reliable, neat, dedicated. Women can and do almost any job: mowing fairways and greens, raking traps, clubhouse landscaping.

"I wish my whole crew was just like the two girls I have this season," says one superintendent.

Girl caddies are part of the trend, too. For instance, Oakland Hills Country Club, Detroit Golf Club, Franklin Hills Country Club and Tam O'Shanter Country Club in the Detroit area now employ girl caddies. The golfers accept them, and the boy caddies treat them as equals. They have a future, too, because the Western Golf Association reports that seven girls have already won Evans caddie college scholarships.

HIGHER MAINTENANCE COSTS

Like most things, the cost of maintaining our golf courses keeps going up. That shouldn't surprise anyone in business, but club members and golfers paying the bill have to be educated.

The annual Harris-Kerr-Forster survey of 100 of the most elite private clubs in 1972 reported an average maintenance bill of $6,554 per hole, or nearly $118,000 for an 18-hole course. That was up 5% over the previous year. After that came the 1973 energy crisis, and rising prices for fuels, pipe, seed, plastic materials, fertilizers and chemicals. Superintendents at most courses were smart and stockpiled fertilizers before the price boost in 1974. But the crunch is coming for the 1975 season. Budgets will increase 10-20%, or courses will be maintained a little less lush -- fertilized and mowed less often, less handwork around hazards and trees.

SEWAGE EFFLUENT FOR IRRIGATION

The fuel crisis emphasized that prosperity and growth are not forever, but rather are limited by natural resources. So it is with water.

Where supplies are short, politicians and the public frown on golf courses using clean, potable water that might otherwise go for drinking, moving industry, and watering lawns. If a golf course doesn't already have its own exclusive, reliable source of water, such as a lake, river or wells, it may be in trouble sooner or later.

We are short of water in this country now, especially in the Northeast and West. Many new golf courses built in recent years in the West have turned to treated sewage effluent for irrigation. In most cases there have been no damaging effects to either fine turf or humans.

Some examples of successful irrigation programs using effluent water are at the municipal course in Las Vegas, Nevada; Mechaneer West Golf Club at Ft. Carson, Colorado; Slaton, Texas Country Club; Panther Valley Country Club, Alamuchy, New Jersey; and Continental Country Club, Flagstaff, Arizona. For these and others the golf course has become an ideal outlet for using millions of gallons of treated effluent not useful elsewhere.

AUTOMATION AND MECHANIZATION

The machine, especially the various electronic marvels, have become important in golf facility operations.

In large private clubs, membership accounts and billings are frequently handled by a computer program. In the kitchen, pre-packaged foods and big freezers and micro-wave ovens have replaced the fry grill. More and more golf courses are irrigating with automatic time clocks.

The new machines have made quite an impact on golf course maintenance. Equipment manufacturers have been diligent in visiting courses and turf conferences, listening to superintendents on what they need, and then producing machines in answer.

The riding triplex greens mower has now been in use about five years. Perhaps 80-90% of all the 18-hole courses, and many with 9 holes, have switched from walking to riding. Very few machines have been turned back or traded in, distributors report. Some superintendents have converted their first riding mower to a tee mower, then bought a newer model for greens.

Such a machine now costs about $3500. But it should have a life of 5-10 years. Properly trained, anyone can cut greens and do a smooth job. Predictions that greens would be compacted and grainier have been mostly false alarms. The riding mower can cut 18 greens in 3 to 4 hours, compared with 12 man hours using walking mowers.

One distributor reported he had received 26 riding mowers for this season, and sold out before the season started. "Because of labor saving, none but the richest clubs can afford not to have one," he remarked. Because of materials and parts shortages, however, orders are backlogged about 6 months.

Another great innovation is the riding trap rake. Available just the last two years, the concept successfully fit the trend to save time. Perhaps 50% of courses with any great number of traps now keep them in shape with tractor-pulled rakes.

Large tree spades, usually rented from landscaping firms, have been a godsend for old courses replacing dead or damaged trees, and to new courses on open land. Such machines make moving a 20 foot pine a routine task.

It hardly seems that automatic irrigation could get more sophisticated, but new types of heads and controllers appear on the market each season. In machinery, better ideas are on the way, we hear, such as a combined vacuum and finger raking machine. How about a golf car riding on an air cushion?

There major trends in the business aren't all that's happening, of course. Many new ideas keep popping up that could become trends. Golf is blessed with many creative, dedicated people who never stop looking for a better way.

Here are some examples:

* The Purr-wick green, featuring underground water reservoirs to keep the rootzone constantly moist, but never too wet or too dry. The idea was developed by Dr. Bill Daniel and agronomy students at Purdue University. Such greens have been installed at several Midwest courses and three new clubs in Colorado.

* A hidden maintenance headquarters. At Meadow Hills Country Club, a non-equity membership club in Denver, the redesign and remodeling of the clubhouse and parking lot area will soon include an underground maintenance headquarters, with office for the superintendent, repair shop, equipment and materials storage. It will be under the parking lot. As a concept this does three things: saves space, places a key administrative area near the management core which is the clubhouse, and removes from members' view what often is an unsightly portion of the club's operation.

* Night maintenance of the golf course. A few have tried this before. But for courses playing to capacity sunrise to sunset, it makes more sense than ever. With an automatic irrigation system, any golf course can be watered after dark. But for the last three years Larry Runyon, superintendent for the City of Kansas City's three 18-hole courses, has done all the mowing at night. Every riding vehicle is equipped with lights. Golfers and maintenance crews don't get in each other's way, play and income are up, and labor costs have actually been reduced.

* No-fault accident insurance for golfers. A new type of policy following the principle of no-fault auto insurance is now availabe in about half our states. The coverage will take care of accidents like being struck by a golf ball, tipping over in a golf car, or falling downstairs in the clubhouse. It pays up to $5,000, for a premium of $16 per year. According to the insurance company's president: "As a result of golf's booming popularity, many golf courses are becoming more crowded and therefore possibly more hazardous." He's undoubtedly right.

Where are the new trends taking us? How big will golf be by 1980 and 1990? Predicting the future is always risky, and it seems we always underguess. Golf is now a world-wide game, still far short of its potential popularity and market. For the final quarter of this century, growth can only be limited by providing enough places to play at acceptable cost.

The National Golf Foundation and the other major golf organizations will have more work to do in education, proper promotion, watching the trends and providing helpful guidance. But we should not lose sight of what keeps us in business, what the game is all about -- pleasure. Golf is a game, a game with challenge and charm unlike any other.

What it's all about is related affectionately in this quote from Arnold Palmer's book, My Game and Yours:

"Especially in the spring of the year, when the first warm sun presses down on your shoulders, when the grass has just been mowed for the first time and sits there damp and green, with its fresh-cut smell floating up to your nostrils, when the sky is a deep blue roof over your head and an occasional cloud drifts by so white that it dazzles your eyes, a golf course is an intoxicating place."

1974 NORTHWEST GOLF COURSE MAINTENANCE SURVEY

Joe Much

No.	Holes	Yards	Irrigation Auto	Irrigation Manuel	Riding Mowers	Maintenance Budget 1974	Labor Costs	Supt. Salary	Fringe Benefits
1	18	6500		x	2	$50,000	$35,000	$16,800	-
2	18	6700		x	3	$104,500	$70,000	$15,600	Dues, Trav., Exp.
3	18	5700	x		3	$55,000	$35,000	$12,000	Auto allow., Ins.
4	18	6500	x		0	$40,000	$20,000	$ 9,500	Ins.
5	18	6475	semi		1	$80,000	$62,000	$12,000	Pension, meals, trans.
6	9	3700		x	0	$40,000	$30,000	$10,800	Ins., Keogh plan
7	18	6280	x		3	$129,000	$80,000	$19,200	(Yes-?)
8	18	6500	x		2	$101,000	$76,000	$18,000	Ins., car allow., dues, exp.
9	18	6130		x	2	$60,000	$26,000	$12,000	-
10	9	3120		x	1	$20,000	$13,000	$ 9,000	-
11	18	6500		x	1	$110,000	$54,000	$10,200	Ins.
12	9	3000	x		1	--	--	$ 8,700	"fishing leave"
13	18	6320		x	0	$150,000	$100,000	$20,000	(Yes-?)
14	18	6250		x	1	$45,000	$20,000	$12,000	Ins.
15	27	6600		x	3	$150,000	$100,000	$16,800	Ins., sick leave, meals
16	18	6900	x		2	$100,000	$51,000	$11,500	Ins.
17	9	3000		x	0	(none)	--	(none-pro supervises maintenance)	
18	18	6760	x		0	$98,000	--	$15,000	Pension, dues, car, vac.
19	18	6700		x	2	$70,000	$44,000	$15,000	Vacation
20	18	6175	x		2	$49,500	$32,500	$11,545	Rent-free housing, utilities
21	18	6660	x		2	$115,000	$77,000	$15,600	Ins., meals, dues, conf.
22	9	3100	x		1	--	$10,000	--	-
23	18	6300		x	2	$129,000	$99,000	--	-
24	18	6000		x	1	$77,000	$45,000	$ 8,000	Rent-free housing, util., ins.
25	18	6100	semi		2	$90,000	$45,000	$11,400	House, ins., meals, exp.
26	18	5900	semi		1	$40,000	$18,000	$ 9,600	Vacation
27	18	6000	x		3	$68,000	$39,000	$ 9,600	Ins.
28	18	6010		x	0	$51,000	$36,000	$11,500	Pens., fam. mbrshp., inc.
29	9	3480		x	1	$20,000	$16,500	$11,500	(Pro-supt.-mgr.)
30	9	3200	x		1	$65,000	$30,000	$10,000	House, gas
31	9	2900		x	1	$35,000	--	$10,000	Ins., car allow.
32	18	6500		x	2	$98,000	$70,000	$13,200	(Yes-$1800)
33	18	6300	x		1	$63,000	--	$ 7,200	6-week vacation
34	18	7050	x		3	$107,000	$70,000	$15,780	Ins., vac., trav., dues.
35	36	6435							
		6190		x	2	$225,000	$135,000	$12,000	Ins., pension, vac.
36	18	6670	x		1	$86,000	$55,000	$13,000	Ins., car

No.	Holes	Yards	Irrigation Auto	Irrigation Manuel	Riding Mowers	Maintenance Budget 1974	Labor Costs	Supt. Salary	Fringe Benefits
37	18	6000		x	1	$41,000	$21,000	$ 7,500	Pension, Ins., sick leave
38	18	7100	x		3	$70,000	$35,000	$11,000	-
39	18	5000		x	0	$68,850	$36,600	$ 9,630	Pension, Ins., Vac.
40	18	6250		x	1	$40,000	$26,000	$ 9,600	none
41	18	6870		x	4	$50,000	$35,000	$ 9,600	Retirement, Ins.
42	9	3000		x	0	$36,000	$19,000	--	
43	9	--	x		0	$16,000	$ 7,500	$ 6,500	Living Quarters
44	18	6320		x	2	$104,000	$69,000	$14,000	Ins.
45	9	3300		x	0	$17,000	$13,000	$ 5,000	-
46	18	6100	x		1	$75,000	$30,800	$13,125	Vacation, Travel Pay
47	18	6470	x		1	$63,700	$50,700	$11,400	Ins.
48	9	2900		x	1	$23,536	$16,186	$ 9,200	$1800
49	18	6330	semi		0	$108,000	$68,500	$12,960	$1900, car Allow., conf.
50	9	--	semi		1	$33,000	$26,400	$ 9,400	Retirement, Ins.
51	18	--		x	2	$72,000	--	$13,200	Ins.
52	9	3250		x	3	$23,000	$12,000	$ 6,850	Living quarters
53	18	6600		x	2	$90,000	--	$11,000	($2,500)

Note: Survey includes private, daily fee and municipal courses in Oregon, Washington, Montana and Idaho. There may be cases where "Labor Costs" do not include "Supt. Salary", but these were impossible to ascertain and add. In most cases total labor costs are listed. The National Golf Foundation's Northwest office is grateful for your cooperation and hopes this survey will be of interest and value to those who participated.

POA ANNUA CONTROL PROGRAM[1]

Roy L. Goss[2]

Many turfgrass managers still feel that it is a losing battle to try to control *Poa annua*. Those of you who have had the privilege of maintaining perfect stands of turfgrasses free of *Poa annua* can appreciate the need and desirability of maintaining stand purity. In play and recreational areas *Poa annua* will not stand up to heavy abuse, nor will it withstand drought stress. On putting greens it creates an uneven putting surface, and the prolific seedhead development is unsightly. Dr. V. A. Gibeault, University of California, Riverside, in a recent publication sums up *Poa annua* about this way: "If a turfgrass stand has from 0 to 40 percent *Poa annua* present, the chances of removing it and stimulating the more desired species by cultural and chemical approaches are pretty good. Therefore, it can be considered a weed. If the turfgrass location has from 60 to 100 percent *Poa annua*, perhaps it is not such a bad species after all. Total renovation may be out of the question, so let's consider annual bluegrass a friend and learn to live with it. If the turfgrass location has from 40 to 60 percent *Poa annua*, the decision must be made whether to take steps to eliminate it or take steps to foster its growth." I think that I would subscribe to this summary made by Dr. Gibeault. Let us consider then some of the cultural and chemical methods by which *Poa annua* can be controlled or eliminated.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Agronomist/Extension Agronomist, Washington State University, Western Washington Research and Extension Center, Puyallup, Washington.

PRE-EMERGENCE CONTROL

Many chemicals have been tested in research programs at the Western Washington Research and Extension Center at Puyallup for control of *Poa annua* in both putting green turf and lawn type turf. Not all chemicals for pre-emergence control are equally effective under all systems of management. Many of our pre-emergent chemicals are not registered nor recommended for use on putting greens. Grasses mowed between 3/16 and 1/4 inch in height frequently will not withstand this treatment. Bensulide (Betasan, Pre-san, Prefar) has given best control of *Poa annua* under putting green conditions in our tests for the past four years. The normal practice of applying 15 lbs. active ingredient per acre once per year, which was the original recommendation, does not work. Tricalcium arsenate has been recommended in the midwestern area for some years and excellent results reported from many locations. The problems associated with Tricalcium arsenate, however, make many turf managers very skeptical about its use. One has to be extremely careful if soils tend to be too wet or poorly drained, and other factors can affect the activity of arsenic as well, including phosphorus levels.

Bensulide and Tricalcium arsenate were the basis for a four year study at Puyallup to determine their affect on *Poa annua* control on Highland bentgrass maintained as putting green. Plot evaluations made on August 20, 1974 reveal that all plots treated with Bensulide at 15 lbs. per acre annually averaged from 47.5 to 65 percent *Poa annua* in the plot area. Bensulide, however, applied at 15 lbs. per acre initially followed by repeat applications of 3 lbs. active ingredient per acre every three months has maintained plots with less than 10 percent *Poa annua* after the first two year's treatment. The initial populations of *Poa annua* in this particular instance was over 40 percent of the plot area.

Tricalcium arsenate applied at the rate of 18 lbs of product (Chip Cal granular) over a 4 month period, then maintained with 2 lbs. of product in May and October for maintenance levels have maintained plots nearly 100 percent free of *Poa annua*.

From this study, it can be concluded that *Poa annua* can be controlled with Bensulide, a relatively harmless treatment on putting green turf if diligently and accurately applied. Other pre-emergence herbicides are currently being investigated to determine both efficacy in the control of *Poa annua* and their phytotoxic effects to bentgrass turf.

POST-EMERGENT CHEMICALS

Whether Tricalcium arsenate and Bensulide had a direct effect upon established *Poa annua* plants was not necessarily determined from our tests. It is felt that the Tricalcium arsenate did weaken and kill mature *Poa annua* within the first year, and it is possible that Bensulide, at the rates applied, had some post-emergence effects as well. It is felt, however, that many of the *Poa annua* plants simply lived out their life and disappeared, and without new seedlings to replace them, resulted in relatively *Poa* free turf. So far, no other post-emergence herbicides have appeared that will selectively remove *Poa annua* from established bentgrass, bluegrass or fescue turf. One new material that has not been labelled nor marketed has shown some promise in this direction and is being actively pursued.

It is a known fact at this point that the manipulation of sulfur and phosphorus levels is extremely important in both pre- and post-emergence control of *Poa annua.* Results of seven years of applications of sulfur on putting green bent at our Station has demonstrated variable effects on *Poa annua* populations. When sulfur was applied at 1.15 lbs per 1000 ft^2 annually (50 lbs per acre), all turfgrasses were apparently equally stimulated and *Poa annua* actually increased. However, when the sulfur was increased to 3.45 lbs per 1000 ft^2 (150 lbs per acre), *Poa annua* was significantly reduced, and especially with variable combinations of phosphorus fertilization. The highest level of sulfur reduced *Poa annua* at the highest level of phosphorus application (4 lbs P_2O_5 per 1000 ft^2 per season), but was highly significant in plots where no phsophorus was applied. The most significant decrease in *Poa annua* in all plots was found where only 6 lbs of nitrogen per 1000 ft^2 per season was applied and where no phosphorus was supplied to the grass. Plots receiving 6 lbs of nitrogen, 4 lbs P_2O_5 phosphorus, and 1.15 lbs. of wettable sulfur per 1000 ft^2 per season had extremely high populations of *Poa annua* as compared with those receiving the highest level of sulfur with or without phosphorus; although the plots that received no phosphorus were nearly 100 percent free of *Poa annua*. Plots receiving 20 lbs. and 12 lbs of nitrogen per 1000 ft^2 per year with P and no P responded similarly to those receiving 6 lbs of nitrogen, although *Poa annua* populations are slightly higher in these higher nitrogen treated plots.

TOPDRESSING AND RESEEDING PROGRAM

Dr. John Madison has presented his approach to putting green quality improvement and the elimination of *Poa annua* and will not be elaborated upon at this point. However, his data indicates that frequent light topdressings combined with balanced nutrition can significantly reduce or eliminate *Poa annua* under putting green conditions. The program he has outlined also calls for the elimination of aerification. The holes left after aerification become planting sites and establishment routes for *Poa annua*. This is an interesting program, and may be followed up by those of you who may be interested.

OTHER *POA ANNUA* CONTROL POSSIBILITIES

1. Use of vigorous varieties. Many of our highly stoloniferous bentgrasses are vigorous enough to provide a dense turf that resists *Poa annua* invasion. These should be closely analyzed. One hundred fifty-seven different bentgrass cultivars are being observed at the Puyallup Station for any such traits.

2. Overseeding. Turfgrass managers who provide bentgrass seed to establish turf increase the possibilities of maintaining higher bentgrass populations or other grass populations as well. This constant replenishment of seed supply will produce some competition for the abundance of *Poa annua* seeds produced.

3. It is essential to control turfgrass diseases to help keep down *Poa annua* populations or eliminate it. Spots killed or severely injured by turfgrass diseases are excellent establishment sites for this weed.

4. Balanced nutrition - If you wish to maintain good stands of *Poa annua*, maintain high phosphorus levels and adequate nitrogen; but if you wish to eliminate *Poa*, you must severely reduce phosphorus applications and maintain good nitrogen, potassium and sulfur levels.

5. Make no serious mistakes in judgment that will injur or otherwise kill your turf.

One final caution should be made. If you are practicing overseeding, do not apply pre-emergence chemicals unless judicious timing is worked out.

THE MAKING OF BEAUTIFUL GOLF COURSES —THE HARD WAY[1]

Ronald W. Fream[2]

Let me start by saying that regardless of where the golf course is located, a skilled golf course constructor and a skilled golf course superintendent are the golf architect's best friends in achieving the stated objective. The desirability, necessity and appreciation of having available skilled and experienced personnel becomes more crucial to the golf architect the farther from the United States the project is located.

As a partner in a golf architectural firm presently serving clients in 16 countries, one of our major concerns is achieving quality golf course construction in remote and adverse locations. By adverse I would refer to the local lack of understanding, comprehension or appreciation for what actually comprises a championship and beautiful course or in some cases a golf course, period. This problem of lack of understanding occurs when a firm such as mine is commissioned to design the first world class or modern championship golf course within a nation. Perhaps it is the first resort golf course in a remote portion of a country which does have some golf. More and more, the 3rd world countries are developing golf oriented resorts as one additional means of attracting cash-laden tourists to a beautiful, but possibly primitive, new area. Also, an emerging or expanding national middle class in many 3rd world or recently industrialized nations are beginning to strive for the status or prestige membership in a golf club might offer. Remember, very few countries other than the United States have municipal public golf courses in any quantity. In many countries, the only golf courses are private and very expensive. As with Americans, persons taking up golf in other countries also become addicted to the sport.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Fream/Storm/Associates, Ltd., Golf Architects and Development Consultants, Los Gatos, California.

The primary problems of construction in areas outside the United States in general are lack of equipment, lack of materials, and a lack of knowledgeable local personnel. Each of these groupings can be expanded and modified in many ways. In Japan, no shortages, except land, exist. That creates its own very monumental problems. In some Asian countries only thousands of laborers are available. Middle east and North African countries especially, reflect a shortage of water.

It is not uncommon to find our project sites located in tropical areas. Rain forests present their own unique problems. Tropical rain forests are especially worrisome for someone like me. The architect must obviously view the site prior to initiation of design studies and construction. Some of these remote sites are primarily inhabited by such crawling things as bushmasters, cobras and green mombas. Once someone else has cleared the way, some feeling of security may be achieved. It is not until the cutlass men have opened the forest and dozers or hand labor has piled the debris that one can feel fully at ease. The rain fall frequency and intensity can be another tropical problem not easily adapted to.

Thick bamboo forests with bamboo stems 3 to 5 inches in diameter and 30 to 40 feet tall are a challenge of their own. Clearing of giant bamboo requires fire, hand cutting with saws or cutlass, and if available, bulldozers. In Northern Japan bamboo about 5 feet tall with 3/4 inch diameter canes can carpet a site as undergrowth beneath a birch tree forest. Hand cutting is a slow, tedious and costly process. Regrowth of the bamboo can be a continuing problem. Armies have literally been used on some project clearing and construction work where the government of the country is sponsoring golf development as part of the emerging tourist industry.

Europe, in general, is well equipped mechanically. The technology of modern construction and local experience has barely reached Europe, however. African and Asiatic areas are not well supplied with the basic mechanical equipment necessary for efficient construction. In Kashmir, a construction company of the Indian Army Corps of Engineers did provide the machines and man power. The difficulty with that army was a stifling quantity of red tape. In Morocco, army personnel were also utilized. The army set up a biviouac camp of tents on site.

In Japan mechanization is awe inspiring. The mechanized equipment on hand often resembles an armored batallion. Each tractor has a ground man to direct the individual operator. The contractor usually establishes a barracks like camp on site for the entire crew. In Japan where only mountainous sites are generally available for golf development, large quantities of earthmoving machines are obviously a necessity if 2 or 3 million cubic yards of earthmoving is considered commonplace for 18 or 27 holes. It is a study in contrast to see 20 to 30 D-8 and D-9 dozers moving a hillside while not far away 20 or 30 men and women hand place and spread the various components of a green seedbed mixture.

The other extreme might be at a tropical paradise such as Bali in Indonesia where a single pre-World War II model Russian bulldozer plods along in its one forward gear while 1,200 women and girls and a few men hand excavate lakes, move rock, build mounds, tees, bunkers and greens with metal and wooden shovels and shallow baskets carried on the women's heads.

Even in remote areas a sand and organic humus greens seedbed mixture is always strived for because of the long-term turfgrass management advantages. In an area as unfamiliar with golf as Tunisia, Mauritius or St. Kitts the construction superintendent cannot easily order up 8,000 feet of polyethylene drainline tubing. All you might be able to get is 3 foot long by 8 inch diameter 40 pound lengths of perforated and non-perforated concrete pipe; a little hard to handle, but useable nonetheless. No easier can the construction superintendent order up large quantities of specifically sized sand for the putting green seedbed or gravel of uniform diameters. The sand may have to come from a beach miles away in 5 cubic yard trucks; if it is legal to take sand from the beach and if the trucks are available or operational. Elsewhere, more or less mechanically screened river bed sand, coral beach sand or crushed volcanic pumice may be all that is available. In Bali, the sand was hand screened from local stream beds. Sand hydraulicly pumped from the sea is another source. In St. Kitts stone "knappers" will make any size and quantity of drain gravel you want - using hand operated hammers to make little pieces out of big ones. In many areas local stream bed rock is all that is available.

Consistent quality brand name organic humus is not always just a phone call away. In some localities such as Glasgow and elsewhere in the United Kingdom organic material such as local sphagnum peat moss is readily available. Ireland, too, has ample supplies of fine peat moss. Irish peat or German peat can be shipped elsewhere in Europe. We have also used Irish peat in Japan. At Sapporo, in Northern Japan, Russian peat moss and local ground pine bark were quite available. There does not seem to be any difference between Irish and Russian peat moss except for the differing political systems and red tape for purchase.

Have you ever built a green using ground cork and hog manure as the organic components? In Portugal ground cork is reasonably available as a by product of the wine bottle stopper business. Pork is a common food and hence a ready source of manure. Rice hulls are a little light but are all you can get in Bali. Not surprisingly, when well composted, rice hulls are a very good source of durable organic humus. Well composted sugar cane debris called Bagasse is a very useful organic humus material which is available in most tropical areas; that is, unless it is being burned by the sugar refinery as fuel during the energy crisis. Filter press mud is another by product of the sugar refining process which works when no other organic humus is available. Seaweed or kelp, ground olive pits, wheat chaff or the leavings of a wine grape squeezing operation may also provide a source of organic humus. It usually is not economically feasible or reasonable to ship in from out of the country some specialized organic material. There almost always is some type of suitable local material available if you are willing to seek it out.

Mixing of the greens seedbed components to insure proper uniform consistency is occasionally less than a mechanized process. In some countries a large cement mixer, soil shredder, skip loader or patrol grader can be obtained for off-site mixing. Occasionally a Howard type rotohoe or a small walking rototiller can be gotten for use in on-site mixing. It is not uncommon in some high labor-low wage areas to perform the seedbed mixing entirely by hand with basket and shovel. Imagine about 40 men, women and children - dressed in colorful sarongs - mixing sand and rice hulls for 18 greens in a lush volcanic valley in Bali. All of the seedbed mixture is transported in baskets balanced on the heads of teenaged girls. We might recommend this as one means of developing very good posture.

What with the costs of surface or air freight transportation, importation taxes, customs duties and purchase equalization taxes, it is not always an easy or reasonable matter to order up all your material requirements from the United States. Import duties and taxes alone can frequently raise FOB United States cost of imported materials and equipment 30 percent to 75 percent or even 100 percent in some cases; hence, the attempt to utilize locally available materials whenever possible.

Only three or four brands of irrigation sprinkler equipment are commonly available, or even dependable, on an international basis. The irrigation system is one area where materials of United States manufacture must generally be used. Most foreign produced irrigation equipment is based upon United States design. For product reliability it is best to go with the tested products. This may upset national pride occasionally, but so be it. Import duties can be quite severe on these items.

Don't expect to be able to install a nice elaborate automatic irrigation system. The state of the irrigation art is rather primitive beyond our somewhat sheltered borders. I have a copy of a magazine advertisement from a major British golf magazine for one of the main British irrigation design and installation firms. This advertisement boasts of the fact that they installed the first irrigation system in the United Kingdom that includes automatic fairway and rough watering during the summer of 1973! Hardly what one might call longterm experience. Green and, to a lesser degree, tee automatic watering is certainly more common. Elsewhere in Europe some American architects have installed full automatic systems in years past. However, what good is automation when no one understands how to properly operate the system and labor is very plentiful at a few dollars per day. In Australia rainmobile type traveling sprinklers are common on tees, greens and fairways. Club members do not expect any better irrigation (possibly because they haven't been adequately exposed to full modern irrigation much yet). Japan has accepted modern irrigation. However, Japan generally lacks qualified irrigation engineers who can properly design the system. Our west coast United States' based irrigation design engineers have had probably the most extensive experience in golf course irrigation to be found anywhere in the world.

Irrigation pipe of PVC or asbestos cement is manufactured in quantity and quality in a variety of countries; if the necessary raw materials are available.

The design of the irrigation system pumping plant must compliment the design of the sprinkler system. Simplicity and durability of operation and maintenance are a must. When rapid back up of spare parts or repair service is not available a duplicate pump system may be provided as a safety measure. This is obviously quite expensive. In some cases no reasonable alternative exists.

The import duty and taxes imposed on brass valves, controllers, wire and sprinkler heads by most countries in many cases more than offsets any installation cost savings realized by $2 or $3 or $6 per day labor rates. Surface transportation charges and time delays in shipping, dockside pilferage and customs clearance, beaurocracy and transport to the job site are additional time and bribe consuming and often frustrating factors to consider. Urgently needed equipment can set on a dock for weeks while the red tape is removed.

Also to be considered is the problem of spare parts. Even with the availability of telex and air freight, days or more commonly, weeks can lapse between time of need and arrival of replacement parts. Large stores of spare irrigation system parts must be pre-determined and provided for. Generally, a one to two year supply is sufficient.

Water for the irrigation system may come as 2 inch per hour tropical showers, unlimited use of rivers and lakes or fixed maximum limits of say 1,500,000 liters (approximately 400,000 gallons) per day in arid climates reminiscent of Los Angeles. Piping water 20 or more miles to the golf course resort site is not uncommon either. Domestic municipal water systems may be unknown. Wells are generally the most desirable solution. Under the influence of a very dry tropical "summer", the available stream flow may not exceed 50,000 gallons a day for several weeks at a time. Ponds or storage tanks are included whenever reasonable as a reservoir and supply storage source.

The improved golf course quality turf type grass varieties for what we call world class or modern golf courses are only available in quantity from the United States. The rest of the golfing world, including the United Kingdom and Australia are from about 5 to 20 years behind us in turfgrass science, research and in some cases also the use of the improved grasses. The conditions found in our own Pacific Northwest are unsurpassed for producing the improved turfgrass variety seed for cool season uses. Turfgrass varieties developed elsewhere are still generally grown for commercial production in Oregon or Washington. Air freight direct from grower or distributor to job site ensures viable seed at the time needed. Arizona is the prime source of common Bermudagrass seed. Some other countries grow commercial quantities of seed, but have been unable to produce the certified quality seed top class golf course development requires. This deficiency is being corrected rapidly by some European seed producers.

Hand pulled homemade wooden board rakes and "people pulled" drags may be all you have to float the seedbed surface before seeding. Brillion seeders are not always available. Perhaps all you will have to seed the entire course with will be 10 or a dozen girls with monkey grinders or 5 gallon cans walking in skirmish lines broadcasting seed.

In tropical climates, the hybrid Bermudagrasses and/or common Bermudagrass are the most dependable and also can be very economical. We favor Tifdwarf for greens and aprons with Tifway. Tifgreen or common Bermuda is used for fairways and tees. Common Bermudagrass can also be used in roughs if economy or speed are required. In arid regions with salt problems and low humidity common Bermudagrass for fairway and tees with Seaside Bentgrass for greens is a successful combination. Establishing a nursery on site using only a few bushels of initial stolon stock can provide more than ample stolon material for planting an entire course. Initial introduction of hybrid selections into some countries may require "covert" methods. Generally, a one acre nursery for greens turf and 3 to 5 acres of fairway turf nursery are ample. If money is no object, all of the stolons could be air freighted to a job site when needed. However, costs are generally more closely restricted out of the United States than here at home. Hence, the establishment of an on-site nursery. Stolonization by hand using gangs of labor is frequently the most expedient means of planting hybrid Bermudagrass. A good local welding shop can fabricate a stolon planting machine. One exception has been Japan. As long as the supply lasted, courses around Tokyo or farther south in the warm humid climate were sodding the entire course from rough to rough, tee to green with Kori (Zoysia); generally variety japonica on everything except the greens where matrella was used. One course we did near Nagoya had a $500,000 price tag just for sodding all 18 holes!. Here, too, hand labor - over 500 people - was used to place each piece of sod.

Fertilizer to make the grass grow and chemicals to keep it growing are not always available in the formulations recommended by the various United States based experts. Make do and make shift are the general approaches. Generally, some type of fertilizer is available from a local agricultural supply source. Petroleum shortages are cutting deeply into the availability of these chemical items. The third world areas are generally not as well suppled with raw materials as we are here in the United States.

Maintenance equipment to keep the grass growing properly is manufactured and available from the United States and, to a lesser degree, from England and Australia. Here again, the state of equipment and technology outside the United States has never had the demand to stimulate innovation to as highly sophisticated a degree as here at home. Don't consider using fancy hydraulic, electronic, elaborate and complex equipment. Getting such items through customs and the import tax man are two large problems. Damage or loss during shipment is common.

Next comes the job of trying to find and/or teach someone to understand how to operate and maintain such equipment. Replacing damaged or broken parts may take weeks. The grass waits for no man. The equipment must be simple and uncomplicated. The man driving the tractor towing the fairway mowing units may never have driven anything but a motor bike before. The equipment must be on hand in duplicate or triplicate. Ditto for spare parts. Hand labor frequently is used in place of even simple mechanized equipment. This is very fine in the low wage high labor availability areas. "Make" work may be an important function for the golf course. Cutlasses or sickles can be used to hand mow roughs. I do not recommend it, but have seen a three foot wide flail mower being used to mow fairways with 10 girls following with straw brooms and baskets to sweep up the clippings.

All of these various items I have discussed actually are dependent upon a few items that are basic and preparatory to all others. The golf architect <u>must</u> provide very comprehensive, easily understood and well-detailed plans and specifications. Terminology much be simplified. Extensive, clearly concise working drawings with many perspective and sectional detail drawings are necessary. Greens drawings are done using both a grid system and contour intervals which may be laid out in the field quite simply. Additionally, we find it desirable to provide accurate perspective renderings of every green to complement the plan views. This allows construction equipment operators who do not read contours to have the architect's perspective as a guide. Perspective sketches of other critical parts of the construction process are also provided. Irrigation system plans are treated in an equally precise manner.

More importantly, we encourage the client to employ a field superintendent whom we select from the United States. Sometimes it is difficult to explain to a client who knows little of the complexities of golf construction to accept a man at $1,500 or $2,000 per month plus wife and expenses to direct a construction crew when the local foreman earns perhaps a few hundred dollars or less per month with no expenses. Daily wage rates for general labor of less than $5 are common in many parts of the world. In Bali, one dollar a day is the current going rate. However, we encourage clients in such areas to pay a premium to the golf crew members as an added incentive to these people. In Japan $15 a day is a common laborer's wage, but is rapidly increasing. In Trinidad, skilled bulldozer operators receive between $6 and $7 per day.

Not only is the wage scale a problem, in many of these emerging countries a foreigner cannot even get a legal work permit. With employment opportunities very scarce, many governments attempt to prevent any importation of labor no matter how unknowledgeable or inexperienced the local people may be. If work permits are granted, only a few outsiders are given permission to enter, and then for only specific periods of time. Obtaining work permits can be a very time consuming process frequently requiring several months. This means the architect cannot bring in numerous skilled and experienced equipment operators to provide the custom shaping of the greens. The architect may declare himself as a tourist upon entry as the most expedient means of getting to the project site. This entry problem varies with the country. Europe and Japan provide quite liberal entry conditions. Some Caribbean countries are very difficult.

The field superintendent must understand and interpret the architect's plans during the periods when the architect cannot be at the job site. The field superintendent must frequently perform and direct all of the critical earth shaping and green contouring procedures. This same field superintendent is chosen for his ability to direct the installation of the irrigation system. Another responsibility is to train and teach the local people including the future local golf superintendent in proper turfgrass management and maintenance. Without proper training of the local people in turf management, all of the prior efforts can be lost. In part to achieve this objective, it is often necessary to provide the client with a very elaborate, and detailed general maintenance program. Obviously, during a 6 month or 1 year stay, no field superintendent can fully train his local counterpart who hopefully is a graduate of an agricultural school. Follow up visits by superintendent and/or architect after turf establishment are always encouraged.

One distinctive challenge my firm has before it will be the construction of the first tournament calibre golf course in Tunisia. To this end, we must obtain a United States trained construction superintendent who fits the various criteria mentioned above. Additionally, this person must be mature; perhaps between 35 and 50 years of age to command the respect of the local Tunisian labor force. Finally, this individual must speak fluent French or Arabic in order to freely communicate with and direct the local personnel. What is that old adage; the difficult we do immediately, the impossible takes a little longer?

The architect's irrigation engineering consultant and agronomic consultant are available to assist and periodically provide on-site review of the construction and turfgrass establishment. Nonetheless, for the most desirable in final results it is the field construction superintendent who truly achieves the golf architect's intentions. Successful golf course construction in remote areas cannot be accomplished to this firm's modern standards without some very knowledgeable construction supervision. By providing training for the local personnel in the science and art of turfgrass maintenance, with future periodic follow-up consultations as needed, the client and his own local people can maintain the course to the standards the architect envisions and the client deserves.

No longer must a golf course in any new area be just a poor excuse; top quality playing surfaces in an aesthetically beautiful setting are a practical possibility at reasonable cost. Knowledgeable and conscientious effort, patience and time are the principal requirements.

1973/1974 SNOWMOLD FUNGICIDAL TESTS[1]

Charles J. Gould[2]
Roy L. Goss[3]

The 1973/74 experiments were conducted on bentgrass putting green turf on five golf courses in Washington and Idaho. Applications were made at three times: early fall to control *Fusarium* Patch; late fall to control both *Fusarium* and *Typhula* snowmolds; and early spring to control *Fusarium* Patch. Unexpected snow interferred with the planned schedule at times. Dates are indicated in the following table.

Table 1. Application Dates

Location	Early Fall 1973	Late Fall 1973	Early Spring 1974
Hangman Valley	Sept. 24	Nov. 14	Feb. 26
Hayden Lake	Sept. 25	Nov. 14	Mar. 11
Moscow - Univ. Course	Sept. 26	Nov. 12 & 13	Mar. 12
Moscow - Elks Course	Sept. 26	Dec. 1 & 2	Feb. 27
McCall	Sept. 27	Oct. 5	May 8

Six replications of 5' x 5' plots were used at each location. Most fungicides were applied in water (at 10 gallons per 1000 ft^2) but a few were put on dry as noted in Table 2.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Plant Pathologist, Western Washington Research and Extension Center, Washington State University, Puyallup, WA

3/ Agronomist/Extension Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, WA.

Weather did not favor *Fusarium* development either during the fall or the spring. Snowcover was intermittent except at McCall where it persisted from November to May so, as would be expected, the most typical snowmold occurred on the McCall course. Attacks in general were not as severe as often encountered. Both *Fusarium nivale* and *Typhula incarnata* were present in early spring in the approximate ratios as shown in Table 2. These are very rough ratios since definite identification of all spots was impossible because of lack of time. Some symptoms seemed to be clear-cut but the majority were intermediate. Sclerotia of *Typhula* were sometimes present in the field but often were lacking in "typical" spots and only developed on samples after prolonged storage in a refrigerator. It would be necessary to "live with" this disease complex during the winter for one or more years to satisfactorily resolve this problem of symptomology under these conditions. Dr. Drew Smith kindly examined our plots at Moscow, Hayden Lake and Spokane and could not find any evidence of other *Typhula* species, *S. borealis* or the low temperature basidiomycete.

Table 2. Percent of Untreated Area Diseased and Percent of Diseased Area Apparently Infected by *Fusarium* or *Typhula*.

Location	Percentage of Untreated Plot Area Diseased	Untreated Plots Percentage of Diseased Area Apparently Infected	
		Fusarium	*Typhula*
Hangman Valley	35	47	53
Hayden Lake	25	59	41
Moscow - University	16	94	6
Moscow - Elks	20	58	42
McCall	66	39	61

Data were obtained at various times by one or more of us on percentage of area diseased and numbers of diseased areas plus ratings of area diseased, color and texture. These are being analyzed statistically and a full report will be made later.

Although the snowmold attacks were not as severe as we had hoped for, there was enough disease to show that certain treatments were very effective. Pertinent recommendations will be made at the Northwest Turfgrass Conference.

The fungicidal tests will be terminated. However, as most of you know, we have a bentgrass variety testing program underway at the Hangman Valley Golf and Country Club to determine if some of the newer varieties are more disease resistant and culturally desirable than varieties presently being used. We will also start an experiment this fall on the effect of nutrition on snowmold development at the Spokane Golf and Country Club.

We are very grateful to the Northwest Turfgrass Association for their financial contribution to this project and also to the excellent cooperation from the respective superintendents or managers: Bud Ashworth (Hangman Valley Golf and Country Club), Vern Harvey (Couer d'Alene Golf and Country Club), Fred Hall (Moscow University Golf Course), Ken Jordan (Moscow Elks Course) and John Dripps (McCall Golf Course). We also appreciate the assistance of Dr. William Bruehl (WSU, Pullman) in examining some disease samples and particularly the assistance of Dr. Drew Smith (Can. Dept. Ag., Saskatoon, Sask.) in visiting four of the experimental areas in March and determining the pathogens present.

TURFGRASS OBSERVATIONS[1]

Ron D. Ensign[2]

We have under evaluation 72 different varieties of turfgrasses at the University of Idaho, Moscow Station. The bulk of this planting include established named varieties of bluegrasses. Some new selections of bluegrasses are also included. Several fine-leafed fescues, turf timothys, and a few ryegrasses are also included.

The entries are planted in 5 x 20 foot blocks and mowed weekly at two heights; approximately one and two inches. Regular color readings are taken as well as notes on spring green-up, diseases, thatch accumulation, and root and rhizome growth.

The fine-leafed fescues greenup slightly earlier than the bluegrasses at this location. Bluegrasses with early (late March-early April 1974) green-up include: Adelphi, Arboretum, Delta, Garfield, Kenblue, Park, Sydsport, P-142 and P-164. Varieties having relatively late green-up are Nugget, Cougar, Newport, P-29 (Glade), Prato, and Fylking.

Color readings among the turf bluegrass varieties are quite striking. Varieties with dark green color readings rather commonly during the growing season include: Adelphi, Baron, Glade, Nugget, Pennstar, Belturf, Ram #1, Continental and Galaxy.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Professor of Plant Breeding, University of Idaho, Moscow, ID.

So far, the plots have been relatively free of diseases although some *Helminthosporium* was evident on some varieties.

Bluegrasses and the fine-leafed fescues appear to be superior turf varieties for this area for general lawn or fairway purposes.

CHLOROSIS STUDIES

Chlorosis is a major problem in grass culture on most calcareous soils in the intermountain areas of the Northwest. This is especially severe in high pH soils in irrigated turf in southern Idaho during the high stress months of July and August. These chlorosis conditions are generally associated with the tie-up of iron with carbonates and phosphates. Plants become yellowish and leaf and root growth is reduced.

Experiments have been established in cooperation with the Chevron Chemical Company and the City of Pocatello on the Highland Golf Course. Replicated plots including applications of ferric sulfate, Ferrous ammonium sulfate and manganese sulfate and zinc sulfate alone and in combinations were applied in June, 1974. Two application rates of each chemical; 0.40 and 0.63 pounds per 1000 ft^2 were applied. Color readings have been taken regularly and tissue samples are taken monthly and analyzed for Zn, Fe, Mn, NO_3 and total P and protein. Data collection has not been completed, but it appears even the minimum application of ferric or ferrous materials gives a definite greening response. Zinc or manganese gave but little response. Further information including residual responses will be taken and data will be analyzed.

BRITISH COLUMBIA TURFGRASS[1] RESEARCH REPORT

D. K. Taylor[2]

FUNGICIDES FOR THE CONTROL OF SNOW MOLD IN THE B. C. INTERIOR

Snow mold is the most serious disease of putting green turf in the interior of the Province. The organisms responsible for most of this disease have been identified by Dr. Drew Smith as two species of *Typhula* (*T. incarnata* and T. F.W.) and *Fusarium nivale*. The results of three years of trials at three locations indicate that non-mercurials such as Tersan SP (chloroneb) 9 oz/1000 ft^2 and Terraclor (PCNB) 5 oz. can effectively control the *Typhula* type snow mold in a one treatment application prior to snowfall. Where snow mold is likely to be severe, rates of PCNB in excess of 5 oz would appear to be more effective and from the results at Saskatoon rates up to 9 oz can be used without injury to the turf.

However, a late single application date was not effective in controlling early fall attacks of *F. nivale*. Therefore a September application of a fungicide such as benomyl or maneb would appear necessary to reduce the possibility of a *Fusarium* outbreak in the fall. PCNB in late fall applications appears superior to chloroneb in reducing the possibility of a spring attack of *F. nivale*.

Mixtures of fungicides applied late in the fall showed promise of reducing the amount of *Fusarium* while controlling *Typhula* as well. Granular fungicide containing either chlorneb or PCNB with fertilizer were promising in a one year trial. However, further trials are necessary to determine the effectiveness of these procedures.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Canada Department of Agriculture, Agassiz, British Columbia.

GRASSES FOR SPORTSTURF

After two winters of simulated wear in a replicated study of grasses and mixtures for sportsturf use, four grasses have shown considerable ability to resist wear or recover well. These are perennial ryegrass, Kentucky bluegrass, dwarf timothy and roughstalked meadow grass. Other grasses such as creeping red or hard fescue, bentgrass, Canada bluegrass and crested dogstail were almost eliminated from the stands.

Results of a botanical survey in May, 1974 showed a mean cover of sown species in pure stands for timothy - 74%, Kentucky bluegrass - 64%, roughstalked meadow grass - 56% and perennial ryegrass - 53%. The remaining area was either annual bluegrass or bare ground. Mixtures of the above grasses were superior to single grasses alone, with best results from a mixture of perennial ryegrass, Kentucky bluegrass and timothy. Timothy was winter green, at times subject to disease or herbicide injury, but seems to have good recuperative ability.

Where perennial ryegrass and Kentucky bluegrass were seeded in various ratios, perennial ryegrass dominated after one year but after two years the proportion of Kentucky bluegrass increased markedly.

Manhattan was the best of the perennial ryegrass varieties tested, superior to Pennfine, NK 200, Game, Norlea, etc., both in pure stands and mixtures. Among the Kentucky bluegrasses Sydsport and Merion were superior to Baron, Fylking and Nugget both in pure stands and in combination with Manhattan perennial ryegrass.

Estimated Mean Percentage Botanical Composition, May 1974

Species or Mixture	Number Treatments	P*	K.	T.	P.a.	BG	P.a.+BG
P	20	53			34	13	47
K	5		64		31	4	35
T	6			73	24	3	27
PK	6	41	34		18	8	26
KT	2		43	43	13	1	14
PKT	3	47	28	13	7	4	11

* P - perennial ryegrass, K-Kentucky bluegrass, T-dwarf timothy, P.a.-Annual bluegrass, BG-bare ground.

Percentage botanical composition of Manhattan perennial ryegrass - Merion Kentucky bluegrass mixtures following wear treatments

Seeding (1972)		Percentage Stand				
Ratio	Rate	1973		1974		
P:K	#/1000 ft^2	P	K	P	K	P.a.+BG
1:2	3.0	58	42	33	56	11
1:1	3.5	70	30	46	46	8
2:1	4.0	75	25	46	40	14
3:1	4.5	86	14	47	43	10
4:1	5.0	87	13	59	25	16

P = perennial ryegrass, K = Kentucky bluegrass, P.a.+BG = *Poa annua* plus bare ground.

TURF DENSITY AND WEED COUNT

Previous results from Agassiz have shown a close correlation between susceptibility to disease and the number of broadleafed weeds. In that instance turf density was reduced by disease and a weed invasion resulted.

However, varieties of turfgrass appear to be inherently different in density. It is reasonable to expect that the denser varieties should be more resistant to weed invasion. A count of dandelion seedling invasion in variety tests at Kamloops in 1974 showed marked differences among varieties within tests. Denser varieties such as Nugget Kentucky bluegrass, Highlight fescue and Penncross bentgrass had significantly fewer dandelions than many of the other varieties under test.

DANDELION COUNT IN TURFGRASS TRIALS AT KAMLOOPS, B.C.
July 22, 1974

Fescue 1969

	Mean No/m^2
Reptans	16.3 a
Boreal	14.7 b
Duraturf	13.7 bc
Rainier	11.5 bc
Commercial	10.7 bc
Pennlawn	10.7 bc
Durlawn	8.3 bcd
Illahee	7.7 d
Dawson	4.0 d
Highlight	3.7 d

Kentucky Bluegrass 1969

	Mean No/m^2
Newport	40.5 a
Windsor	25.0 b
Park	22.5 bc
Fylking	20.0 bcd
Cougar	19.7 bcd
Primo	17.5 bcd
Merion	17.3 bcd
Pennstar	15.3 cd
Prato	11.3 de
Nugget	5.5 e

Mixture 1972

	Mean No/m^2
Boreal	40.0 a
Boreal-Sodco	29.7 b
Boreal-Merion	27.8 bc
Highlight	24.0 cd
Sodco	23.4 cd
Merion	23.3 cd
Highlight-Merion	21.0 de
Highlight-Sodco	20.8 de
Boreal-Nugget	15.4 ef
Highlight-Nugget	11.1 fg
Nugget	9.0 g

Bentgrass 1970

	Mean No/m^2
Highland	17.7 a
Boreal	12.5 b
Exeter	10.3 b
Emerald	9.7 b
Penncross	5.5 c
Bardot	5.5 c

SCREEN TURF CULTIVARS[1] FOR THE NORTHWEST

Stanton E. Brauen[2]

There are now in excess of 270 turf selections and cultivars being evaluated at the Research Station at Puyallup. These 270 sources consist of bluegrasses, fescues and ryegrasses. In addition, all fescues have been established at Port Angeles for evaluation under low maintenance conditions. Data have been collected on the performance of these varieties under general turf management conditions during the past year.

Among these cultivars and selections there appears to be a number of promising materials for Northwest use. Probably no single grass will be the epitome of desires, but there appear to be grasses commercially available now or within a short time that will broaden substantially the future selection of quality turfgrasses. Of course, only competitive, high seed producing varieties will survive in the end and be available on the market.

These evaluations have shown many bluegrasses to be susceptible to tissue necrosis during the winter months. This necrosis is similar to a crown rot and occurs west of the Cascades. The causal agent has not been identified. Yet, other selections and cultivars of bluegrass show complete resistance, at least in the first season. Several of these grasses that show resistance should improve bluegrass capabilities in western Oregon and Washington. It is possible that some varieties resistant in the first year will break down in subsequent years.

1/ To be presented at the Northwest Turfgrass Association Conference, Sun River, Oregon, September 25-27, 1974.

2/ Assistant Agronomist/Extension Agronomist, Washington State University, Western Washington Research and Extension Center, Puyallup, WA.

Several goodlooking Chewings fescues, Red fescues and Hard fescues appear forthcoming if seed production is economic. Although it is too early to determine the best adapted varieties of bluegrass and fescues from this collection, there are a few varieties that have performed well during the first winter. Some of these are listed; others may turn out to be equally well adapted:

BLUEGRASS	FESCUE	RYEGRASS
Bonnieblue	Menuet	Manhattan
NJE P59	Jade	Pennfine
A-34	Oregon K	EER-7
Birka	Jamestown	N7-157
Pennstar	Barfalla	Sprinter
Majestic	Frida	EER-88
HV-44	Lirouge	Epic
Kimono	HF-11	TS 222
Adelphi	Koket	NK 200
Galaxy	Mariet	
Merion	Halifax	
Banff	Glory	
Fylking	Oregon D	
Baron	Lifalla	
EVB Selections	Erika	
NK Selections	Waldorf	
	Highlight	
	Dawson	
	Encota	
	Polar	

The following listing contains the names of varieties or selections performing well during summer. Again, there may be other varieties that could be added to the list:

BLUEGRASS	FESCUE	RYEGRASS
Bonnieblue	Jade	Pennfine
Windsor	Mariet	Manhattan
Majestic	Waldorf	Sprinter
NJE P59	Oregon K	Eton
Merion	Frida	Ensporta
Fylking	Rolax	N7-157
Baron	Halifax	Epic

BLUEGRASS	FESCUE	RYEGRASS
Adelphi	Menuet	TS-22
Birka	351 Daehnfeldt	Barlenna
Galaxy	SuR-006	EER-7
Enoble	SvR-005	NK-200
Nugget	Polar	
Sydsport	Wintergreen	
Glade	SvR-007	
A-34		
EVB Selections		
NK Selections		

In the end, it will be desirable to select or have varieties that perform well in both seasons. Naturally, this combined with good seed production performance will limit substantially the numbers of varieties available on the market. In the meantime, further evaluations will be needed to determine these features. The present results look promising and should add measurably to the release of improved turf varieties for the Northwest.

PROGRESS REPORT ON BENTGRASS[1] VARIETY EVALUATIONS

Charles J. Gould[2]
Roy L. Goss[3]
Stanton E. Brauen[4]

One hundred and thirty-five cultivars and selections were tested during 1973/74 at the Western Washington Research and Extension Center. Most of the experimental area was dug up and reseeded or stolonized on May 31 and June 1, 1973, in order to: (1) provide room for new selections, (2) increase the number of replications of varieties that had appeared most promising in the 1972/73 tests and (3) reduce the number of replications of the less promising ones. In some cases, the use of only one or two replications was necessitated by scarcity of seed or stolons. Most of the plots will be left intact for the next three years in order to observe reaction of the grass under more mature conditions. As occasion requires, the number of replications of the least promising varieties will be reduced to one in order to make room for new introductions as well as more replications of the more promising varieties.

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2/ Plant Pathologist, Western Washington Research and Extension Center, Washington State University, Puyallup, WA.

3/ Agronomist/Extension Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, WA.

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A general mix fertilizer with urea as the major source of nitrogen was used during most of the year, but it was necessary to switch to ammonium sulfate during summer months to suppress the development of *Ophiobolus graminis* var. *avenae*.

In order to both inoculate and to expose the varieties to more than one possible strain of the fungus *Fusarium nivale*, clippings from various diseased sources, such as golf courses and home lawns, were scattered over the plots intermittently during the year. During the winter the disease developed rather severely on some plots, but its distribution was spotty. Certain varieties that had appeared reasonably resistant in the 1972/73 tests did not perform as well in 1973/74. Therefore it will be necessary to continue the tests for several years before we can be reasonably sure that resistance is present.

Turf varieties respond somewhat differently to attacks by *F. nivale* and these differences make resistance rating somewhat difficult. For example, in some varieties the spots may be few but large while in other varieties they are smaller but more numerous. Also some varieties heal more rapidly than others. In view of all these differences, we have decided to select for larger scale tests those varieties which produce the most healthy grass for most of the year.

We appreciate the seeds and stolons we have received from various sources and will welcome additional varieties as they become available. We particularly thank the United States Golf Association Research and Education Fund, Inc., for financial support, in part, of this project.

RESULTS OF FUNGICIDAL TESTS[1] ON BENTGRASS TURF

Charles J. Gould[2]
Roy L. Goss[3]

FUSARIUM NIVALE - Fusarium Patch

Two large scale tests were run during the 1973/74 season. One (5B) was a continuation of a test started November 13, 1972. This was repeated since *Fusarium nivale* had not developed appreciably in the test area during 1972/73. An additional test was started in the fall of 1973 on an adjacent area in order to test several new compounds and schedules. Both plots were originally planted to Highland bentgrass but contained a considerable percentage of *Poa annua*, which is also subject to attack by *F. nivale*.

Applications were scheduled for three-week intervals, weather permitting. Most fungicides were applied in ten gallons of water per 1000 ft. on five replications of 25 ft^2 each. A few materials were applied dry. Several alternating programs were tested at various intervals. In some cases we intentionally started with a high rate of a benzimidazole and subsequently dropped to a lower rate in hopes of finding an effective schedule with fewer applications.

Unfortunately very little *F. nivale* developed in the plots in spite of repeated introduction of diseased clippings from various sources. In a final effort to obtain some disease control data, the turf in 5C was covered with saran

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shade cloth from April 1 to 29 (at first intermittently and later continuously) by which time the grass was somewhat etiolated. Although the fungus had started attacking the turf, the poor condition of the latter resulted in a rather abnormal development. Therefore, both 5B and 5C will be rerun this fall.

CORTICIUM FUCIFORME - Red Thread

Red Thread began appearing in the 5B set in October and became progressively worse until the weather turned warmer and somewhat drier in late March. The data show that certain products gave excellent control of Red Thread. The best contained thiram, but combinations with Dyrene were also very effective. A supplementary experiment was started on February 14 on an adjacent infected area to compare the relative effectiveness of thiram and Dyrene in reducing the Red Thread infestation.

We are grateful to the following companies for their financial support which enabled us to run the above experiments: Eli Lilly and Company, Mallinckrodt, O. M. Scott and Sons, Velsicol Chemical Corporation, Diamond Shamrock Corporation, and Rhodia, Inc.

OPHIOBOLUS GRAMINIS var. AVENAE - Ophiobolus Patch

This experiment was started on August 11, 1972 to investigate the effect on *Ophiobolus* Patch of different sources of nitrogen, lime, sulfur, fungicides, and particularly to test the possible inhibition of the *Ophiobolus* fungus attacking bentgrass by adding soil from a field in eastern Washington which inhibits infection of wheat by a similar *Ophiobolus*. The disease has not yet developed sufficiently to permit evaluation.

AGRONOMIC TURFGRASS RESEARCH REPORT[1]

Roy L. Goss[2]

PUTTING GREEN NUTRITION, N-P-K-S

Tests were continued during 1974 with variable rates of nitrogen, phosphorus, potassium and sulfur, and data were collected with regard to color and *Poa annua* as influenced by treatments. The highest color ratings were found in plots receiving sulfur at 1.15 lbs or 3.45 lbs per 1000 ft^2 per year. These figures are based upon August 20, 1974 evaluations. The highest color ratings were 8.75 and ranged down to 5.0 on a possible scale of 9.0. Interestingly enough, 6 lbs. of nitrogen, 0 phosphorus, 8 lbs. K_2O potassium, and 3.45 lbs S per 1000 ft^2 per season produced color ratings of 8.25. Plots receiving 20 lbs. of nitrogen per 1000 ft^2 per year in various combinations with P and K and high sulfur had the highest color ratings up to 8.75. Plots receiving 20 lbs of nitrogen with no S ranked as low as 6.25 on the average for color. Plots that received only 6 lbs N will lose color this winter.

Perhaps the most significant figures are in the *Poa annua* evaluations. With 20 lbs of nitrogen and variable rates of phosphorus and potassium and no sulfur, *Poa annua* ratings were as low as 30 percent of the plot. However, when 1.15 lbs of sulfur was added to these 20 lb nitrogen plots at both levels of P and K, the percentage of *Poa annua* increased up to 65 percent. Twenty lbs of nitrogen, 0 phosphorus, 8 lbs K_2O and 3.45 lbs sulfur resulted in less than

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10 percent of the plot containing *Poa annua*. *Poa annua* populations were higher than they should be in all plots receiving 12 lbs of nitrogen, regardless of P, K or S. This is possibly due to the fact that phosphorus levels are not under stress, and these high phosphorus levels are stimulating more *Poa annua*, although when sulfur is added, there is a decrease in *Poa annua* in the plots. Likewise, the highest level of sulfur resulted in less *Poa annua* than the lower levels of sulfur.

Based upon seven years work on variable rates of sulfur application, we could safely recommend sulfur applications between 2 and 3 lbs per 1000 ft^2 per season. Caution should be exercised, however, not to apply all of this amount in one application. Rates no higher than 1/2 lb per 1000 ft^2 should be applied in single applications, and all applications should be timed for the cool season, that is, March and April, October and November. As an added bonus, all plots receiving sulfur, even from 50 lbs per acre (1.15 lbs per 1000 ft^2) per season, have no algae within the plot. At low levels of sulfur, the algal effect may not be obtained in one year, but will certainly be effective with continued applications.

SLOW RELEASE NITROGEN TRIALS

Sulfur coated urea at 8 lbs and 4 lbs per 1000 ft^2 respectively, Blue Chip Nitroform at 8 lbs and 4 lbs per 1000 ft^2, Scott's Turf Builder at spreader setting No. 5 (recommended setting), Urea at 8 lbs per 1000 ft^2, Agriform (19-6-13) at 8 lbs and 4 lbs, IBDU at 8 lbs per 1000 ft^2 have been applied and observed for two years. In a summary statement, all materials applied at 8 lbs per 1000 ft^2 were superior to those applied at 4 lbs. In general, sulfur coated urea applied 3 times (May, August and November), Blue Chip Nitroform applied May, August and November, and Urea applied at 5 times per year were generally best quality. Agriform applied in May only maintained excellent color and growth characteristics from a single application.

Sulfur coated urea provided the best carryover effect colorwise over winter until the next spring. Although Agriform at the highest rate had the highest overall plot rating of 8.5 out of a possible 9.

These trials have been conducted on Merion and Cougar bluegrass and will continue for one additional year.

EXPERIMENTAL TOPDRESSING PROGRAM

The topdressing program as described by Madison and others, University of California, Davis, has been initiated at the Western Washington Research and Extension Center at Puyallup with certain modifications made to correct for soil differences for the Pacific Northwest. At the time of writing this paper, 5 topdressings have been completed with the fertilizer additions and Kingstown velvet bentgrass overseeded on a plot that was originally planted to Toronto bentgrass with approximately 20 percent *Poa annua* mixture. The appearance of the plot is superior in both color and texture to any previous appearance in the last two years, but it is still much to early to assess any true response to this program.

Evaluations will be made throughout the next 2-1/2 years on the overall quality of the plot, *Poa annua* percentages, bentgrass dominance (whether Toronto or Kingstown will dominate) and other quality factors such as surface conditions, drainage, etc. More will be reported on this work in 1975.

PLAYFIELD CONSTRUCTION AND MAINTENANCE

Research on quality playfields has been limited to practical applications on school and park sites. Due to the cost of initiating a significant program of this type at the Research Station, and the fact that play would not occur on the plots, all attempts in this area have been conducted in cooperation with schools and parks.

In general, our recommendations for proper play and athletic field construction are as follows:

Use 75% sand of high quality and 25% organic material such as sawdust or various bark preparations. The sand should meet the following specifications: Preferably, no particles retained on a No. 16 screen, but with a maximum of 15% retained. Ninety-five percent of the particles should be retained on a No. 100 screen to avoid compaction and sealing problems. The most desirable range would be between a No. 30 and 100 screen; however, this particular gradation of material is extremely difficult to come by.

We further recommend that drainage tile be installed at intervals necessary to achieve rapid drainage (15 to 25 foot intervals) 16 inches or more below the finished grade, if it is determined that the subsoils do not have sufficient permeability to carry the drainage water. It is preferable to lay down a base material such as pitrun at least 10 inches deep over all tile lines followed by a minimum of 6 inches of the prepared sand and organic mixture. Following this type of construction, a minimum of 20 lbs of 0-20-20 and 1-1/2 tons of dolomitic limestone should be incorporated into the surface 4 inches prior to planting. One pound of available nitrogen per 1000 ft^2 should be applied immediately before or after planting. For maximum quality, it is recommended to apply 15 lbs of urea formaldehyde per 1000 ft^2 worked into the surface 2 inches of soil to maintain a constant release of nitrogen for a period of several weeks.

The area should be seeded to a mixture of Manhattan or NK-200 perennial ryegrass and one of the improved bluegrass types such as Merion, Fylking, Baron, Bonnieblue, etc. The best procedure is to plant 70 lbs. of bluegrass per acre with a brillion drill, and after the bluegrass has germinated, and approximately 3/4 inch high, overseed the area with 100 lbs of ryegrass per acre. This will eliminate the extreme competition of the ryegrass with the bluegrass and will achieve a more uniform mixture in the stand. If this is too cumbersome, then seed the area with 70 lbs of bluegrass and 30 to 40 lbs of ryegrass per acre, mixed.

These procedures are proven to be highly successful by a number of athletic sites in western Washington and will serve as the basis for future recommendations.

BENTGRASS MANAGEMENT PLOTS[1]

Roy L. Goss[2]
Charles J. Gould[3]
Stanton E. Brauen[4]

Fourteen selected bentgrasses from previously screened cultivars were stolonized in September, 1973. At the same time, ten screened cultivars were seeded in plots at the Western Washington Research and Extension Center. Due to a shortage of stolons from some of the varieties, some plots were slow to fill, therefore, quality ratings were not made on these plots until August 20, 1974.

Color and texture ratings were made on the plots, and those receiving 7.75 rating or higher out of a possible 9 are as follows:

Stolonized Types	Seeded Types
Arlington	Kingstown Velvet
Northland	Emerald
Waukanda	Prominent
Yale Selection	Bardot
Hayden Lake Selection	Penncross

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4/ Assistant Agronomist/Extension Agronomist, Washington State University, Western Washington Research and Extension Center, Puyallup, WA.

In regard to texture, those receiving ratings of 7.75 or higher are as follows:

Stolonized Types	Seeded Types
Nimisila	Kingstown Velvet
Northland	Novobent Velvet
Waukanda	Emerald
Yake	Prominent
Keen's 36	Tracenta
Arrowwood	Bardot
Smith's 721	Highland
Smith's 736	Penncross
Penn No. 5	A-75
Hayden Lake	Boral

Only one out of the stolonized group received a rating of 9 or near perfect texture, and that was Yale. Only the velvet bent selections of the seeded types rated a perfect 9 for texture.

Textural ratings of these plots at this time can be misleading due to the young age of the plots. Many of the stolonized plots will improve in texture with age, and perhaps some of the seeded plots may decrease slightly.

These plots will receive both high and low nitrogen treatments (12 lbs and 4 lbs per 1000 ft^2 per year respectively), and then crosschecked with fungicides and no fungicides. This will give us information under field management conditions whether or not these varieties that were picked for *Fusarium* resistance for the most part and agronomic characteristics will maintain reasonable disease free qualities. Some of these grasses were not selected because they were resistant to *Fusarium*, but because they had outstanding agronomic qualities. Highland bentgrass was included only as a check against all the others since it is known to be very susceptible to *Fusarium* patch disease, but generally does have a suitable texture. More information will be forthcoming on these cultivars within the next two years.

POA ANNUA PRE-EMERGENCE PLOTS

For further information regarding results of trials with pre-emergence herbicides, refer to the paper in these Proceedings related to this subject.