James B. Beard

NORTHWEST TURFGRASS ASSOCIATION

Proceedings Of The 36th Northwest Turfgrass Conference

Sept. 21 - 23, 1982
Yakima, Washington

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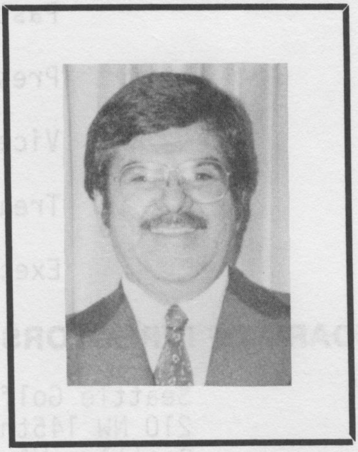
PRESIDENT'S MESSAGE

NORM WHITWORTH



Thank you for making the Northwest Turfgrass Association Conference, held in Yakima, a success...

It was a year you could use many excuses for not attending, starting with economy through job security.

One hundred sixty (160) of us attended the Conference, with almost half playing in the golf tournament on the demanding Yakima Country Club.

The Conference programs were well attended and warmly received. It would have been very difficult to find a weak speaker or topic. A "big cheer" for the split sessions with the grounds people, schools, and municipalities leading the way. We won't forget the evening with golf course architects. With 110 people at the banquet, it had to have been one of the largest in years.

I personally would like to thank the Board of Directors for their help and encouragement through this year as President of the Northwest Turfgrass Association.

NORTHWEST TURFGRASS ASSOCIATION

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WATER - AN OVERVIEW[1]

Dr. James R. Watson[2]

During the past few years it's doubtful if any topic has received more attention or has been discussed by more diverse groups than that of water. Certainly this is true of the turfgrass field and it is increasingly true of non-turfgrass related areas. Why? For one thing, there is widespread recognition and awareness that water is our most important natural resource. And, that problems exist and that they will become more critical in the next few decades.

Water problems are not all related to pollution, either direct as in the case of sewerage discharge into streams, lakes and aquafers; or, indirect as the discharge of, for example, sulfur dioxide into the atmosphere with its return to lakes as acid rain. Acid rain has become an international issue between the United States and Canada as well as northern Europe. Disease and water relationships long have been recognized by the World Health Organization. In 1975 this organization reported that only 38% of the people in the third world (developing nations) had access to fresh water - potable water. During this past year newspapers carried two or three stories regarding community water systems that were unsafe for drinking purposes -- this in the U.S.!

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Vice President, Agronomist, The Toro Company, Minneapolis, MN 55420.

The problem is one of increasing use. The demands on the world's fixed supply of water are increasing at an alarming rate. Agriculture uses in excess of 80% of our fresh water and needs more! Industry needs more and our increasing population needs more. By the year 2000 our total needs will be 33% greater than in 1977.

Nevertheless, over the past few years much has happened with water that is good and that is encouraging. Progress has been made in the areas of recognition and acceptance of water problems and, in some cases, implementation of long range programs has occurred. Hopefully, this will lead to local and regional solutions.

Legal aspects of water cry out for solution. Standardization at the Federal level -- to monitor the international aspects of water is essential. Most believe and seem to agree that local governments should refrain responsibility for controlling the pumping of ground water (The Cross Section, 28:8, August, 1982). But, this may intensify the conflict between states for the water in large aquafers like the Ogallala that underlies parts of 9 states.

The news media carry information on water and its importance almost on a daily basis. Local, state, regional and national turf conference programs continue to allot time for discussion of water and problems related thereto. These topics continue to fall into three broad categories. They are:

1. There is a vital need, a desperate need, for everyone who uses water for beneficial purposes to use it more wisely. To practice water conservation every day.

2. There is a need to impress upon everyone who uses water to grow healthy turfgrasses for any recreational or aesthetic purpose, that that is a very important beneficial use of water. These areas help to cool our cities and to disrupt the flow of winter winds thereby reduce energy. Also, they provide healthy recreation.

3. It is time to recognize that wastewater - sewage effluent - is an important source of water for turfgrass irrigation. Further, that use of this "recycled" water is in reality "water conservation". Further, we need to recognize and to distinguish between potable and non-potable waters. And to use each advantageously.

Water shortages are occurring in a number of areas, especially in those underlain by the great Ogallala Aquafer. This huge underground reservior continues to be mined. Schemes to replenish it with Missouri and Red River waters have been proposed, but are not likely to become reality for many years. In the meantime, the only viable alternative, dry land farming, is being revived and will likely spread. Lack of water is the major reason at this point, but eventually cost of pumping also may become a factor.

The problem of location -- where the water is located -- is another area of concern. Conflicts between the "haves" and "have nots" have and will continue to intensify.

For example, coal companies need Missouri River water for slurry operations in Wyoming. South Dakota resists. The problem of location or position remains one of major importance. As does the allocation of water resources like, for example, water from the Colorado River which must go to Colorado, Arizona, Nevada, California and Mexico.

There simply is not enough river to go around. By the time it reaches Mexico the water is very salty - too salty for use. As a result the Federal Government will pay - several billions of dollars - to remove salt so that fresh water may be released into Mexico.

Canada and Russia have 20% of the world's fresh water. The U.S., 3%. In the August 16, 1982 issue of Forbes magazine Fact and Comment edited by Malcolm S. Forbes, he stated, "Not in the lifetime of some of us, but Canada's most vital export to the U.S. will one day be water - not oil, not natural gas, not minerals and metals, not newsprint." Further, he pointed out that a major oilman told him three years ago (Forbes, Aug. 20, 1979), "Both the U.S. and Mexico will be dependent on Canada for two-thirds of their water supply." He concluded by saying, "In the lifetime of younger readers, our present pipelines, and future ones, will be carrying more water than oil and natural gas." Thus, the problem of location of fresh waters is being addressed.

Salt water intrusion is occurring in Florida, Texas and elsewhere. Sink holes are appearing in Florida, sometimes gobbling up large sections of towns and, at least one city, Sebastian, FL, has been denied permission to drill new wells.

Long range research programs to direct actions and to effect solutions are being initiated. For example: Fountainhead. The Freshwater Foundation, Navarre, Minnesota, recently announced a program called Fountainhead, a vital five year plan "to intercept the growing international water crisis". It is a new 7 million dollar fund raising program to build up the expertise of the Freshwater Foundation and the Gray Freshwater Biological Institute. The program will attack major freshwater problems by updating and expanding the research, facilities, and programs initiated during the past 14 years.

Other research agencies are developing programs and soliciting funds to produce drought tolerant, salt tolerant grasses that will require less water and less maintenance. The USGA, Green Section, for example. Water conservation and use of waste waters remain the key to current and future water management on to grass facilities.

In 1979 when I spoke to this Association on a similar topic, I listed several simple, basic steps that I believe will lead to water conservation. I'd like to repeat them because I believe they are still most pertinent.

1. Establish watering priorities. Give highest priority to the most intensively managed areas; for example, the greens, the most valuable part of the course and where the most critical play takes place.

2. Follow sound irrigation practices. Irrigate when there is the best combination of little wind, low temperature and high humidity. When watering trees and shrubs, use probes so the water will penetrate deeply.

3. Reduce, or avoid where possible, other causes of stress. Make certain there is adequate internal soil drainage to ensure maximum root growth--more importantly, to avoid root zone saturation.

4. Alter major cultural practices. Test the soil annually to ensure adequate fertility, especially for phosphorus, which encourages root system growth -- deeper roots, thus expanding the area from which the turfgrasses can draw nutrients and moisture.

   Raise the height of cut for all areas. Raising the height of cut on a golf course green as little as 1/32 of an inch can have a significant effect on the ability of the grass to tolerate stress.

   Increase frequency of spiking or cultivation (core) -- if temperatures are not extreme -- to trap moisture and to hold it longer in the vicinity of the root system.

   Explore new concepts of applying water. Separate your watering program into one for maintenance or soil moisture and one for regulating temperature. Dr. Ralph Engle has shown the beneficial effects of misting as opposed to drenching on the development of more extensive root systems of bentgrass.

5. Expand use of mulch. This is often overlooked. Apply heavy layers of mulch -- any organic debris that's available -- around the base of trees,

shrubs and flower beds, to hold in moisture and to help control weeds.

6. Erect wind barriers. Especially where there are large expanses of open spaces.

7. Experiment with anti-transpirants. Although techniques for inhibiting transpiration have had mixed results, some reduction in moisture loss through transpiration might be accomplished with use of chemicals, emulsion or films.

8. Treat each day as if you were in a period of severe drought.

9. Aggressively seek additional or alternate sources of water. Among the alternative sources are ponds, catchment areas, collections of marginal water and waste water.

Water management is a key conservation technique. Coupled with an expanded use of waste water, turfgrass facilities should be able to maintain current levels of turf quality for the foreseeable future.

However, there is a need now for each turf facility to take stock of their individual water needs. They need to meet with the local water management authority and make their needs known! They need to establish a base position so that when the time comes for allocation, the facility will be in line for their fair share. An example of this approach was that taken by members of the South Florida turfgrass industry. They met with the South Florida WAter Management District and presented a summary of their needs. They described the average acreage (125) for the 350 golf courses within the district. Pointed out this "constitutes an urban life support factor by providing oxygen for 2,920,000 people each year," and that a conservative estimate of the economic value is 350 million dollars annually. They, then, presented a detailed water requirement schedule by defining the basic areas and establishing priorities and quantative values for each. (I have slides to show these values.)

As a result, during a critical period they were able to continue to irrigate their golf courses. Not so in New Jersey; where, during a severe drought, golf course watering was curtailed. The clubs then had to initiate programs to effect legislation to permit watering of, at least, greens. Rains came a short while later and avoided disaster, but the potential existed.

In summary, our water problems are still with us. They will not go away. We must plan now to ensure a fair allocation of water for the vital green spaces for which we have responsibility.

WETTING AGENTS - WHAT MAKES THEM WORK?[1]

Kathy Welch[2]

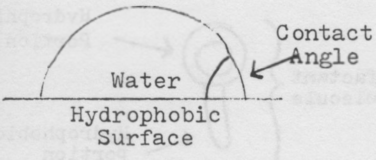
In order to explain the possible mechanisms by which wetting agents alter the behavior of water movement in soil, we must first examine some of the properties of water, soil, and water movement in soil. Water is a highly polar molecule; as a consequence, water molecules cohere to one another. This cohesion accounts for the surface tension of water, which is higher than that of most other liquids. This is a beneficial property in living systems, but can be a disadvantage in certain soil types.

Various factors affect the infiltration (movement of water into soil) and percolation (movement of water through soil) of water. Some soils repel water and are therefore hydrophobic. For example, when organic waxes in soils dry, they can repel water. Thatch also repels water. In addition, infiltration of water into soil is often reduced by compaction, slopes and volcanic ash. The percolation rate is influenced by soil type. Soils with high clay content usually have a slow percolation rate.

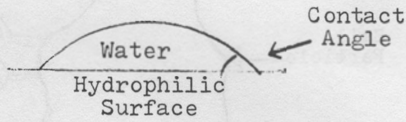
The relative wettability of a soil can be described in terms of the liquid-solid contact angle. As the contact angle increases, the infiltration rates decreases (6,7,13) (Fig. 1).

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Mallinckrodt, Inc., St. Louis, MO.



Slow Infiltration

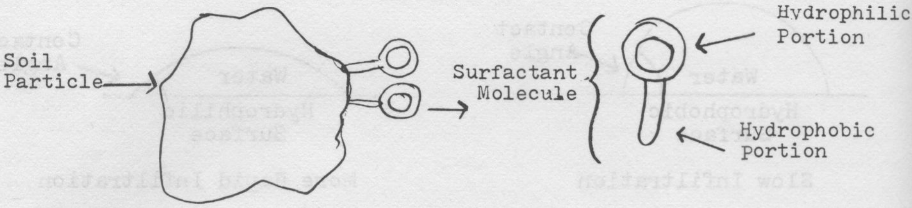


More Rapid Infiltration

Capillary and gravitational forces move water into soil. Capillary force is more important in initial wetting. Both the surface tension of water and the contact angle between water and the soil surface affect water infiltration. A decrease in the surface tension of water decreases capillary force, but a decrease in the contact angle increases capillary force.

Pelishek, et al. (13) reported that a wetting agent solution wet through a thatch core in less than one minute while tap water wet through in about 14 minutes. Why did the wetting agent improve infiltration in this and similar experiments? Surfactants, or surface active agents, are molecules which consist of a water-loving (hydrophilic) portion and a water-hating (hydrophobic) portion. The special properties of the molecule permit it to disrupt the cohesive forces between water molecules and thus decrease the surface tension of water. The decrease in surface tension is associated with a decrease in the contact angle between water and a hydrophobic surface. Water infiltration rates increase as a result.

The initial infiltration rate is only the first part of the story. The residual effect in hydrophobic soils or thatch is probably more important. For persistent effects, a wetting agent must remain in the soil. In theory, the hydrophobic portion of the wetting agent attaches to the soil particle (Fig. 2).



The concentration of wetting agent required is measured in terms of the critical micelle concentration (cmc) of each wetting agent (15). The cmc is the concentration of surfactant at which the molecules aggregate into micelles with the hydrophobic portions of the molecule directed inside and they hydrophilic ends exposed to the water (3). Consequently, different wetting agents adsorb onto soil particles at different concentrations.

There are three possible interactions between a wetting agent and a hydrophobic surface. In case 1, the hydrophobic portion of the wetting agent molecule has no affinity for the soil. According to Rieke (14) and Moore (9), esters attach more readily to sands, ethers to clays, and alcohols to organic matter. If no affinity between wetting agent and soil exists, upon rewetting the dried, treated soil, the surface remains hydrophobic and water retains its high surface tension. The two remaining possibilities occur if the hydrophobic portion of the molecule has an affinity for and is retained on the soil particles. In case 2, the soil surface remains hydrophobic, but the wetting agent adsorbed on the surface redissolves into added water, thereby reducing the surface tension of water and the contact angle between the still hydrophobic soil surface and water. In case 3, the soil surface is converted to a hydrophilic one and water retains its high surface tension. Water infiltration improves in both cases 2 and 3. Of these two possibilities, Valoras and Letey (15) concluded that treatment of a water repellent soil to a wettable soil upon drying is best achieved by a surfactant which is irreversibly adsorbed by the soil (Case 3). This prevents large amounts of surfactant from entering the soil solution where it can be toxic to plants (2). Since water would still maintain its high surface tension, movement by capillary force would be greater in Case 3 than in Case 2; hence infiltration of water would be theoretically better in Case 3 also.

In most cases then, a turf manager prefers a soil wetting agent which is irreversibly adsorbed onto soil particles of all types at low concentrations. Numerous benefits can result from using a soil wetting agent with these properties. Investigators have demonstrated that wetting agents can reduce localized dry spots which are the result of hydrophobic soils, slopes and thatch (7,12,13). Puddling is due to high water tables, high rates of water application, low infiltration, and slow percolation. Wetting agents can reduce puddling caused by low infiltration and slow percolation (7). This improvement in water infiltration and percolation reduces surface compaction. When traffic occurs on soil which hasn't reached equilibrium after watering, the soil particles tend to rearrange and compact. Because soils treated with wetting agents reach equilibrium quickly (about six times faster than non-treated soils), the same traffic causes little or no compaction (4,10).

Turf grown in treated soils experiences uniform root zone moisture and hence improved water availability. Consequently, researchers (5,8) demonstrate an increase in rooting and better cellular structure of the grass. Seed germination and establishment is also improved (11).

Some diseases of turf are associated with water mismanagement. Wetting agents appear to reduce the incidence of Fusarium blight in Beard's test results (1). This disease is associated with water-stressed turf. Dew formation is reduced in treated turf. Because many pathogens causing disease in turf require water on the plant surface for infection, a reduction in dew formation can make environmental conditions less favorable for disease.

Water is the carrier for most chemicals applied to turf. Improving water distribution with a wetting agent, therefore, should improve chemical response.

In summary, selection of the proper wetting agent should be based on its residual effect in soils. The material of choice should be irreversibly adsorbed to soil at low concentrations. The use of a preferred wetting agent causes uniform root zone wetting and reduces puddling and localized drying under many situations. As a result, compaction of the soil and wilting of turf is curtailed. In addition, fertilizer and pesticide efficacy can be improved.

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ECONOMICAL USE OF WATER[1]

E. Lee Bean[2]

Most conferences, such as this one, for the past couple of years have had a common theme that concerns water shortages and how to avoid waste. With additional demand and a limited supply, we in the turfgrass industry must compete for our share by selling the need for turfgrass or we may see new projects in the future with minimum or no landscaping. Visualize a project with acres of green gravel and a few flower pots. Of course, some areas have more available water per capita than others; however, water can be transported and people can move from one location to another. Population expansion in areas of water shortages will, in the near future, be limited, and the cost of water will be one deterent to new projects. I was called in on one project this summer where the cost of water for a nine-hole golf course was $70,000 per year.

We, in this industry, understand the importance of turfgrass and that we must use some form of irrigation to keep it green during the summer. Does the average John Doe know what percentage of total water demand is used for turf irrigation? Do we have adequate data to retain our share? Are we using our share efficiently and are other users avoiding waste? Cost per unit volume and rules made by our elected leaders will eventually force economical use of water. I am sure we all give more thought about filling our gas tank these days than we did in 1972. Most of us are not concerned about what we spend each month to water our lawn, but are becoming more concerned as the water bill increases. The cost of gasoline is about the same throughout the United States while the cost of water varies according to the cost of delivery to the user. Transporting water from

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Irrigation Engineer, Boise, ID.

distant sources for use in populous areas will have a tendency to increase costs in all areas. In other words, you may enjoy economical water now but it could become a major expense in the future in all areas.

Economical use then will be forced on us by additional costs and in some cases, rationing will be employed, especially when our reservoirs are low. When the reservoirs are low, who will be cut off first? Why water the grass when you can't take a 30-minute shower!

We must establish turfgrass needs through education and do the best we can to avoid waste. Do we achieve more than 50% efficiency in turfgrass irrigation when we consider all areas, including home lawns? Observing daytime sprinkling in Boise leads me to believe that more than 50% of our irrigation water is wasted. Our water company recommends, by radio advertising, odd and even day watering according to your house number, but only to reduce volume to maintain line pressure. They do not seem to care about how much you use, only that you have adequate pressure. Hopefully, some day this radio advertising can be used to educate the customer that irrigation efficiency is important.

We have a challenge, and an opportunity, to sell more efficient irrigation systems, that will save a very necessary resource, that will become very important to our grandchildren. However, we must not only learn how to design better systems, but must teach the user how to operate these new and existing systems efficiently.

The component manufacturer, the distributor, contractor and designer must share the responsibility. I am sure we all agree that a well designed automatic sprinkling system, using proper components, that can apply the exact root-zone moisture during a set time limit, with the best possible efficiency, is most cost effective. Our future market can be broken into two categories. One, is the updating or replacement of existing systems that are inadequate and inefficient, and the second will be providing systems on new projects. It seems to me that replacing or updating existing systems will be the larger market. We must all avoid selling inadequate systems, even though the project owner is only interested in first cost; however, there are no codes or laws to keep the inadequate system from being permanently buried. There are no laws defining component performance as we have in other industries. For example, the gas tank in your automobile must hold enough gas to take you 200 miles. I can imagine how many rules could be developed by a new federal bureau made responsible to guide our industry! To envision what could happen we only need to think about our backflow prevention codes and wonder how long it will take to have a uniform code nationwide. The Irrigation Association is making some progress in setting standards and have a new program to certify designers, which should at least qualify new and existing designers. I was hired to conduct eight two-day seminars last spring and one problem was to calculate the precipitation rate for a given problem. Most of the students were already designing systems; however, only about 20% knew how to solve this simple problem. The most economical system must be designed to apply the correct amount of water to satisfy the peak demand within a set time period. The designer cannot make these calculations unless he understands how to use the basic formula to determine precipitation rates and how this applies to the development of a seasonal watering program.

In conclusion, if we consider the hose-end and the quick-coupling valve systems sold in the past, I believe we have made some progress in turfgrass irrigation. I also believe it will be sometime in the future before we can be sure that all new systems installed will be as efficient as the customer deserves.

Education, to make our customers aware of irrigation efficiency, and what components are necessary, must be the responsibility of everyone in our industry. The component manufacturer must only offer products that do an adequate job and fit the efficient system. The designer must understand requirements, the contractor must assemble the components properly, and the owner must follow required watering schedules.

WATER SOURCE PROBLEMS[1]

Donald J. Tolson[2]

Last January Ben Malikowski called me to ask if I would come to the 1982 Northwest Turfgrass Conference and share what I have experienced in my first three years at Yellowstone Country Club. That is how I came to be standing here, prepared to launch into the topic of water source problems.

Water problems are the reason I look forty-eight thought I'm only thirty-two, the reason my boys ask each other "who is that old boy?" shooting off the fireworks on the Fourth of July, and the reason my wife has joined the battered spouse league. For the last three years I've been trying to resurrect a golf course that was almost totally destroyed by water: too much water, poor quality water, no drainage for the water.

Basically the problem on the golf course started with overwatering, then was compounded by the facts that 1) the water supply was contaminated, and 2) there was poor drainage combined with a high water table. In this presentation I'll be using slides taken of YCC to illustrate the problems, as I explain some causes and effects I've observed, share step-by-step what's been done to try to remedy the difficulties (including what did and didn't work), and discuss preventive measures to avoid future disasters.

First, to understand the mess in which I found myself, one needs to know a little of the history of the Yellowstone Country Club. The YCC was designed and built in 1958 by Robert Trent Jones, Sr. and in the first twelve years was well-managed by a qualified superintendent, who died in mid-season of 1971. The mechanic filled in and remained as superintendent until

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Superintendent, Yellowstone Golf and Country Club, Billings, MT.

he retired in the fall of 1979 when I, with much trepidation, accepted the position. The mechanic was hard-working and sincere but his management program consisted of 1) fertilize, 2) WATER, and 3) mow. If things were not green enough he would apply more urea and lots of WATER. Too much water was the beginning of the end of YCC. To make matters worse, in 1973 an automatic irrigation system was installed, and that golf course was super-saturated from spring to fall for the next six years. Thus, the first problem was established. As you all know, the first thing that happens with over-watering is: out goes the bluegrass and bentgrass, and in comes the Poa. Gone is the blue and bent that can withstand some poor water quality, that is winter-hardy, drought-resistant and disease-resistant. In comes good old Poa, that stresses every time you look at it wrong.

Mother Nature wouldn't cooperate either. The winter of 1978-79 gave us record snowfalls. In May of 1978 we had ten inches of rain in ten days. Our annual is fourteen inches. Finally, in early 1978 a spring developed in the hills above the golf course and ran through the course right into the irrigation pond. What a deal! Free water and lots of it. For a year the golf course was watered with that spring water, and when hot weather came in July 1979, they began losing turf.

When Dr. Douglas Haas was consulted, he evaluated the situation and pinned the problems to the water. After testing, the report showed C_4S_3, a water classification that indicates high salinity and alkalinity. C_4S_3 is water so bad it's not suitable for use on field crops, much less golf turf. Total salts was 3583 ppm. Sodium was 21 meq/l; desirable is .05-3 meq/l. Obviously, contaminated water was the second major problem. Immediately the water was diverted around the irrigation reservoir, and the superintendent resigned. That November I signed on and began my battle.

Because of the years of overwatering, my turf was sitting on top of a soil profile that was horrendous. The first three to four inches down was black muck in which roots could not survive, and below that was a high water table that allowed for no internal drainage. The problem was worst on greens and four of the fairways. Thus, the third major problem was drainage; there was none.

Physiologically, what happened during the year 1978-79?

1. The greens, because of poor management, had a thatch layer about two inches thick. They felt like a pillow to walk on, and putted about the same way.

2. The water had a high level of bicarbonate, 358 ppm. Alone, high bicarbonate levels are not a problem, but high concentrations in irrigation water cause the removal of calcium from the soil, leaving sodium in its place.

3. Salt and sodium at such high levels caused the plants to stress and die. At least as critical to the longterm pricture was a process in which the proportion of sodium attached to the clay in the soil increased, causing the soil to disperse, which reduced water penetration.

The result, after a year of irrigation, was four inches of black aseptic muck with two to three inches of thatch on top. In the spring of 1980, the greens were mostly dead. In summary, the viability of Yellowstone Country Club was threatened by 1) too much water, 2) contaminated water source, and 3) poor drainage.

The following test results illustrate some of the problems in numerical terms. The samples were taken over a two-year period at Yellowstone Country Club.

#1 - Water 4/28/1980
Hardness: 1624 ppm (off the page)
Bicarbonate: 358 ppm (possible problem)
Electrical conductivity: 5.6 mmhos/cm (high)

#2 - Soil 3/17/1981

pH: 6.0-6.5 (no problem, yet)
Soluble salts: 1.7-2 (optimum .10-.60)

#3 - Soil 4/20/1982

pH: 6.9-7.4
Soluble salts: .45-.70

That winter I spent a great deal of time studying my problem and spent several hundred dollars on phone bills from calls to Dr. Paul Riekey at Michigan State, Dr. Jack Butler at Colorado State, Dr. Haas of the USGA, and Dr. Watson from Toro. By spring I had formulated a plan.

1. Start a sand topdressing program. I had never before been convinced sand topdressing was the way to go, but my soil profile was so poor I had no choice.

2. Use sulfur and gypsum to try to lower the soil pH and leach the salts and sodium.

3. Cut back on water as much as possible, and improve drainage by installing drain tile in the greens and fairways having high water tables.

The following spring, when the rest of the grass in town was green, I knew I was in big trouble. I had lost 30-40% of tees and fairways, and 80% of my greens. On April 20 I started my counterattack and aerified greens with 5/8 inch tines, removed the plugs, put down 20 lb of gypsum per 1000 sq. ft., topdressed and overseeded at 2 lb/1000 sq ft, watered heavily for a couple of days trying to flush what sodium I could, then waited for my seed to germinate. We had a beautiful spring and about ten days later the seed began to germinate and I was on top of the world. I thought I would have a pure stand of bentgrass shortly and could get started with my program.

Within a week all of the seedlings were dead.

I checked the water in the reservoir and found it was just as bad as the spring water. The previous fall they had emptied the reservoir to have room to store the effluent water from the treatment plant. The water table around the reservoir was so high the ponds filled with ground water. This was the water I had to use until May 25 when my ditch filled.

The only thing I could do was keep aerifying and overseeding. Each time I did I got a bit more cover, mostly Poa coming from last fall's seed. By July we had 85% cover on all but two greens. I had aerified four times with 5/8 inch tines and removed the plugs, overseeding and applying gypsum and sulfur each time. We had aerified tees twice, and overseeded each time. Fairways couldn't be aerified because when the irrigation system was converted to hydraulic, a sod cutter was used to put down much of the tubing, with the result of lots of tubing that is one inch deep. To circumvent that problem, I used a fairway sweeper with a thatching attachment on the bad areas, overseeded the worst spots, and put down gypsum.

By fall of my first year we had aerified greens seven times, removed the plugs and overseeded with bentgrass each time, and applied about 30 lb of Ca_2SO_4 per 1000 sq ft. Between each aerifying we topdressed with sand once or twice using 6-8 cubic feet of sand per 1000 sq ft. That amount is two to three times the recommendation for a sand topdressing program. I had achieved a pretty healthy stand of turf with a soil profile consisting of 3/4 to 1 inch of sand on top of 3 inches of muck filled with aerifier holes.

An interesting note is that the roots would not grow in the muck, only in the aerifier holes. Until this day it is impossible to find any roots in that zone, except in those holes. Those greens were the worst type on which to manage a decent putting surface. Theoretically I should have cut way back on the water to dry them out, but with so much salt I couldn't. The less water that is in the soil profile, the more saline the soil becomes. Any time the turf was stressed, in the aerifier holes it stood up and looked good, while the turf not in the holes went limp. Great putting surface!

About mid-July we had started the drainage project on the greens, beginning with the putting green, but it hadn't progressed very far on the path to recovery. We trenched it, removed the material, and put down 3 inch A.D.S. drain tile with drain guard. We then backfilled with sand to the surface and resodded. Recovery was so dramatic after three weeks that my greens committee needed no more convincing to let me get started with the rest of the greens. Before fall we had finished 7 more problem greens, and by October 1, we had healthy turf on all the greens we had redone.

By late October we were ready to begin draining the low fairways with subsurface water problems. We contracted the work to a fellow with a tile layer, which excavated the trench, laid the tile and backfilled, all the while it was rolling down the fairway on huge tracks that never left permanent marks. Incredible piece of equipment! That fall and the next we drained all four fairways with subsurface water problems.

When the time came to put the greens to bed that first winter, I decided to really soak them, put down snow mold protection, and hydromulch the surface to try and hold them through the cold weather. Remember, my root zone, except in aerifier holes, was less than 1 inch deep. I contracted out the work and for $3,000 ended with an approximately 1/8 inch covering of mulch on 19 greens.

The next spring, 1981, we verticut the mulch, swept it up and topdressed, and the members played golf the next day. The entire removal process took about 8 hours, and the greens were in very good shape. We had covered them the day before Thanksgiving and uncovered them on March 25. That second year went smoothly. The contamination in the reservoir was almost as bad as the year before but because of the healthier turf and much improved internal drainage, the poor water seemed to seemed to have little effect. By fall we had completed our drainage program.

From the beginning of our program through the second year we had aerified 11 times, removing the plugs each time and topdressing as often as possible. We had accumulated a 2 inch sand layer with lots of aerifier holes in the top 3 inches below the sand. We were, finally, just approaching a manageable zone in which to grow turf.

I encountered two main problems with my sand topdressing program and with the hydromulch. My sand had too high a percentage of fines and I pushed it so fast there was no thatch at all. The greens became very firm. Also, the Poa is always a little stressed when it was getting buried twice a month! (No grain, and the greens were uncovered in March in 50° weather under duress from a lynch mob that wanted to play golf. An artic front moved in the day after I finished uncovering them. The temperature dropped into the teens for the next several days, and when the sun came out, the Poa was gone! There must be 3 to 5 days of above 28° weather before the greens are uncovered.

The last three years have been quite a learning experience. Though I still have not been able to solve completely the problem of bad water in the spring, the situation has improved. We have a better contract with the ditch companies who supply our good water. We still have access to the effluent water from the treatment plant. Installing drain tile to improve the drainage system has helped to put us out of reach of the high water table and the naturally high-alkali water of our valley. The turf is vastly improved from using good management practices including avoiding overwatering, and following a regular program of aggressive aerifying, sand topdressing, application of sulfur and gypsum, and overseeding. The regime I have followed should be adaptable to most golf courses with similar problems, with modifications made for individual variables. Perhaps the most important thing I did was to call people who were experts in their fields when I needed advice. That kind of help is available to all of us for just the price of a phone call, and can mean the difference between a live golf course and the other king!

THE WINNING FORMULA FOR SUCCESS - THE POSITIVE MENTAL ATTITUDE[1]

Gerald Sweda[2]

What do you think contributes most to a person's success. Most people would chose one of the following:

EXPERIENCE, KNOWLEDGE, WILLINGNESS TO WORK HARD AND LONG, LUCK, A COMBINATION OF ALL.

Actually, an examination of the evidence identifies a factor entirely different than any of these. The results of numerous studies reveals that the major factor leading to success - is the way a person THINKS and FEELS.

HOW YOU THINK AND HOW YOU FEEL - IN MOST CASES - DETERMINES HOW YOU PERFORM. HOW YOU PERFORM - DETERMINES HOW SUCCESSFUL YOU WILL BE IN YOUR ENDEAVORS.

It's the way you see things and how you feel about them. In other words, IT'S YOUR ATTITUDE.

Attitude is a word we hear all the time, especially when the conversation involves performance. Attitude is that special something that ever supervisor, every manager and every owner looks for in the people they employ. They want people with a POSITIVE MENTAL ATTITUDE. WHY? Because of the things a POSITIVE MENTAL ATTITUDE ALLOW A PERSON TO DO.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ O. M. Scott and Sons Co., Marysville, OH.

IT ALLOWS YOU TO GROW

IT GIVES A PERSON COURAGE

IT PROVIDES A PERSON WITH VISION

IT MAKES ONE PERSISTENT

IT ENABLES ONE TO IMPROVE

YOUR ATTITUDE, MORE THAN ANYTHING ELSE, TELLS PEOPLE THE KIND OF PERSON YOU ARE AND THE KIND OF WORK YOU WILL PERFORM. IT'S CLEARLY A CASE OF - YOUR ATTITUDE..DETERMINES YOUR ALTITUDE.

Basically, there are two kinds of attitudes. Positive and negative. Most people realize that they are not the same. However, many people do not know exactly what the differences are. For that reason, lets explore some differences in attitudes, as they pertain to some very important issues that we face in our everyday lives. Issues that I call "Life's Growth Determinators".

THE FIRST OF THESE IS CHANGE

How do you think and feel about CHANGE? Find out by completing this statement..changing the way I do my work is........... Do you see that kind of change as a threat? Something wrong and unnecessary? Something that you would fight and resist? These are typically NEGATIVE.

On the other hand, do you see CHANGE as an avenue to new enthusiasm. A way to take the boredom out of work and make the job better. That's POSITIVE.

THE NEXT GROWTH DETERMINATOR IS THE UNKNOWN

How do you think and feel about THE UNKNOWN? Complete this statement..facing a new situation is .... Do you think being forced to do new things is wrong and unfair? Are you being exploited?

Should only new people do new things? NEGATIVE THINKING.

Can you see the UNKNOWN as a place to try new ways? A chance to experiment? A chance to show what you can do? An opportunity? Once again - POSITIVE.

WHAT ABOUT THE GROWTH DETERMINATOR - FAILURE

What are your thoughts and feelings regarding this interesting character - FAILURE? Try completing this statement.. failure is .... Do you take failure as a personal rejection of your worth as a person? As proof that you are no good? The thinking of a NEGATIVE mind.

Or, do you see failure for what it is? A temporary setback. A learning experience. An opportunity to try something. POSITIVE.

FINALLY, THE GROWTH DETERMINATOR OF SUCCESS

What is your attitude towards SUCCESS? Complete this statement.. success is .... Is success the end of the effort? The chance to quit and let the others do theirs? Or is success the good luck you have always been waiting for? NEGATIVE THINKING people think so. But some people see success as a positive reinforcement. Proof that what you tried doing could be done. And the present success allows you to try for an even higher level.

CHANGE . THE UNKNOWN .. FAILURE .. SUCCESS

Four interesting issues that I call "LIFE'S GROWTH DETERMINATORS". I call them that because I believe that it is these factors, and your reactions to these four factors, that will determine how you do in life. Your level of accomplishment. In answering the statements, how did you do? Were you mostly POSITIVE or NEGATIVE? Was it a mixture of both? Don't despair. Even if it was all NEGATIVE ... IT CAN BE CHANGED. No one is stuck with a NEGATIVE ATTITUDE. Let me share with you SEVEN STEPS TO BUILDING A POSITIVE MENTAL ATTITUDE.

NEGATIVE ATTITUDES COME FROM "DOUBT". Doubt in yourself. Doubt in the future. POSITIVE ATTITUDES COME FROM "BELIEF". Belief in yourself. Belief in tomorrow. BUILDING A POSITIVE MENTAL ATTITUDE COMES FROM RE-KINDLING BELIEF - IN YOURSELF.

STEP 1. IDENTIFY PAST SUCCESSES.

STEP 2. DETERMINE YOUR AREAS OF STRENGTHS.

STEP 3. RE-ESTABLISH AND RE-EVALUATE YOUR GOALS.

STEP 4. IDENTIFY YOUR TRUE OBSTACLES.

STEP 5. ZERO IN ON THOSE YOU CAN DEAL WITH.

STEP 6. DEVELOP A STRATEGY FOR EACH OBSTACLE.

STEP 7. PUT YOUR STRATEGIES AND PLANS INTO ACTION.

THE RESULT OF YOUR EFFORTS IN COMPLETING THESE SEVEN STEPS IS A NEW FOUND BELIEF IN YOURSELF AND IN YOUR PLANS AND ABILITY TO GET THE JOB DONE. CONFIDENCE.

CONFIDENCE is a major characteristic of winners. Successful people all display CONFIDENCE.

There are many challenges to be faced in life. Many "LIFE'S GROWTH DETERMINATORS". If you can face them and meet them head on ... with positive determined thoughts and feelings ... I am convinced you can and will be as successful as you deserve to be.

NEW TRENDS IN GOLF COURSE DESIGN[1]

Ronald W. Fream[2]

Let us hope that there are not too many more new trends in golf course design. Golf today suffers mightily from too many new trends in design.

It is important to establish a working definition before proceeding further. Taken literally, golf course design refers to the functional design of a golf course. The very fact that design is the term used and not "architecture", to me, illustrates precisely why there are too many new trends which actually are more detrimental than beneficial to golf.

I would like to elaborate upon the distinction between golf course design and golf course architecture as I believe the definitions to differ. The pertinent distinction between design and architecture is the more comprehensive scope which architecture implies.

Too many golf courses of recent design are merely an arrangement of sausages or bananas more or less randomly scattered about a piece of ground. Round, flat greens and small, square or rectangular tees are attached at either end of the usually flat, more or less green, fairways.

Such monotony is enough to discourage all but the most dedicated or least sophisticated of golfers. Beyond the steriotyped appearance is the all too common absence of proper seedbeds, the poorly drained bunkers, tees insufficiently large enough to support the volume of traffic across the course, fairways of an amaigamation of turfgrass, annual or perennial weeds and bare

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Architect, Santa Rosa, CA.

dirt, and an almost total lack of accomodation with the natural geography and vegetation of the site. Furthermore, all too many designed courses illustrate a near total lack of concern for and awareness of the needs of the golf course superintendent.

Too many golf courses, worldwide, have been designed; too few have been architecturally created with an overview which is comprehensive and attentive to not only the design but the ecology of the site, construction feasibility, construction economics and longterm turfgrass maintenance considerations.

New trends in design should certainly not include new approaches to the design of a proper golf course. Little if any design effort today which is of merit is, in fact, new. Golf has long been played. Golf has long been played on the greatest of natural grounds. Golf has long been played on the most natural of grass surfaces.

To come along and try to improve on the actual design concepts is foolish and quite impossible. Few courses of recent creation can compare favorably with those long considered great as golfing courses. Certainly, better turfgrass, more luxuriant turfgrass, more artistic, ornamental, artificial, contrived, emasculated or fabricated courses abound. Few true, demanding, natural courses are being created. Too many recent efforts are seemingly the product of the same rubber stamp, the same mediocre stereotype, the reflects little of the true origins, character and challenge of the real first class courses.

Lush green grass does not, will not and cannot ever make a golf course great. Lush courses, all bright green, are still mediocre if the fundamental design concepts used to conceive the course are mediocre or unimaginative. A great playing course will continue to play greatly, even if a drought has parched the turf. A mediocre course is little or nothing if a hot spell has stripped the Poa annua from the round, flat, compacted putting greens.

Ever increasing energy costs, escalation land prices, looming water shortages, inflationary clamouring for employee raises - all the interconnected and interdependent pressures which combine to raise the cost of golf course construction and turfgrass maintenance creating pressures which are demanding and dictating that something be done to moderate the cost of providing and playing golf. Designing courses only with play in mind will offer no options or solutions to the problems present, imminent or projected at some near or far distant time.

New trends certainly have forced golf, in many locations around the world, to adapt to sites far less than ideal in topographic configuration, difficult soil types, limited or quality impaired water supplies or climate. Ever increasing golf play in the United States, which continues to grow at some six percent per year, from a base of over fifteen million golfers, places even more pressure upon the poorly designed, improperly constructed or just old fashioned and worn out courses which are ill prepared to accomodate increased play. Long established courses in many countries must now remodel to provide more efficient and more resistant playing surfaces as pressure for more play continues.

Increasing land costs universally add stress to those seeking areas of sufficient size to develop new courses. Existing courses with designed-in problems cannot readily afford to relocate and reconstruct to overcome their problems.

Basically, one approach is to concentrate on providing the finest possible teeing surfaces, greensites and interconnecting fairways. Best possible and ultra luxurious or excessively green are different results. Beyond that, make good use of whatever natural environment is at hand for the intervening areas of the course. Certainly, allowing the bush to reestablish in a real estate development oriented golf project is not practical, though modest and natural roughs may be. Yet, in many situations well tended greens, fairways and tees are all that need to be well maintained. Natural or naturally appearing roughs can offer drama, variety, challenge and a unique beauty manicured turf cannot surpass.

Creating smaller, sporty, challenging courses on modest sized sites (25 to 60 acres), nine hole/eighteen hole courses, using multiple tees and multiple greensites with common fairways, offer play of creditable stature on limited land areas. While not accomodating the volume of golfers of an 18 hole course, reduced initial costs and operating expenses may make golf available where otherwise it might not be. They key is to provide something far more dramatic and enjoyable to play than the sterotyped pitch and putt or typical executive course.

Certainly greens, tees and fairways should be well maintained. Proper maintenance starts with proper construction. The "designer" may or may not understand the desirability of having a silt and clay-free sand seedbed mixture on the greens. Someone unfamiliar with the demands of turf maintenance may not appreciate the longterm value of designing-in large teeing surfaces. An awareness of maintenance requirements also can be reflected in sand bunkers which drain after a rainstorm or fairways that similarly shed excess water rather than retain it. Someone who merely designs and considers little, if at all, the impact of shade on turfgrass in a wooded site, or plants artistically attractive trees with no concern for the voracious root system of those trees, is contributing to longterm maintenance problems.

Remodeling and renovation are obligatory occurrences on many courses. Correction of compaction problems induced by poor design, poor construction, poor maintenance, overuse, old age or a combination of all these factors is a universal and generally unpleasant event. Whether the renovation and remodeling is for one tee, a greensite, a single hole or an entire course, consideration must be given from the commencement of the undertaking to the longterm needs of turfgrass maintenance. Redesign for remodeling can and should involve the same architectural considerations as for new construction.

Green and tee sizing for maximum trafficability plus ease of maintenance is important. Golfer attracting aesthetics helps produce revenue. Construction efficiency helps conserve revenue. Efficient use of the irrigation system from engineering to operation is important. Ease of movement and function of the maintenance equipment has longterm benefits. On many courses, speed of play or excessive slowness of play impact revenues and perhaps the successful operation of the course. Design can help or hinder this factor. Country clubs must pay attention to maintenance budgets today with an intensity and questioning eye not as casual as a few years ago.

Perhaps, least appreciated but worth reemphasizing is the lasting effect properly prepared seedbeds will have on any golf course. When design only is the consideration, the problems of clay, dirt, more or less soil and various other seemingly trivial factors disastrous to the longterm playability and maintainability of the course are to be anticipated. Designers not schooled in agronomy all too often overlook the vital need for properly prepared seedbeds.

The golf course architect can influence the image or style of the future golf course while that course is on the drawing board. It is very important to consider the objectives and needs of the individual client. It is also very important to strive for harmonious results, fully compatible with the site and enviornment. It is important not to be unduly influenced by arbitrary goals or short term views of the needs of the final design product.

New trends in golf course design really are those long experienced successful factors of architecture, perhaps once overlooked for design sake alone. More attention to the longterm needs of turfgrass management, while considering and making use of the great old concepts of strategic and penal play, forced carries, undulating fairways and dramatic greens, deep and punishing sand bunkers - in general, golf courses more near to natural than artificial, more of an "always there" appearance than manufactured, true to a well hit shot but a bit deceiving, a bit unforgiving, not stereotyped and certainly always memorable. New trends really are a return to what has always been grand and wonderful about the true great golf course of our Earth, combined with the awareness of the unavoidable need for proper seedbeds and modern turfgrass maintenance, where that maintenance should and need be.

NEW TRENDS IN GOLF COURSE DESIGN[1]

Robert M. Graves[2]

Over the past 23 years I have been asked to speak on "New Trends in Golf Course Design" more times than any other single subject. On the surface this is a sensible request but, for the most part, fruitless, at least in terms we would normally consider.

Golf course design is considered concurrently, a profession, an art form, an inexact science, a business, and at least the work of a frustrated, perhaps demented soul whose main purpose in life is to create hate and discontent amongst the golfing fraternity. Whatever it is, our daily chores are governed more by the traditions and constraints of the past than by the wonderous changes in turf, trees, irrigation, drainage and other related construction and maintenance processes that modern science and technology heaps on us each day.

Golfers resist changes in the basics of the game. Keep that edict in mind as it relates directly to our topic.

If you read any of the more popular golf publications, the latest "new" idea could be summarized as "natural" golf course design. It incorporates forced carries off the tee and between predetermined landing areas; so-called "contour-mowed" fairway shapes; naturally occurring plantings (turf or otherwise), or other native material in the rough; and target areas to hit to.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Architect, Walnut Creek, CA.

This is the direct opposite of golf course design construction and maintenance processes producing golf courses featuring wall-to-wall and very lush turf; with few imposing tree masses, lakes, bunkers, or other hazards to intimidate the golfer!

And as any of you who have any interest, in the history of golf will acknowledge, none of these "new" ideas are new at all.

Golf was born and nurtured within the concepts of the "new" idea. Forced carries, naturally shaped course features, and rough close to fairway edges, leaving relatively small target areas to hit to, were all part of the earliest golf courses known to man.

So why this sudden return to the original methods of golf course development? Simply, it is finally sinking into our heads that we likely cannot continue to throw money and water at our golf courses as we have in the past. Construction and maintenance budgets are strained to the maximum now, and water supplies continue to dwindle.

The California drought of a few years ago proved we could get along if we had to on much less water. But the only logical way to reduce construction and maintenance costs is to construct and maintain less golf course. Eighteen holes will be the stipulated round of golf forever, so we are left with the option of reducing the maintained area to be dealt with.

Unfortunately we are dealing with people (read golfers) in addition to turf, water, trees, wind, etc. I noted that golfers resist changes in the 'basics' of the game. The only thing the average golfer will resist more vehemently is a change which affects his score; or at least the score he feels he is rightfully due if he played his "real" game.

The same golfer, who will put down any sort of change in the traditional 18 holes played nose-to-tail on a course and in a manner reflecting the traditional layouts, will demand that a tree, or bunker, or rough or whatever that causes him concern, be banished and that lush turf be substituted in its place. No thought of changing his swing or his game with lessons or practice. No, we must alter the golf course so as not to impede his progress. The results can be seen on many of our courses, and often reaches its zenith on municipal or resort layouts where concern for speed of play and/or unruffled feathers far outweighs conserving the heart and soul of the game of golf.

It seems academic to ask, but consider also why we face this growing concern about our total scores as opposed to simply enjoying a pleasant few hours of friendly combat in a beautiful setting.

Well, something else evolved in golf play that is a very prominent factor leading to the necessity of today's "new" ideas in golf course development.

The game of golf was originally a one-on-one struggle referred to as match play. It could have been played on any sort of course as the total score mattered not a bit. What counted as winning the most holes over your opponent. The beginning of what I consider the disruptive medal play mode, was first noted in the 1700's, occurring simultaneously with the first recorded rules of golf.

There is still an impetus for the earliest type of golf play with the British Amateur, Ryder Cup, Curtis Cup and Walker Cup still contested by match play. Our United States Men's Amateur had changed back and forth from match to medal many times since its inception. But the Masters and World Cup always were medal play. Then the Professional Golfers Association really triggered the most massive movement from match play when in 1958 they chose medal play for their major tournaments. This was due primarily to the intricacies of TV coverage we have all witnessed.

So millions of golfers watch their heroes do battle by medal play, where total score means all, on the tube if not in the flesh. Consequently, the average golfer (although Nassaus are still a popular betting system) simply must count his total score to compare with his past efforts and that of friends, fellow competitors and the TV troops. If you're going to live or die by your score, then our egos dictate that we do anything and everything in our power to improve, including changing the golf course. Everything except practice that is.

We can reduce construction and maintenance costs and we can lower our water consumption. At the same time we can return the game of golf to the traditions and concepts it was created in.

Our golfers will have to solve their problems on the practice tee. Many will discover for the first time the thrill of improving themselves, and ultimately the joy of making that short they thought impossible. Some will actually grow up!

If such a process really does take hold, what additional results can we expect?

There will be a loss of those golfers whose egos can't fact the realities of the game and their incapabilities. As a result of the loss of some golfers, likely some golf courses will close when the pressures of operational cost and lowering profit compares too unfavorably with other potential uses for their property.

One of my favorite fantasies is that by such attrition we wake up one day with half as many golfers playing half as many courses. The good news is that all remaining golfers are true lovers of the game and are not in it for anything but enjoyment of their favorite pasttime. The same type of dedicated golf addicts develop, design, build, maintain and operate each and every golf course. No one is allowed whose main goal is to exploit the game. Wouldn't that be a pleasant situation?

NEW TRENDS IN GOLF COURSE DESIGN[1]

John Steidel[2]

The subject of this presentation "New Trends in Golf Course Design" is slightly perplexing because there are so very few "trend setters" among our profession. It seems to me that most Golf Course Architects (amateur and professional) are either adapting from these trend setters into their own style or responding to the desires of the golfing public.

I don't feel that my own firm has been established a long enough period of time to be considered a "Trend Setter". I do feel that our responses to the desires of the golfing public and the demands of golf course operators are quite innovative. I will address my remarks to my developments rather than passing along second-hand what other designers are doing.

It seems to me that a vast split has developed in the types of courses that are being built. It seems like there are very few moderate budget courses being built, a surprising number of projects with substantial construction budgets, while the vast majority of golf course construction budgets I have knowledge of could best be classified as meager.

To those of you in golf course maintenance who have seen your budgets stay the same or be reduced over the past three years, or those of you in any way aware of the economic climate of this area, this should come as no surprise.

My goal when I start any project, new construction or remodeling, is to build a well-designed, interesting golf course, or golf course feature that my client can

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Architect, Kennewick, WA.

afford to build and can afford to take care of. If I don't do that I am designing for my own ego and am being irresponsible.

After a golf course has been constructed and is operating, to reduce a maintenance budget, some tough choices must be made. You must give less attention and spend less money on some things. Those who must make a choice will take care of their greens, tees and fairways before they take care of their hazards and roughs every time.

It is my belief that existing courses will undertake this sort of program only as readily as the public agrees to accept any other form of conservation." That is only when it is absolutely forced upon them.

I offer the following example: In the Northwest we received a warning of things to come in the drought conditions that existed in 1977-78. Rather than adapting their courses to using less water, which could have resulted in less maintenance cost year round, those courses who could increased their water supplies and modernized irrigation systems to provide more and better coverage.

I have found it much easier to design conservation into a course than to implement it through remodeling. Through examining golf course features, each briefly, I can demonstrate the current trends in my golf course design that respond to present needs.

I believe that the most cost effective green design is to build straight sand greens with a limited drainage system. My greens generally range from 4,500 square feet to 7,000 square feet depending on the length of shot, contour of the green, shape of the green, and anticipated use of the course. Larger greens are generally not appropriate unless unusual circumstances exist and are more expensive to maintain. Building smaller greens of less than 4,500 square feet is not the answer either. Even if the greens were of a shape and slope, so that all legal area for cup setting could be used, a green needs to be at least 4,350 square feet to yield 2,000 square feet of cup space, which I feel is the minimum.

Did you also know that if your greens aren't at least 5,300 square feet that you are taking care of more green where you can't legally set a cup than green area where you can? That proves to me that smaller, flatter greens aren't the answer and I believe that those of you maintaining such surfaces already know that.

My tee design and construction have become fairly standardized. My tees have a sand surface and proper slope. Tees on par fours and par fives should be at least 4,000 square feet, while tees on par threes can be as much as 10,000 square feet. The important feature is to balance the cost of taking care of these tees and the usable square footage of the tees with the need to put variety in your course.

If it is a desire to properly challenge scratch golfers, a tournament tee must be constructed 30 to 50 yards behind the men's regular tee. If women are to be accomodated properly they too need a separate tee 30 to 50 yards forward of the regular tee. Only a very steep slope justifies many separate tee surfaces on the same hole.

Sand bunker design, too, has moderated. Depending upon the objectives of the course and the site, I find it necessary to build 40 to 50 sand bunkers on eighteen holes to provide proper challenge. We all know that these hazards are work and cost money so those that we have must be designed for maintenance. They tend to be larger than the sand traps of the past. To a degree grass mounds can be a less costly alternative to sand bunkers.

My primary response design-wise to respond to lower maintenance and construction budgets is to provide less fairway to be maintained and rough that requires less maintenance. The easiest way to accomplish this is to vigorously control the area to be irrigated to approximately 50 to 60 acres on an eighteen hole, regulation length course.

By vigorously controlling the area to be irrigated I mean convincing the Course Developer this concept is best for him in the long run and by making sure the Irrigation Designer doesn't irrigate the areas of the course intended to be non-irrigated rough, including areas off the tees.

The result is fairways that average 40 yards wide with irrigated rough for 10 yards on each side of the fairways. There are many grasses both in most wet and dry climates suitable for use as non-irrigated, low maintenance rough. The key is to select grasses that don't need a lot of moisture, fertilizer or maintenance that produce a rough where a golfer can find and play his ball. Drip irrigation of new tree plantings, at least in the early years of growth, is helpful and compatible with this concept.

Other types of plant material may also be used rather than grasses. Many of you are undoubtedly familiar with the City of Industry Golf Courses in California, where they used wild flowers in low maintenance areas. Such areas must be located for all practical purposes out of play or they will result in slow play through lost golf balls.

I have also found that in using low maintenance grasses, wild flowers, or other native plant materials, competition from weeds must be minimized and that some maintenance in irrigation fertilization and mowing may be required for successful establishment. In only very few instances is existing native plant growth acceptable for this use.

Restricting the amount of turf that is intensively maintained is not a new idea. The old Scotch courses were hardly maintained and the general public was made aware of it by the promotion of the Tournament Players Club course in Florida this year where fewer than 40 acres of turf are said to be maintained. I feel that the golfing public and even some of the touring pros need more turf than 40 acres. However, I feel the trend of taking care of less fairway and taking less care of rough is vital to the growth of golf.

WHAT IS INVOLVED IN GOLF COURSE MANAGEMENT[1]

Richard W. Malpass[2]

There are many types of golf course operations and ownerships and, although having worked on only two courses in the past twenty years, I have served under several types. Having helped construct the first golf course I worked on, I later became superintendent for eight years. During that time it went from a privately owned public course to a privately owned private club with the owner operating the course, to a corporate owned property leasing the facilities to a club but retaining the operation of the course to, finally, the club leasing the course and operating it. For the past twelve years I have been superintendent at a private club where I am ultimately responsible to a general manager.

Because of the degree of knowledge and ability required by the individuals concerned, I have always felt that the long established triamvurate of club manager, golf professional, and course superintendent was one of the more satisfactory methods of operating a golf course facility. Each is a professional in his particular field and all are responsible to, generally, their respective committees and ultimately to the Board of Directors and President.

However, because of the type of facilities, the value of the investment, numbers of members or users of the facility, the number of employees involved, it has become desireable for many to operate under a general manager concept. Many of our courses now have properties valued in the millions of dollars, with large operating budgets, and with a number of departments involved in the operation. As a practical matter and

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Superintendent, Riverside Golf and Country Club, Portland, OR.

for efficiency of operation a general manager co-ordinating the functions of the different departments has been the manner many Boards of Directors have adopted to conduct the affairs of their association. Committees are still used with department heads reporting to the general manager and he to the Board of Directors or governing body.

My personal opinion is that, if all members of the aforementioned triumvurate had been well qualified professionals, it might not have been necessary to add one more position to the upper level of management with the attendant cost thereof.

One positive result of great benefit to our particular club has come about because of our having a capable general manager who has seen that funds set aside for a particular department of the club have been used for that department. Too often we have seen clubs where the golf course, itself, suffered because the club house always had the priority for funds. The superintendent was expected to keep a course in top condition with equipment that might better have been in a museum or junkyard. Members and guests used the club house because that was where the lockers and showers were located and lunches or meals could be obtained there. But they had joined to play golf and golf was the main reason for the existence of the facility. If the superintendent is required to maintain the facility with old, outdated equipment, the course will suffer. And when the course suffers, the entire operation suffers.

When I first was elected to the Executive Comittee of the Golf Course Superintendents Association of America the general manager concept of golf course operation was beginning to be used. It was feared by many superintendents and golf professionals because it appeared that it would take away some of their responsibilities and would destroy lines of authority and communication with committees, Boards of Directors, and golfers. In the years following, we have seen many superintendents and golf professionals advance to become general managers themselves.

The problems with the system arise, as I have seen it, where a general manager tries to run the entire operation himself rather than having qualified people head the different departments and letting them take care of the day-by-day operation. The superintendent's job, in particular, is becoming more technical.

He must be able to identify a host of turf diseases and prescribe the treatment for them. He must be a licensed applicator of many of the chemicals used for disease treatment. He must have a knowledge of application of weedicides, insecticides, and chemical for other uses. There are many more technical aspects of his job that could be related here, but we will pass over them. Budget preparation is an important part of his job and working within that budget is an important responsibility. Communications with superiors, his own crew, and golfers is extremely important in order to keep the whole operation working smoothly. The wise general manager will hope to have a well qualified superintendent in charge of the golf course and cooperate with him to see that the golfer is afforded the best possible playing conditions that can be provided within the limits of the budgeted funds provided.

While we are mentioning budgets, how many of you listening today have taken your club budget and examined it closely. Segregate the golf related income then compare it with golf related expenditures. You may get a shock when you find out how little of the income gets directed into the operation of the golf course. Perhaps you are a golf club or a golf oriented facility and would suppose that every effort would be made to return as much of that income back into the golf course in order to keep it and the equipment in top condition. To put it very crudely in the words of an old farm proverb, "the golf course is sucking the hind teat." One nationally known superintendent told me that his green committee and Board of Directors made a substantial revision upwards in his budget when he pointed out the difference in golf related income and what was being spent on the course.

I cannot emphasize enough the importance of having an operating budget and a separate capital budget. Capital expenditures do not belong in an operating budget. Too often I have seen a superintendent directed to complete a project on the golf course involving a substantial amount of funds which he is told to take from his maintenance budget. Maintenance must then be curtailed in order to keep in bounds of the budget. Then the membership complains about the state of the golf course and the superintendent gets the blame or the axe.

With the abundance of good help available and with students coming out of two and four year turf programs at our universities there is no excuse to hire any but the best. Employees motivated by the desire to improve themselves in their chosen profession make excellent employees. We have had a very close working relationship for many years with one or two universities and regularly use students for summer-time help. We have been very satisfied with the arrangement and have appreciated the fact that many of them have gone on to become superintendents in their own right. We also encourage our employees to take night classes or other schooling to better themselves. Business law, accounting, welding, horticultural courses, these and others make for more capable people and certainly better their chances for better paid jobs. Too, we encourage several of the crew to have their applicators licenses for pesticides, fungicides, weedicides, etc.

And then there is communication. Here is where many fall amiss. How many of you regularly have a column in your club paper? How many have appeared on radio or TV garden show programs? How many make an extra effort to be available for your golfing members to answer questions about their lawns or shrubs. How many of you faithfully attend your local association meetings, regional turf meetings, or belong to your national association. You are cheating yourself and your employer if you don't. Sure, it costs money for dues and for travel, but your employer will receive his money back many times over from the valuable information that you will receive if you will but apply yourself. It has never cost my employer to send me---it has paid and paid well in a better golf course or turf facility. And while talking about communication remember, "To be a good communicator, avoid being a 'know it all' because everyone knows you don't."

You are attending this conference in the hope of bettering yourself. You have come to learn and to exchange learning experiences with others involved in your profession. Hopefully, you will go home better able to meet the daily challenges of your job. Let me leave you with a thought expressed by Eugene E. Jennings, Professor of Administrative Science, Graduate School of Business Administration at Michigan State University and it is this: "The road to the top is a journey into self-insight and development. Men at the top know who they are, what they want to do, and how to get there."

HOW GOLF ARCHITECTS AND SUPERINTENDENTS WORK TOGETHER TO PLAN EFFECTIVE MAINTENANCE[1]

Dick Schmidt[2]

The realistic financial facts of the 1980's and beyond are very clear, as anyone in the turfgrass industry should be able to recognize. We must learn how to control maintenance costs in labor, materials, and equipment repair. The costs of fertilizer and chemicals, as well as equipment repair costs, can be controlled by good management, cutbacks in area maintenance, and materials used. We, however, as turfgrass managers can find it hard to control maintenance costs on golf courses and other turfgrass areas when the owner and/or architect run wild and free with little or no though to future maintenance and maintenance costs.

I believe in the past some designers and architects thought they could move the land as they so wished and thus thrive on their own little ego trip. Well, my friends, times have changed and changed drastically. Land owners, developers, designers, architects, and golf course superintendents have got to get their heads out of the sand traps and lakes and look for better and more economical turfgrass maintenance. I would agree that golf courses built strictly for low budget and easy maintenance are basically unattractive. I strongly suggest, however, that golf courses can be built to attract the play needed for financial support. Contours, lakes, bunkers, tree planting, and other features must be built with the future in mind. Most every golf course built requires far too much labor to maintain.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Superintendent, Port Ludlow Golf Club, Port Ludlow, WA.

The golf clientele of today has been spoiled and now expects near perfect turfgrass conditions. We turfgrass managers must strive to obtain these conditions where possible. However, with today's high cost of labor and maintenance, we must be willing to compromise. If, when during construction or rebuilding, the owner, architect, and construction superintendent would consider future maintenance problems and added cost of labor and materials, I am sure wiser decisions would be made.

Take Port Ludlow as the prime example. In 1979 the golf course maintenance budget at Ludlow was in full swing with no thought to the future. We did everything you could think of to maintain 100% of our 160 acres. In 1980 our same $260,000 budget was cut to $120,000. How many golf courses could stand $140,000 cut in their budget? How would, or how could you accept this humiliating defeat? How could you go from a 15-man labor force to a 5-man in summer and a 2-man in winter?

Well, I'll tell you first hand. It's very difficult to accept. Your first thought is the heck with it. I'll just get another job. Then you think, well, I'll just draw my paycheck each month and do more fishing and hunting and let the course go to hell. After all, that must be what they want, right? Wrong. They, the owners--believe it or not--expect you to maintain the golf course very close to what you had done in the past. How many golf courses would survive with such low maintenance; furthermore, how many superintendents?

Well, I swallowed my pride, ate lots of "crow", and did some very hard soul searching. I came up with a very workable maintenance program. I believe we survived the financial crunch because future maintenance was given considerable thought when our course was still on the drawing board. I also feel the architect was very openminded when it came to the "in field" changes myself or the owner wanted. What is put down on paper in an architect's office hundreds of miles away doesn't always fit. The architect and owner must have enough faith in their construction superintendent to listen to problems arising during construction.

There are numerous golf courses around just the Northwest with greens that measure 6-8,000 square feet but because of mounding and contours you actually only have 3-4,000 square feet of usable surface. Multiply that 3,000 square feet by 18 greens and you find you are maintaining 54,000 square feet of unused and unwanted golf course. The same goes for tees, bunkers, creeks, etc. Why build 50, 60 or more bunkers when most of them only hurt the power golfer. Why not have 20 or 30 possibly built larger and in proper locations. Are traps for aesthetics or four making the playability of a hole more difficult? Why spend 5 to 6 hours a day maintaining sand traps when, with proper design and maintenance planning, 2 hours a day is plenty?

Developers and future golf course maintenance people must communicate with the architect and have a firm understanding of what is wanted from the final product. The architect must have in his mind, and on paper, a complete understanding of just exactly what is wanted. He must be able to relate to future maintenance problems and maintenance budget requirements. There is definitely a lot to be learned every time a new project is started. My only hope is that future designers, architects, owners, and construction superintendents can build what is the best possible product for today and for the future.

HOW GOLF ARCHITECTS AND SUPERINTENDENTS WORK TOGETHER TO PLAN EFFECTIVE MAINTENANCE[1]

John Steidel[2]

There are some days that each of you in golf course maintenance probably curse the designer of your course for leaving you so many problems. You feel in your mind that if the Golf Course Architect had just one iota of common sense he would have done certain things differently and enabled you to take better care of your course at less expense.

You should also know that at times Golf Course Architects cringe when they have to play a course that they designed and observe how the Golf Course superintendent has ruined their creation - it spoils the round - by making maintenance decisions that affect the appearance or playability of the course, while not resulting in any significant savings in his budget.

There is some truth to both feelings and the way to alleviate them is by Golf Course Superintendents and Golf Course Architects working closely together and openly communicating their thoughts and concerns. I know as an Architect that the Superintendent is my most important ally, whether the project is a new course or remodeling. He can make me look good or awful. I believe that I can help make their courses look and play better.

Communication between a Golf Course Architect and Golf Course Superintendent is essential. The more we understand each other's role in golf course development and operation, the better job we can do together. Believe me that at times our work gets very frustrating

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Golf Course Architect, Kennewick, WA.

and there is a great temptation to design what we want and let the Superintendent figure out how to take care of it, but I know that this is not right.

By examining the roles of the Golf Course Architect and Golf Course Superintendent in both new golf course construction and remodeling I will suggest ways we can work together more effectively and do our jobs better.

To a great extent the Golf Course Architect should be considering future maintenance the moment he begins a project, whether new or remodeling. It is foolish and irresponsible to design something that the client is unable to or cannot afford to maintain.

From almost day one on a new golf course project the future maintenance budget should influence the design as much as the construction budget does. The projected future budget could influence green size, tee size, shape and configuration, number of sand traps, irrigation system, tree planting and turfgrass types.

Most often these decisions are made by the Golf Course Architect without the input of the Golf Course Superintendent who will actually take care of the project. It is, therefore, essential that the Architect seek out and use knowledge obtained from knowledgeable Superintendents on how design is affecting maintenance.

I know that I become a better Golf Course Architect by receiving feedback from Golf Course Superintendents who have constructed golf courses and maintain courses - especially the courses I designed. I appreciate hearing about problems my design might cause. I have heard complaints like the greens are too big or small, too many sand bunkers, san bunkers that can't be mowed around, sand bunkers that are too close to a green surface, tree planting errors (wrong species, wrong place, too many), slopes that are difficult to maintain and I respond to them.

I hear many complaints that irrigation systems are, in some respects, poorly designed or installed, and I make sure that my irrigation engineer designs what is best for the client and that he does follow up to make sure it is installed properly. I have also seen many instances where golf course owners and Superintendents are left alone to complete a course when the guidance of the Golf Course Architect is needed most. It is in the Architect's best interest to always be available to his clients on a continuing basis through the first years of operation.

In new golf course construction, I believe in hiring the future Golf Course Superintendent as soon as possible to be the construction supervisor or inspector. He should be on the job at least by the time the irrigation system is to be installed.

Once this individual is on a new construction job, he has the opportunity to respond to what he sees during the installation of the irrigation and drainage systems, during tee, green, and bunker construction, during tree planting and seeding. A good construction supervisor can make an average course good or a good course great. I feel that the on-site person during construction is as important to the success of a golf course as either the Golf Course Architect or future Golf Course Superintendent. I know of no secret formula for finding these people. I do know that it is essential that we have a respect for each other's abilities and an understanding of what we are trying to accomplish.

Golf courses designed primarily for easy maintenance are boring and usually unattractive. Different mowing heights and irregular shapes of golf course features are needed for a golf course to look and play correctly. The supervisor must understand that. However, if he sees a slope that he can't mow or a potential wet or dry area, he must make the Golf Course Architect aware of the problem, both so that it can be changed and if a mistake is made, so that the Architect won't do it again.

The construction supervisor and future superintendent often has considerable control over how a course is completed. On many projects, toward the end, the client often seems to run out of money. The Golf Course Architect's visits get fewer and fewer. The contractor on the job wants to leave as soon as possible. The Golf Course Superintendent is the only one on the job that cares.

I have discussed the roles of the Golf Course Superintendent and Architect in new construction but perhaps they are even more closely interdependent in a golf course remodeling project. Remodeling in general is an enigma. It is often more difficult and expensive than new construction but the rewards to golfers and a successful remodeling project are substantial.

However, in my experience, remodeling projects have proven frustrating for the Golf Course Architect and sometimes risky for the Golf Course Superintendent. They must be approached very cautiously and systematically with great care fiven to all stages of work. At times I feel like remodeling projects are potential graveyards for Architects and Superintendents alike. I offer the following case histories:

-At a prestigious course in Oregon, a Golf Course Architect is hired to re-design a green and a tee. Because of primarily poor direction and communication the Architect prepares plans costing thousands of dollars that the club never uses, and the next season the club hires another Architect to prepare plans for the same work.

-At a major course here in Washington, a Golf Course Architect is hired to design several greens. The Architect makes certain promises to the green's committee on how and when work is to be done. Although the promises were unreasonable, when the expectations of the green's committee weren't met, the Golf Course Superintendent was dismissed.

- Finally at a wealthy club in California, a Golf Course Superintendent mistook insect damage on a newly seeded green for a disease. When the newly seeded grass disappeared after six weeks the green had to be reseeded. For this mistake, the green's committee fired both the Golf Course Architect and Superintendent.

I could continue this horror story further - it happens all the time. I feel that we are compelled to work together to create successful golf course remodeling projects.

What, then, can Golf Course Architects and Golf Course Superintendents do to increase the chance of the success of a remodeling project?

1. The Golf Course Superintendent must be actively involved in the selection of the Golf Course Architect. Remodeling is very often problem-solving. If you Superintendents let the golf professional select an Architect, chances are it will be the golf professional's problems that get solved and not yours.

   If the Golf Course Superintendent doesn't select the Golf Course Architect, the chances for effective communication are reduced as is the chance of a successful project. I've found that if the Superintendent can recommend an Architect, then he is in a strong position at the course and it is usually easier to work together.

2. After the Golf Course Architect has been selected, the Golf Course Superintendent must accurately and completely present the problems to be solved and a background into the club. The Superintendent, if he has been at the course any length of time at all, has a working knowledge of physical situations and conditions at the course that may not be readily apparent. He also knows the likes and dislikes of certain members. There may be some situations the Superintendent doesn't want attention given to. The Architect should be informed of all these situations. There is no need to get the project tied up in little squabbles if you don't have to.

3. At the appropriate time, the Golf Course Architect must make the Green's Committee and the golfers aware of the facts of life of remodeling - i.e. that it's going to cost money and usually disrupt

play on the course for some period of time. That must be understood by all before starting. It is amazing that these people just can't believe it will take 10 to 12 months to reconstruct a green.

In conclusion, there is a lot to be learned from Golf Course Superintendents and Golf Course Architects getting together and discussing their work. We must understand and respect each other's work. The Superintendent can do this by thoroughly acquainting themselves with the work of different Architects. The Architect does this by being on golf courses at times when they are being maintained as opposed to when he is working or playing them and by attending meetings like this and listening to you rather than just speaking to you.

In new golf course construction it is essential that the future Golf Course Superintendent be on the job as early as possible. In remodeling, the Golf Course Architect and Superintendent absolutely must work together to put together a comprehensive program that will result in a successful remodeling project.

Golf Course Architects and Golf Course Superintendents by working together over a long period of time can create better golf courses to play that are easier and less expensive to maintain.

IRRIGATION STRATEGIES FOR THE GOLF COURSE[1]

Tim Ansett[2]

Sometimes, the importance of water to a golf course is overlooked or misunderstood. A typical golfer probably doesn't think much about water on the course unless confronting it as a hazard or being disturbed by irrigation. We, as turfgrass professionals, must have a greater understanding of its role, recognizing that golf course turf could not exist without water. This is quite apparent in arid regions, where supplemental irrigation is required for mere survival of turf. But even in areas having greater natural precipitation, irrigation allows turf quality to be maintained through seasonal dry periods.

Superintendents from other parts of the country, hearing of Northwesterners rusting and growing webbed feet, would be amused to learn we are concentrating on irrigation at this year's conference. They fail to recognize that even in our wettest areas, west of the Cascades, during 5 months of the year, evapotranspiration exceeds rainfall. Furthermore, because waterlogged soils limit turf rooting in winter and the transition between wet and dry seasons is sharp, irrigation is even more important.

Recognizing that irrigation is necessary to provide quality golf turf, it must be realized that irrigation practices will affect turf quality. Various irrigation strategies could be categorized, but only two will be defined here: (1) irrigating for aesthetics and (2) irrigating for playability. The aesthetic strategy would dictate that a golf course be irrigated enough to keep everything green. Brown or dormant

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ U.S.G.A. Green Section, Vancouver, WA.

turf would be avoided even if it meant turf became unusable because of waterlogged conditions. The playability strategy would dictate that irrigation should be only enough for turf survival. Dormant brown dry areas would be preferable to wet spots, because dry spots are still playable.

Obviously, either of these strategies could be carried to the extreme. In practice, an intermediate strategy is more often used. As I am sure you are aware, the USGA strongly believes that irrigation strategy should be dominated by considerations for playability. A dry golf course is the best test of golf and the most enjoyable to play, so overirrigation must be avoided. I am sure that superintendents are not the reason too many golf courses in this country are overirrigated. All of you realize that keeping turf on the dry side minimizes soil compaction, reduces ball marks on greens, and encourages deeper turf rooting. In preparation for USGA championships in the Northwest and elsewhere, superintendents have been very cooperative in keeping their courses dry. Golfers in our championships are also cooperative in accepting and enjoying the firm and dry conditions.

Unfortunately, typical golfers may think that all turf on the course should be green and that greens should hold any shot, however poorly struck. As this typical golfer is paying the bills, a superintendent is often forced to irrigate more than he really wants to. That typical golfer is also forcing additional expenses on the superintendent (for aeration, fertilization, and disease control) or turf quality is being reduced. While this conflict of interests will no doubt continue, the time to push for playable turf rather than a lush turf has now come. Demands for water use have made it a scarce resource, and even in the Northwest, restrictions in some localities have already arrived. Politically and economically, golf courses cannot afford to overirrigate, despite that typical golfer's views. As overirrigation ceases, that typical golfer will enjoy a more playable golf course. Irrigating for playability must be our irrigation strategy, for the future and for today.

Once a decision is made to keep the golf course dry and playable, other cultural practices must be adjusted. Excess fertilization must be avoided, yet an adequate supply of required nutrients should be assured. Turf rooting should be encouraged through cultivation. Thatch must be controlled through aeration, topdressing, and liming. Improved turf varieties should be introduced by overseeding. The use of wetting agents will help to maintain water infiltration throughout the season, as will regular spiking and slicing.

In trying to maintain a dry, playable course, most important will be the actual irrigation system you possess and how you utilize it. Spacing of heads, pipe sizes, and available pressure must allow you to apply water uniformly. If manually controlled, you must have workers capable of exercising control over the amount of water applied to specific areas on the course. If automatically controlled, you should have individual station control over areas with unique requirements. This usually means individual head control on greens and tees, with no more than 4 to 5 heads per station for fairways. Obviously, the best control set-up will vary depending on soil variations and topography. However, if you do not have adequate separation of individual areas, an automatic system might provide worse control than a manual one.

Regardless of whether your normal irrigation is controlled manually or automatically, to avoid wet areas, some handwatering will likely be required. Syringing to reduce evapotranspiration during high temperatures may also be appropriate.

As to when to irrigate and how much water to apply, you must know your turf rooting depth and the amount of soil moisture within that root zone. When moisture in the root zone is down to 1/2 to 1/3 of full capacity, it is time to irrigate. You should then apply enough water to wet the soil through the root zone. Using a soil probe or similar device is the best way of determining soil moisture and rooting depth. The interval between irrigations and the amount of water applied during each irrigation will vary during the year, depending on rainfall, turf rooting depth, and evapotranspiration. Failing to modify irrigation frequency and amounts throughout the season results in excessive wet and dry areas on the course. Remember that deep and infrequent irrigation is preferable to light, frequent watering.

Much has been written about the benefits of withholding irrigation for as long as possible in the spring. This encourages deeper turf rooting but more importantly, encourages more drought-resistant plants to dominate the turf community. Turf plants which must be irrigated frequently to survive in May will be even harder to save in July and August. Use natural selection to produce a hardier turfgrass stand.

Remember not to apply water faster than the soil can receive it. Use repeat cycles to minimize runoff whenever possible, even with a manual system. Maintain maximum potential infiltration rates through the use of cultivation practices and/or applications of wetting agents. Don't just add time to the irrigation schedule when poor infiltration is the problem.

Many "irrigation problems" result from a failure to monitor the system to assure that all heads, valves, controllers, etc., are functioning as they should be. Make sure someone in your operation is responsible for regularly checking the functioning of the system, <u>before</u> turf dies or a swamp develops. Again, don't just add or subtract irrigation time when the problem may be a malfunction.

Even if using proper irrigation techniques, you may find it difficult to keep the course dry and playable with your current irrigation system. This will be particularly true with a single row fairway system on a course with clay soils and/or severe changes in topography. In upgrading your system, consult with a qualified golf course irrigation design engineer. Only after the design is completed, solicit bids from proven installers. Too many courses have saved money on a system by installing an inferior design, incapable of performing effectively. Don't waste resources, time, and effort by saving money on a "bargain" system. An automatic system is only an asset if it provides you, the superintendent, with uniform coverage and sufficient control over individual areas of the course.

In the future, there will be increased pressure on golf courses to reduce their water use. Some reductions in water use can improve the health of the turf and provide a more playable golf course. Further reductions might only be realized through reducing the acreage of irrigated areas. Make no mistake about it - golf courses will have to use water more effectively - along with everyone else. By making an adjustment in your irrigation strategy now, you will be better prepared for the future.

MANAGING SAND SPORTS FIELDS[1]

Dr. Roy L. Goss[2]

Regardless of the quality of construction that goes into a good field, inadequate maintenance can nullify the best quality materials and best construction practices if not carefully carried out. It is most important to closely adhere to the following recommendations.

FERTILIZATION

Closely observe the germination and growth rate of young seedlings. If they are not developing rapidly, light applications of 1/2 lb nitrogen per 1000 ft^2 or less may be necessary every two weeks to keep the seedlings developing rapidly. This is assuming, of course, that adequate levels of phosphorus, potassium and micronutrients were incorporated in the seedbed prior to planting. Other factors can be listed as follows:

1. Nitrogen. Apply 5 to 8 lb nitrogen per 1000 ft^2 annually divided into 5 or 6 equal applications. Nitrogen may be supplied from soluble materials such as ammonium sulfate, ammonium nitrate or urea. Nitrogen can also be supplied from IBDU, urea formaldehyde or sulfur-coated urea or as a mixture of solubles and slowly available materials. At least one application of nitrogen should be made during the winter - December or early January on the West Coast area or by mid-November in the interior to provide adequate nitrogen for root growth of the turfgrasses. The other applications can be divided uniformly throughout the year.

1/ Presented at the 34th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA 98371.

2. One to two lb of P_2O_5 phosphorus per 1000 ft^2 per year. Two lb of P_2O_5 can be supplied from 20 lb of single super phosphate or 4-1/2 lb of treble or concentrated super phosphate.

3. Four to six lb of K_2O potassium per 1000 ft^2 per year. You would probably be wise to maintain the higher level since potassium can readily leach from sands and it is very important to maintain vigorous, healthy turf. In order to supply adequate sulfur, it is advisable to use potassium sulfate as a source. Potassium sulfate is 50% K_2O; hence, 2 lb of potassium sulfate will supply 1 lb of K_2O.

4. A complete micronutrient mix should be applied once or twice annually to insure adequate levels of these trace minerals. A granular form of micronutrient has been introduced within recent years on the market and is called Esmigran (no advertisement intended, and to the writer's knowledge, there are no other granular sources), although there are a number of formulations of micronutrients available.

5. Lime according to needs as indicated by soil test reports. Dolomitic limestone can be alternated with agricultural limestone to supply necessary magnesium. Soil tests on intensively used fields should be conducted every year for the first two to three years and every two to three years thereafter to monitor soil nutrient levels.

OTHER PRACTICES

1. Aerification. After use has been initiated, it is important to use hollow tined aerifiers three to five times annually to help insure adequate water infiltration and oxygen diffusion into the soil.

2. Remove accumulated dead and matted organic material which is punched into the surface due to cleats and foot traffic. Heavy layers of dead and

decaying organic matter can produce a sealing effect in the surface and significantly reduces the infiltration rates of water and will definitely result in wet, soggy fields and accelerated loss of desirable turf. This is probably the most neglected factor and usually becomes apparent after the second or third playing season.

3. Reseed worn areas of the field with turftype perennial ryegrasses in the spring and fall to insure maximum density of the turf. Seeding can be accomplished with slicer-seeders at other times to help maintain its density.

4. Topdress worn areas with sand to aid in germination and maintain smooth surfaces. Sand particle sizes should fall between the No. 16 and the No. 140 screen with minimum percentages coarser and finer.

5. Mow at least twice weekly so that clippings will not become unsightly. Sweeping is not necessary since grass leaves contribute very little to thatch formation, will supply a significant amount of nutrients which were removed from the soil, and upon decomposition will increase the nutrient-holding capacity of the soil.

6. Carefully monitor irrigation practices. Examine the soil profile to determine that at least half of the water has been removed before reirrigating. If the sand is moist, hold off irrigation for additional days until the need arrives. Excessive irrigation will definitely result in nutrient leaching and restricted root growth.

7. Pest control. There are few pests that affect sports fields in the Pacific Northwest with the exception perhaps of weeds. Broadleaf weeds can be controlled by standard procedures and annual bluegrass (_Poa annua_) can be removed with endothal according to published information from the Research Station. In general, diseases and

insects create few problems on these fields and will not be discussed at this time.

In summary, the writer feels that if the above outlined maintenance procedures are carried out and controlling administration cooperates in the amount of use a high quality field is subjected, we do not have a specific number that we can place on the games such a field will support. The writer strongly believes that fields of this nature will support 35 or more league type contests and some additional use from practice. Practice should be performed on other areas with limited use on the field, however. It is not uncommon for fields of the quality described to support as much as 100 soccer games throughout the entire winter when carefully maintained. Each situation is generally different and weather factors are extremely important in governing this use. Therefore, specific numbers cannot be spelled out. Do the right job and you will find that grass fields are not only more desirable, but are the cheapest in the long run.

DRAINAGE OF ATHLETIC FIELDS[1]

Donald A. Hogan[2]

In the Pacific Northwest, west of the Cascade Mountains, the single most important factor for successful Athletic Fields and Playfields is proper drainage. East of the mountains drainage and compaction have a distinct relationship. Good drainage can only be achieved if all elements that are influential are satisfied. These elements are: (1) Design, (2) Construction, and (3) Maintenance.

Before we discuss these items it is advisable to review the basic principals of drainage. Drainage occurs in the following forms:

1. Percolation through the soil
2. Surface run-off
3. Evaporation

<u>Subsurface</u>

For turf and non-synthetic athletic fields the most important form is movement of the excess moisture through the soil. This is referred to as percolation, which is the vertical downward movement resulting from the effect of gravity. There are two basic forms of action, non-saturated and saturated flow. For unsaturated movement all of the water is transmitted along the surface of the soil particles, being held by molecular attraction, moving from one to the other at the point of contact. In this condition the voids between the particles are filled with air. In saturated flow the water moves mainly through the void

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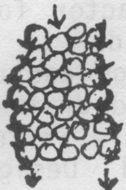
1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Professional Engineer, Seattle, WA.

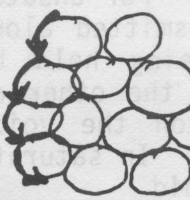
areas. This is undesirable because the air is displaced with water and the soil particles are exposed to a buoyant condition. Diagrammed, these conditions appear as follows.



Unsaturated

Saturated

One can easily see that under unsaturated conditions the water can move downward even when increasing the amount being transmitted. However, when reaching a saturated condition the water will build up on the surface until the water in the voids can move away. This essentially is a backing in the soil similar to a plugged drain. As the particles become smaller, they position much closer together which increases the distance and time the water must move to proceed downwards. Therefore, there are different rates of percolation. The ability for a soil to transmit water is defined as the permeability of the soil. This appears as follows:



Larger Particles

Smaller Particles

One very important barrier that must be overcome before percolation can occur is the transfer of the water from the surface into the soil. This is called infiltration. At very slow rates of infiltration there is a buildup of water at the surface which can produce a saturated water layer over unsaturated soil. Layers of water that exist over unsaturated soils are referred to as perched. This is very common in turf areas where thatch and mat have built up.

Surface

Run-off from turf fields is very slow due to the resistance to flow at the surface caused by plants. This is a condition of saturated flow at the surface. Slopes in excess of 2% are required to effectively move the water. Surface run-off onto athletic fields is undesirable and should always be avoided.

Evaporation

Evaporation is a major contributor to the removal of surface water and the drying effect at the surface. If the turf layer is open and relatively thin, this removal can be very rapid. However, if there exists a thick layer of thatch, the drying will be very slow because of the water holding characteristics of this material. One can envision the effect similar to a sponge in this situation. For effective evaporation there must be air movement. Temperature and humidity have a significant effect on the rate of evaporation.

Athletic Field Construction or Rehabilitation

Unfortunately, the majority of new fields built in our area of interest are incorrectly constructed and therefore function unsatisfactorily. Many are complete failures and require major improvements in the first few years of existence.

Soils

The key to a successful field is the proper soil structure. At most sites satisfactory soils do not exist. Importing special granular material of proper particle sizes is required. This can only be accomplished with strict control of all materials delivered to the project. Where topography does not permit increasing grades, existing material has to be excavated and removed.

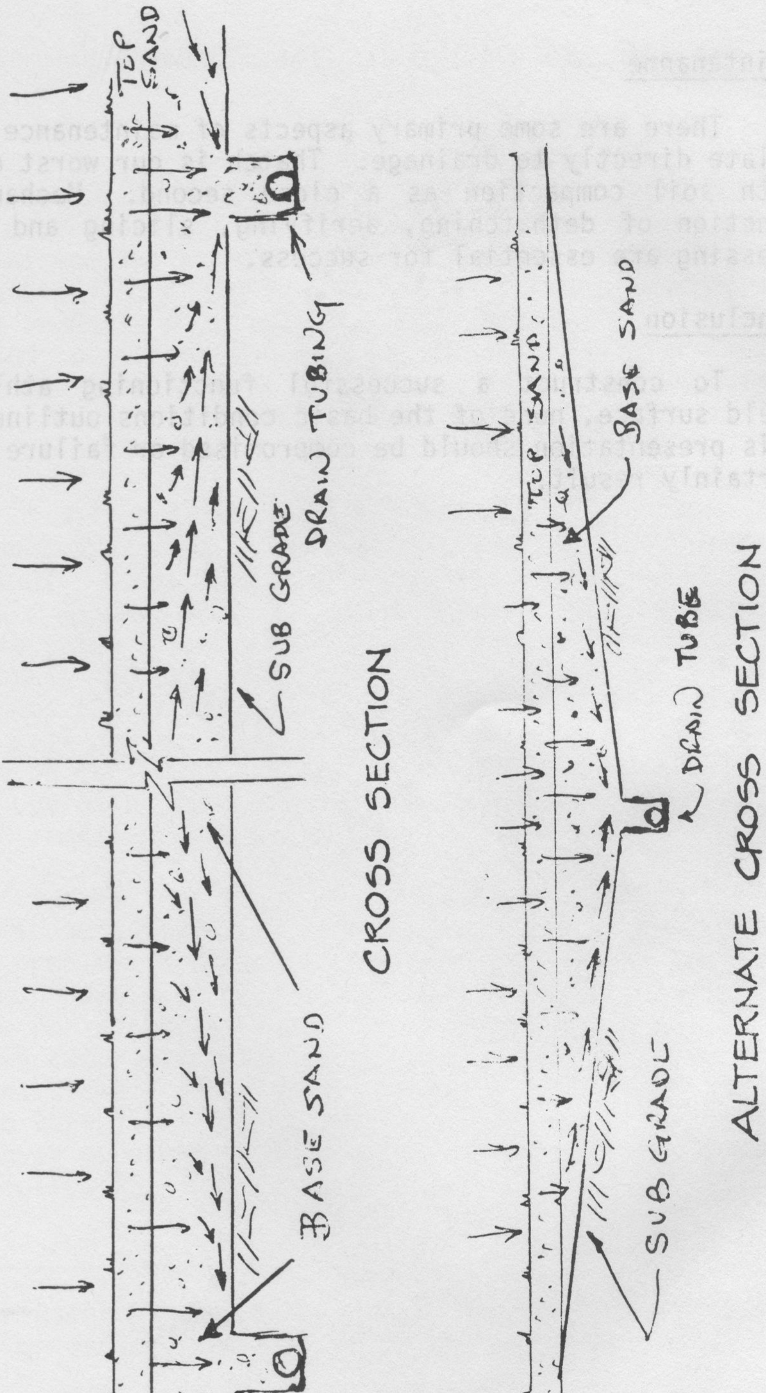
Generally soils composed of particles ranging in size from 1.0 to 0.2 mm are most desirable. A portion of up to 20% may be as coarse as 5.0 mm. However, the amount smaller than 0.1 mm should not exceed 2% of the total weight of the soil. Refer to recommendations of Washington State University Extension SErvice, Dr. Roy L. Goss, Agronomist, for specific recommendations. To reduce the cost of the total imported material, coarser less expensive granular can be utilized as a base under a top layer. Caution should be exercised and do not use pit run or bank run material that is composed of too great a range of sizes and too high a percentage of fine sizes.

Drainage Disposal

Excess water moving through the soil must be free to move away. If the subsoil is relatively pervious, it will seep into the lower water table. If the subsurface is impervious, the water will need to be collected in a subsurface system of perforated drain tubing and piped at an effective grade to a storm drain, ditch or other water course. The depth of the select material is important. For percolation into the subgrade the layer must be thick enough to permit a buildup of water below the surface so as to gravitate downward. For a subsurface drainage system configuration, the strata needs to be at a depth that will result in the gradient lateral movement to the tubing without building back up to near the surface. It also is acceptable to slope the subgrade to permit the water to flow to the pipe so that the amount of sand can be reduced.

Construction Practices

During the construction process care must be exercised so as not to damage the subsurface piping. Imported material must not be contaminated with site soil. In addition, the sand should not be excessively compacted by construction equipment and trucks.



TOP SAND
SUB GRADE
DRAIN TUBING
BASE SAND
CROSS SECTION
TOP SAND
BASE SAND
DRAIN TUBE
SUB GRADE
ALTERNATE CROSS SECTION

Maintenance

There are some primary aspects of maintenance that relate directly to drainage. Thatch is our worst enemy with soil compaction as a close second. Mechanical function of dethatching, aerifying, slicing and top-dressing are essential for success.

Conclusion

To construct a successful functioning athletic field surface, none of the basic conditions outlined in this presentation should be compromised or failure will certainly result.

IRRIGATION OF ATHLETIC FIELDS[1]

C.H. Kuhn[2]

Let us first understand that the irrigation of athletic fields is not a complex matter; it hardly deserves special attention except for one simple fact.... people insist on continuing to try to find ways to violate even the simplest of logical approaches. I am called to present the case of athletic field irrigation with the fervent hope that we can leave the simplistic alone and not strive to find ways to contravene the laws of nature.

I will not take up your valuable time by dwelling on such trivia as quick coupling systems or hose-oriented systems. While these systems still exist, they are slowly sliding into the sunset as we recognize the agronomic value to properly designed automatic irrigation systems. Budget constraints may force you to the lesser systems but as all of you School Administrators know, you will pay the Maker his dues when you attempt to make up for short construction budgets with maintenance and operation budgets that are even more constrained (and sometimes non-existent).

Automatic irrigation systems for athletic fields are today's standard; with that in mind, let us address the problems that arise from this acceptance. The most common complaint arises from those who do not wish to have ANY sprinkler heads on the playing surface. This is an admirable dream and, while not impossible, is so impracticable as to be unacceptable. Remember that I said that it is not impossible; however, I have never been an exponent of Rube Goldberg and have no intention of following his ways.

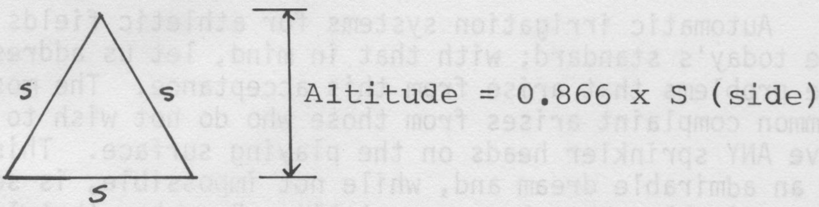
1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ C. H. Kuhn and Associates, Mercer Island, WA.

Before we address the "unique" approaches some have attempted in the irrigation of athletic fields, let us first keep in mind that the irrigation system is there to give an agronomic assist to the grass surface. In proper design we have the option to help the field, not add to the miriad of ever-present problems which already exist, ie. over-scheduling, compaction, lack of maintenance and fertilization, etc. Therefore, any proper athletic field irrigation system accentuates the need for proper UNIFORMITY OF PRECIPITATION. Particularly on our newer sand-organic fields......fields designed to pass water rapidly......we must aim for the best uniformity possible. If we ignore uniformity, we may have stressed areas, areas where the thatch may become saturated or areas where there is insufficient plant food because we have washed the fertilizer down into the sand base below the roots. WE MUST THINK UNIFORMITY!

Uniformity directs us to follow the basic laws of hydraulics and physics:

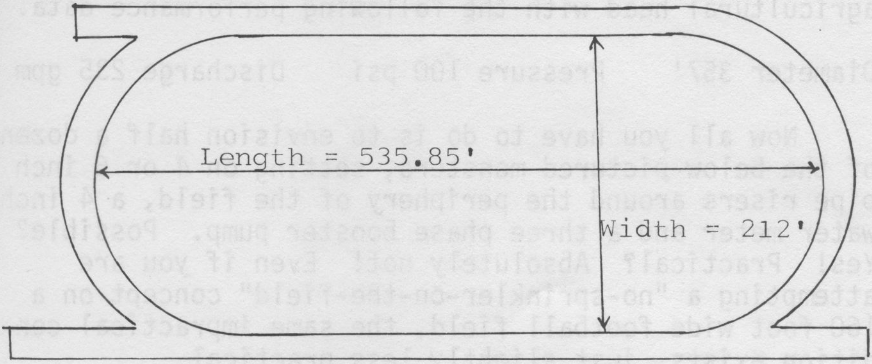
Law 1: In an isocoles triangle (triangle with three equal sides), the altitude is equal to 0.866 of any side.



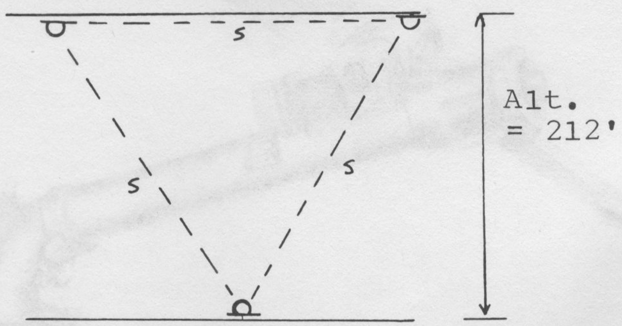
Law 2: For uniform precipitation in a no-wind condition, the spacing of sprinklers should never exceed 70% of the sprinkler diameter (triangular spacing) or 60% of the sprinkler diameter (square spacing).

These two laws are basic; if we ignore them, or if we violate them, we are asking for the negative results of non-uniformity. Let us then apply these laws to an athletic field irrigation system and see what types of irrigation systems we can arrive at.

Let us start out with a very common football field/ soccer field as found within the boundaries of a 400 yard track. The track and field measure out as shown below.



So you say that you do not want any sprinkler heads on the field? Let us apply the laws to this field to see what happens.



Law 1: Altitude = 0.866 x Side; 212' = 0.866 x Side; Side = 244.8'

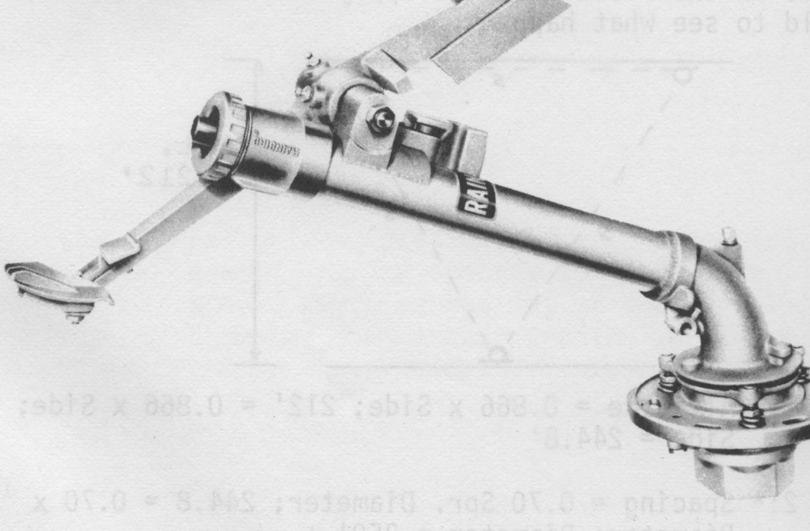
Law 2:* Spacing = 0.70 Spr. Diameter; 244.8 = 0.70 x Diameter; Diameter = 350' $\pm$.

* The 70% of diameter is an absolute maximum for triangular spacing. Some manufacturers suggest less and with slight winds recommend a spacing of sprinkler to sprinkler. The computations above are based on absolute maximums and are not necessarily recommended for your use.

With a sprinkler catalogue in hand, one must now search for a rotor-pop-up sprinkler that has a 350 foot diameter. Such an animal does not exist. Is there any sprinkler that will perform as required above? Yes, an agricultural head with the following performance data:

Diameter 357'   Pressure 100 psi   Discharge 235 gpm

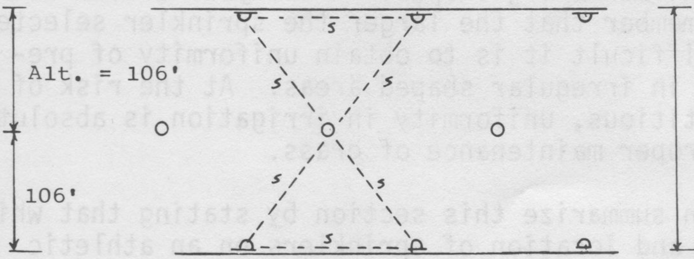
Now all you have to do is to envision half a dozen of the below-pictured monsters, setting on 4 or 6 inch pipe risers around the periphery of the field, a 4 inch water meter and a three phase booster pump. Possible? Yes! Practical? Absolutely not! Even if you are attempting a "no-sprinkler-on-the-field" concept on a 160 foot wide football field, the same impractical condition exists, just slightly less practical.



CONCLUSION

Stop trying to invent a "headless field". Attempts to do so with the largest pop-up rotors on the market have provided nothing more than a system that wets all of the field but in a manner that is so non-uniform as to present serious agronomic deficiencies.

The next question that arises asks whether you can provide a system with a limited number of sprinklers on the field. Let's address this question by applying the same laws as before:



Apply Law 1: Altitude = 0.866 x side
106' = 0.866 x side
side = 122.4'

Apply Law 2: Spacing = 0.70 Sprinkler Diameter
122.4' = 0.70 Spr. Diameter
Diameter = 175' ±

Obviously this approach is quite possible since there are numerous sprinklers of the pop-up variety that will meet this requirement. Again we must stress that the aforementioned conditions are for no-wind and with the sprinklers stretched out as far as technically possible. A typical sprinkler for the aforementioned conditions:

Diameter 186'   Pressure 60 psi   Discharge 70 gpm

There is one drawback to this type of head on the playing surface and that is it's exposed surface diameter .....9+ inches or more. A booster pump is also frequently required.

Most athletic field irrigation systems within a standard track end up with four to five rows of heads (a row on each side and two to three rows in the field). Many times this is a function of the available pressure; more often it is the designers choice since the smaller sprinkler has better nozzle breakup than the large heads and the uniformity is better controlled with smaller heads in the wandering shape of a 400 yard track. It is well to remember that the larger the sprinkler selected, the more difficult it is to obtain uniformity of precipitation in irregular shaped areas. At the risk of being repetitious, uniformity in irrigation is absolutely vital to proper maintenance of grass.

We can summarize this section by stating that while the number and location of sprinklers on an athletic field carries weight, the real purpose of the system is to keep grass viable and healthy. Uniformity of precipitation promotes those conditions above all else.

<u>Full Circle Heads and Part Circle Heads</u>

Sprinkler heads of the size and type most commonly found on large turf areas such as on an athletic field are gear driven or impact driven heads wherein the fulls and part circles heads have the same (or near same) nozzle sizes. Accordingly, a half circle sprinkler will precipitate twice as much water in a given period of time as a half circle head. It is for this reason that we seldom mix arcs on large heads...if we do, we have thrown uniformity to the winds. Occasionally it is possible to space the heads in a manner which will permit using a quarter head of 1/2 the gallonage of a half circle head and tie them to the same automatic valve. Know what you are doing in this area of design before you go out haphazardly. Where possible, keep fulls and part circle heads separate. Recognizing that this may add to the initial cost of the system, it is better to use a few capital construction funds early on than to build in a problem that will create eternal maintenance problems.

Irrigation Cycles

Most new athletic fields are being constructed of sand-organic material over well-underdrained subgrade. When these fields are first constructed, root systems are shallow and nutrient levels are set quite high. Accordingly, irrigation cycles should be established to insure that water is placed at a rate that will permit the dissolved fertilizer to remain somewhere around the root zone. As the grass matures, depth of movement of the water at any one application can increase. The important thing to remember about irrigation is that irrigation cycles should be set to keep the soil at or near field capacity and to replenish the storage as it is used. This does not mean that you continually add minute quantities of water nor does it mean that you give it a tropical rainstorm application once per week. Even with the deeper root zones that we now appreciate with sand-constructed fields and with the greater water storage depth, the granular and free-draining sand does not have the water holding capacity of loams and silts. We need to replace the water used through the process of evapotranspiration regardless of the medium in which the grass is grown. Care must be exercised on sand/organic fields to apply the water to make maximum use of that which is applied. Because sand/organic is free-draining, system operators tend to over-water since there is seldom the tell-tale evidence of standing water so often found in loam/silt fields. When we over-water we waste our fertilizer and dissolved nutrients down the drain tiles. The best determination of amount of water to apply can be arrived by sampling soil plugs occasionally to examine the presence and depth of available water. Then, when applying the water, avoid heavy one-time applications in the same day; rather, use lighter applications several times that evening. For instance, if you need 20 minutes per night, 2 tens or 3 sevens will give you the same total water but will avoid heavy, one-time washing applications. Many field irrigation systems precipitate at the rate of 0.4 to 0.6 inches per hour which is a pretty good rainstorm in anybody's language. Not even grass loves a monsoon.

If your field is of the loam/silt type, the multiple, shorter applications on the same night are even more important. A one time application will undoubtedly create standing water which may remain until morning play starts. Water and athletes create mud through the destruction of the soil structure; each repetition creates more problems. By using three cycles for the daily water need, the first cycle acts as a tool for breaking the surface tension that exists after a day or two of surface drying. By the time the second application is made some 2 to 4 hours later, the surface has been wetted and the next light application can freely move into the close-knit soil. The same applied for the third application. Remember, we are not violating the old axiom of watering deep and infrequently; we are simply making certain that we receive a certain amount that evening and that all of the water is used where it fell. This is just plain common sense. Furthermore, we have found that we use less water when we use the multiple applications on a given night. Get used to this practice by setting the stations at 7 minutes for your early spring watering, just add another start pin for your early summer irrigation and perhaps a third pin for the July-August dry days. Try it, I think you will like it.

In conclusion, let me remind you of something you already know; you are trying to grow grass on one of the most difficult pieces of terrain given to man. It seems that every afternoon there are 40 to 50 athletes out there practicing (and tearing up) and at night and under the lights, formal games of what they practiced during the afternoon. Then, on the next morning, the PE class gets out there and stomps, compacts and wears out more of our turf. And you are expected to keep healthy, thick and vigorous turf under these conditions. You may never succeed totally until you can schedule the use of the fields properly, but you can help stem the destruction by installation of irrigation systems with emphasis on uniformity and by application practices that enhance turf growth and promote sound agronomic practices.

CONSTRUCTION TRIVIA

1. Design system so center of field is irrigated on one valve, then water adjacent rows, then sides.

2. Use triple swing joints for best head adjustment.

3. Locate auto. valves in groups OFF the playing surface.

4. Install spare wires from the controller to remote valve(s), passing through each intermediate valve box.

5. Never allow splices in the 24 volt wires except at valve boxes.

6. Locate controller, if possible, to permit visual observation of system operation.

7. Install irrigation piping laterals in same trench with drains for reduction of first cost. (This is a controversial subject).

8. Install quick coupling valves for ready access to supplemental water.

9. Use booster pumps if necessary to obtain proper sprinkler pressure. Low pressure sprinklers usually equate to poor nozzle distribution and precipitation uniformity.

10. Avoid sprinklers immediately in front of soccer goals.

11. Drain systems by use of compressed air.

12. Insure that installing contractor is responsible for winterizing and spring re-activation of system, at least once for each activity.

13. Insist on complete and accurate As-Built drawings.

14. Use tried and tested products; don't be a guinea pig.

15. Insist on close inspection of system as it is being constructed; buried mistakes seldom show up until AFTER warranties expire.

RENOVATION OF SPORTSFIELDS[1]

Eugene Howe[2]

Thank you for attending this split session of the Northwest Turfgrass Association Conference. You may have noticed in yesterday's fine meetings that most of the topics covered were oriented toward the golf course. It is my opinion that the turfgrasses in parks, school grounds, and athletic fields are also an important part of the turfgrass industry. We are fortunate to have this opportunity to discuss the different needs and problems that your jobs entail. The Program Chairman, Jim Chapman, is to be congratulated for the fine job that he has done in putting this year's program together. Past sessions may not have been of great value to those of you that do not manage, say, a golf course green. I hope that you will benefit by attending this particular part of the program and tell the Board of Directors that you would like to see this idea repeated to meet your specific needs.

Renovate -- Webster's tells us that 'renovate' means, "to make new or like new, clean up, replace worn and broken parts in, repair, to refresh, revive".

The reasons for renovating an athletic field or large turf area can be varied: inadequate design and engineering; improper initial construction; lack of proper maintenance; overuse of the field with no time for the turf surface to rest and heal itself; or a combination of one or more of these.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Sportsturf Northwest, Kirkland, WA 98033.

Of course, an overused, though accurate, excuse for the condition of a turf field is money, or the lack of it. The dollars possibly were not available in the beginning to properly design, engineer, and build a field. Then again, many grants are available to design and construct parks and fields, but no funds put aside for the proper maintenance of the facilities after they are built. In some cases, the budgetmaking bodies that you deal with cannot be convinced that the Northwest really does need that automatic irrigation system or that drainage system to get rid of excess water. Turf managers usually have others in front of them come budget time with 'more important' needs than funding for grounds capital improvements, additional capable employees, and the correct equipment and supplies to properly maintain their facilities.

Athletic field are a capital investment, one that should be supported by those who ask that they be kept in ideal playing condition at all times. Without this support and the necessary funds, the turf manager cannot do his job. Many times they are called upon to do the impossible. If he is not successful in his attempts, the fields and heavily used turf areas are sure to become dangerous and uninviting places to play and be. In my opinion, they will also be more difficult and costly to maintain in this poor condition.

One of my customers, a school district operations manager, describes his district's athletic fields more as 'classrooms' than landscaped areas. He feels that these areas should be considered separately in the type and amount of maintenance they receive as compared with the grounds. This specialized attention is necessary in order for the fields to withstand the tortures of athletic use.

If properly built, maintained, and cared for, the turf surface can give the athletes a safe area in which to participate and play while giving spectators and passersby an aesthetically pleasing panorama to view. Granted, there may be some surfaces that may tolerate the seasonal changes better than a turf surface for the constant playing of some of the more rigorous sports, especially with our Northwest climate when most of the damaging sports are played during the worst possible times. These surfaces also have their negative points in that great sums of money are required to install them and dollars are still necessary to maintain them properly. Once an artificial surface is installed, many consider it a maintenance-free surface when it is not. Replacement costs are usually not considered. The change was made to artificial surfaces because it was thought that finally the ideal solution was finally found. Certain injuries, less than ideal playing conditions, and maintenance costs were considered when making the change from turf. Now a totally different type of injury is now so prevalent on artificial surfaces that most athletes and sports medicine officials agree that maybe this was not the best course of action. Most of the turf field difficulties can be corrected with proper construction and, most importantly, proper maintenance procedures.

A marginal playing surface can be renovated into a decent turf field usually without closing the facility for a year or two to start the construction phase all over again. These renovation projects can be classified either as a major or a normal project. The major project is one that disturbs the entire surface, possibly using a chemical such as Roundup to kill the turfgrasses, possible tilling and subsoiling, installing irrigation and/or drainage, improving the soil properties by bringing in a good sand or sandy-type soil, grading, leveling, and eventual reseeding. This new field should be allowed to go through one entire growing season before it is put into play. The normal turf renovation project starts with a decent field and soil conditions and attempts to improve the turf cover and improve the quality of the soil without the major disruption. The turf cover is usually worn and thin and is in need of a better growing environment and additional turfgrass plants of the improved variety to make a better playing surface. This process is really a concentrated maintenance effort and will allow the turfgrass manager to catch up on the maintenance of the field that may have slipped over the years, which is usually the reason for the turf field to be in its present need of repair. The results of this process can be dramatic and very beneficial depending on the condition of the field from the start, the results desired or expected, the degree of proper maintenance that will follow, and the dollar, labor, equipment, and supply resources available to do the job correctly and swiftly.

The majority of my discussion will focus on the Normal Turf Renovation process. In discussing the separate elements of this type of renovation, I will be using a field that I had complete control of this past year to describe a program. Unfortunately, I will have to describe it verbally without the benefit of slides to show you the work in progress because the field is located on the Trident Submarine Base in Bangor where a policy that does not allow any cameras on base is strictly enforced. This field was fortunate enough to be built quite well in that it has a good drainage system and a decent automatic irrigation system. It is built with native sand from the base and appeared to be graded well. The reasons for it needing a heavy renovation was due to the lack of proper maintenance and excessive use by Navy and Marine intramural football teams. The center of the field was as sandy as a beach with absolutely no turf surviving at all.

The remainder of the field was had and had a crusty layer on the surface. When I saw the site in September the turf was sparse, dry, and yellow. Because of the nature of the governmental beaST, I began my work in mid-November on the demand of the Base Commander. He wanted to see some action on this field at once. I had originally planned to use my Lely Roterra horizontal tiller which uses rotating fork-like tines to stir the surface. The center of the field needed to be loosened up and leveled off again and a fairway aerifier and slicer-seeder used through the rest of the field. While using the Roterra I noticed that it also did a great job on the hard, crusty sod, so I changed plans and used this on the entire field. I figured that as long as the center of the field had to grow from scratch, that the rest of the field would not have trouble keeping up. This tilling keeps the soil in its profile and keeps the sod up on the surface. Some of the pieces of broken sod lands upside down and will not retake, but 80 to 85% replants itself and actually grows much better. The entire field was dragged several times with a flexible tine harrow and rolled. Instead of using the slicer-seeder now, the whole field was re-seeded with a Derby perennial ryegrass using a Brillion seeder and fertilized with a starter fertilizer. Even at that late date the Derby did much better than expected, so I got a good jump on the major work coming up in the spring. After the first of the year and after a professional soil test was taken a fertilizer with minors was applied to this sandy soil. The next month the recommended rate of lime and gypsum was applied. In March an accelerated fertilizing program was begun using both a slow release and fast release nitrogen fertilizer. At this time the first of four topdressings were done. Each topdressing applied 1/4 inch of sand (46 cubic yards) on the entire field and then dragged with the tine harrow. April saw the overseeding of the field with a mix of three improved bluegrasses at 4 lb per 1000 ft^2. The second topdressing followed and the seed and sand were dragged together for good germination. The same process was followed in May with more Derby ryegrass at 4 lb per 1000, the third topdressing, additional fertilizers, and the beginning of regular mowing and irrigating. The irrigation system was charged and checked and was then programmed to run like it never did before. Additional Derby was put into the field with the slicer-seeder in June. It really did not need it, but this process did double duty by flipping the remaining small pieces of upside down sod out of the way of the growing turf, and improve the grain of the field to improve its popular new visual effect. Additional fertilizer was added to keep a good growth rate throughout the summer months. It was mowed twice a week, though a third mowing was necessary at times. Additional fertilizer and the final topdressing finished this project, and its green and healthy turf cover and vigorous root system is ready for use. They were told that the plants are still young and may need some additional help this fall, but the extensive corrections are done. We both were extremely pleased with the results. They actually had the chance to recoup their maintenance mistakes and start over again without really starting over. Hopefully they will continue with the maintenance schedule that was set up.

Though many turf surfaces could use such an extensive renovation job, I have found that most jurisdictions go about the process piecemeal, usually because of the lack of understanding of the procedures and/or the lack of funds. This extensive project makes the uninitiated turf manager uncomfortable about what the result will be, how long it will take to look good, how to keep people off the field and off his back while it is being done, and basically, if the expense is worth the effort.

One school district that I dealt with had considered removing the poor turf on their football stadium and installing an artificial surface. After discussing this renovation program with the superintendent, the school board decided that they could take the large amount of money necessary to install an artificial surface, invest it, and renovate the field every year just on the interest earned alone.

The sub-elements that make up a renovation program should be discussed separately in order to understand what the entire process will accomplish. There is no magical change in the quality or appearance of the turf overnight. There is no reduction of maintenance on the renovated fields. There is an increase of manpower and equipment requirements for renovation, either in-house or through outside contracting, and there will most likely be an increase in maintenance afterwards, which is usually necessary with or without a renovation program to keep the fields in good playable conditions. I base my business theory on the assumption that most jurisdictions do not have the desire to purchase expensive specialized turf equipment to be used a few times and that the members of the grounds crew usually do not have the expertise to do some of these practices correctly and swiftly -- where their time can be more productive doing the many other necessary jobs.

Most crews are spread fairly thin as it is and to increase their workload more would put hardships on regular maintenance schedules.

Soil aeration is a mechanical form of cultivation which loosens the soil and/or removes cores leaving holes in the soil. The coring of a turf field relieves the compaction of the soil. All soils are subject to compaction, some more than others. This is one of the main reasons why fields are being developed on sand. Athletes pounding on a wet field quickly close the pore spaces between the soil particles. It is these areas which carry the air, water, and nutrients to the roots. Compacted soil restricts this downward movement. This, in turn, does not allow the turf roots to go deeper, creating shallow roots and turf that is weak and prove to injury during times of stress. Soil aeration is usually done with a tractor-mounted fairway type machine that pulls plugs in the fall and spring and can be changed to slice deep through the soil in the summer. Additional benefits of this practice, besides the relieving of soil compaction, is the stimulation of root development by increasing the penetration of air and moisture into the root zone; increased water infiltration and surface drainage; provides openings for fertilizers and pesticides; provides openings so sand topdressing can be worked into the soil; and increases the decomposition of thatch. Soil aerification is usually done to a depth of 3 inches. A field can be gone over two or three times as long as the tractor tires do not plug up the holes already made. The approximate cost of soil aerification is \$1.85 per 1000 ft^2.

Turf aerification, commonly know as verticutting or thatching is a process which improves the infiltration of water, air and nutrients into the sod layer. This is accomplished by raking, slicing, or vertical cutting of the turf surface. This process is suggested when a heavy buildup of thatch occurs. Thatch is an accumulation of living and dead stems, leaves, roots, stolons, and plant residue at the soil surface. It occurs when the production of plant material exceeds the rate of plant decay. Thatch seals off the surface inhibiting the movement of water, air, and nutrients to reach the roots. Thatch can also harbor destructive turf diseases and insects. This practice should be done whenever the thatch layer is about 1/2 inch thick, in the spring and/or fall, and should be followed by an application of fertilizer to aid in recovery. At times verticutting is beneficial two times at 90° to each other. Vacuuming and/or sweeping of thatch debris is, at times, necessary. This process can also be coupled with overseeding if done properly. When done at the right times of the growing season, verticutting stimulates growth by encouraging healthy root development and/or tiller and rhizome growth. Problems can also occur when verticutting because the disturbing of the soil at improper times may allow for the growth of weed seeds and/or annual bluegrass. The approximate cost of verticutting is \$2.98 per 1000 ft^2.

Overseeding uses the same process as verticutting by adding another piece of equipment to the rear of the vertical mower. This piece of equipment has discs that follow in the slices created by the thatching blades. Tubes deposit seed at a pre-set rate that drops down the discs and into the soil, usually at a depth of 1/4 inch. This way of introducing seed to the field is superior to broadcasting because the seed is driven into the ground to make the critical contact with the soil for germination. These discs are spaced three inches apart so, at times, two trips over the field will be beneficial. If the overseeding is to be coupled with the verticutting process, it is usually done on the second pass of the verticutting. If the thatch debris is to be removed, it must be done before overseeding. The cost of the overseeding is the same as the verticutting with the addition of the cost of the seed desired.

Effective topdressing of large areas is relatively new. This process has been used on golf course putting greens for many years with outstanding results. Topdressing is the distribution of an even layer of a material (usually sand) over the turf. This, when following soil and turf aerification, improves the soil characteristics and provides an effective growing medium for turf plants and helps reduce thatch. Other benefits are noticed after several topdressings such as: the levelling of irregular surfaces, a new base for turf plants to grow through, thus, in time, improving the drainage and downward movement of nutrients, air, and water, and the improvement of turf texture and density. The topdressing material should conform with the existing soil material except when the field is on inferior soil. In this case the topdressing material must be modified to improve the soil structure. Once the correct material is established, it should remain constant. The number of topdressings an area receives should be dictated by the severity of the problems it is trying to solve. At no time should each topdressing exceed 3/8 inch in order to protect the turfgrass plant trying to emerge through the material. Several light topdressings are better. The field surface should be dragged afterwards to help fill in the low areas. Sanding trucks normally cause more problems when used as topdressers by increasing compaction and making tire ruts to fill in. Fertilizer spreaders can be used for topdressers when properly outfitted. This system has worked for some and has failed for others. It takes a long time and puts the material down at a very light rate per pass. There are walk-behind and tractor-drawn machines that are specifically made for this purpose. I have put down 46 cu. yd. on a football field by myself in 6 hours with a tractor-drawn unit. This process costs approximately \$10 per 1000 ft^2 complete or \$7.50 per 1000 ft^2 when a tractor and operator is provided to assist. This does not include the topdressing material.

There is a gray area between maintenance and renovation. Certain maintenance practices can reduce the need for constant renovation. One misconception that I have run across is allowing the turf growth to get up to knee height when the field is not in use. The idea being that the longer the turf goes up, the deeper the roots go down. This may be true to a height of up to 3 or 4 inches, but to let the turf grow taller is actually detrimental. This weakens and thins the turf stand, the opposite of what is intended. Turf should be mowed at the same height all year long, athletic fields from 1-1/2 to 2 inches.

One other example is attempting to control annual bluegrass in athletic fields. Annual bluegrass is an indicator of poor maintenance practices. This weedy grass is difficult to control and its presence in this situation is undesirable. The shallow root system and inability to produce rhizomes and stolons will not allow annual bluegrass to recover from injury or stress. This grass thrives on wet, compacted areas so athletic fields are usually an optimum residence. Bare spots in the field, either by tearing or desiccation, can spread to desirable areas. Both pre-emergence and post-emergence programs are available. Fertilizing programs should be set up and followed, usually after a complete soil test is given. This test will also assist the turf manager by recommending other soil amendments to apply, such as lime and/or gypsum and the amounts. Another maintenance procedure that eventually leads to turf renovation is irrigation, or, actually, the lack of it. Turf requires 1 inch of water per week as a rule of thumb. If nature does not provide us with this amount, we must give a hand by irrigating to keep the turfgrasses growing vigorously throughout the drier months. This amount of water should be constant. It does no good to begin watering the turf in August after it has gone dormant. This practice does nothing but waste water, a practice that should not be tolerated. I believe that water can actually be saved if the turf is irrigated properly throughout the spring and early summer before the hotter and drier months. The frequency of watering is usually determined by the soil structure with a heavy watering into the root zone being best. Overwatering can be as detrimental as underwatering causing drainage problems, destroying the soil structure, encouraging shallow root growth and annual bluegrass dominance.

The timing of the normal turf renovation projects is sometimes dictated by field use and demand. Baseball fields can be worked on it the late summer and early fall. Soccer popularity makes it necessary to work on the fields whenever possible. Overseeding can take place to the end of October and can begin in March. Topdressing can be done during any month if the conditions are right. Soil and turf aeration are best done in the spring and fall when the turf is growing actively. Football fields can be aerified after the season is over if there is no surface water. The center of the field can be overseeded before the last two games are played so that the athletes can work the seed into the ground. Remember that bluegrasses take three weeks to germinate so late season overseeding should be limited to the ryegrasses. A late fall and mid-winter application of fertilizer is helpful for the turf to get a quick start on the upcoming growing season. Two final ideas on renovating are to concentrate on the center of your fields where most of the action and damage occurs. Also, one problem that exists on almost all fields is the compaction of the area beneath the depth reached by the aerifier tines. The one tool that can fracture and break up this hard soil is a tractor-drawn subsoiler. This tool does cause some damage to the surface, but the benefits outweigh the problems, especially when it is used before a normal renovating program.

One final note on renovating. These projects take time to plan, to arrange, and to schedule. Please keep in mind that the renovation season is actually quite short. It is best to not wait until the turf needs help because it is then sometimes too late. At times specifications, bid documents, and signing of contracts are necessary. Wintertime planning for spring renovation should be done instead of waiting. Do not forget the total needs of your athletic fields and large turf areas. Do not rest on the laurels of a good season. Do monitor the condition of your fields constantly. And do remember that renovation is possible to "make new or like new, replace worn parts in; repair, revive", usually without limiting play or closing the facility.

CONCLUSION

In closing I would like to suggest that the turf managers of athletic fields, parks, and other large turf areas become more involved in the Association. The past conferences have been structured toward the golf course only because the golf course superintendent has been the active element. It is only natural that the Association conferences follow those who lead it. The first year of a split conference idea is a good chance to increase the information that you need to help you in your job as a turf manager. This will only happen if you both take part in the Association AND pass the word on to others about the benefits derived from being a member and attending these fine conferences. There is much to be learned in this field and this forum is the best way to understand the many facets of turf management. The education of those who manage turfgrass areas is very important. It is their jobs, in turn, to educate those people who manage the purse-strings of the facilities that they manage.

Many of you might not know, or might not have visited the Western Washington Research and Extension Center located in Puyallup. Much of their research concerns golf course turf management. In reality, their management of fairways should be identical to your management of parks and large grounds. Their management of tee areas should coincide with your management of formal athletic fields. This Research Center is supported by your tax dollars and part of your Association membership fee is earmarked for turf research. This service is there for your use so you should use it. Again, thank you for coming and participating. Hopefully you have learned something new about turf, athletic field renovation, and the Northwest Turfgrass Association. Turfgrass is beneficial to all of us by contributing to our visual aesthetics, enhancing our environments, supporting our economy, and providing a pleasant place for people to gather and enjoy themselves, not to mention a great place for many people to work. These areas are not only golf courses, so take pride in your turf areas and in your skills as their managers.

BUDGET CUTS AND THEIR EFFECTS ON MAINTENANCE[1]

Kenneth L. Worcester[2]

It is well known that the effects of budget cuts on maintenance are devastating. Generally, it seems, the first things to be cut from a budget are equipment acquisition, new positions, and, all too often, temporary hire or summer help.

The effects of these cuts will usually appear in areas ranging from increased downtime and maintenance costs on older equipment to increased workloads in departments that are usually already understaffed.

Unfortunately, some of the worst maintenance problems arise through the absence of summer employees. The absence of these employees can affect whole programs and services, such as athletic field set-up and accomodation of large picnics, as well as maintenance and grooming of landscaped areas.

In dealing with budget cuts, a grounds manager should remember that many household budgets within his jurisdiction are probably tightened up also. Keeping this in mind, sympathy should not be expected and cuts in services should not be vindictive or made just to "pay back" the voters. However, visible cuts should and must be made.

In parks, as well as school districts, the number one priority is generally placed on athletic fields due to the number of people that participate in athletics either as players or spectators.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Parks Department, City of West Linn, Milwaukie, OR.

Even if we cannot provide services such as field marking and set-up, it is our primary responsibility to provide safe and "playable" athletic fields. I have found that almost every coach, teacher and athletic association will cooperate in any way they can to provide their teams with the best playing areas possible. It may take some training of set-up techniques and special arrangements to supply volunteers with drags, line markers, line cutters and other equipment but it is well worth it when measuring manhours saved by a maintenance department through any given athletic season.

Another maintenance practice that reflects obvious effort to save money is one that I consider "defined maintenance". This is done by limiting the strict mowing, fertilization and irrigation schedules to the "live", end zone and sideline areas of a football field. This results in a defined athletic field, separated from the rest of a large area in a manner that will rarely draw criticism.

Due to the liability involved, I have to rank play equipment, restrooms and wading pools as second priority and recommend that no cuts be made in maintenance practices in such areas. Nor should this responsibility be left to volunteers. The only way to avoid maintenance in this area is by complete closures. Such actions rarely set well with the public and are often looked upon as "political blackmail".

Third in priority ranking is the maintenance of picnic areas, shelters and landscapes around public buildings. Fortunately, these are areas where the efforts of volunteer groups can be highly utilized. Such organizations as Lion's Clubs, Dad's Clubs, "Friends" groups, Boy Scouts and neighborhood groups, to name a few, are more than willing, if not anxious, to participate in community service projects. These activities, again, may take a lot of coordinating, promotion and supervision to be successful. A manager utilizing volunteers should also realize that they will not, and should not be intended to, replace employees. If volunteer roles can be kept as simple as possible, there is a good chance that projects will be successful.

Paid man-hours will be saved and, as a bonus, good feelings toward the district will be generated.

Last, and least, of our priorities are future park sites, public open spaces, and street meridians that are generally neglected except for occasional mowings to alleviate fire and visual hazards.

Obviously, the best way to deal with budget cuts is to avoid them. Hopefully, this can be achieved by preparing more detailed and in-depth budgets. For instance, large miscellaneous line items are too easy to cut. Whenever possible, list dumping fees, small tools, or any items that might come out of a miscellaneous account, under a separate line item including with it a brief explanation. Include, as their own line items, specific improvements for each area considered such as major renovations for ease of maintenance. Basically, any line item that can be broken down into smaller ones should be. This should hinder a budget committee's ability to cut "off the wall" figures or to round out line items.

TRIPLEX MOWING OF LARGE TURFGRASS AREAS[1]

Dr. J.R. Watson[2]

For the past number of years there has been increasing emphasis on reductions in maintenance costs associated with golf course operations. Since 1974 cost reduction programs throughout the turfgrass industry have been intensified. And rightly so, for the increased cost of supplies, materials and labor have caused golf course superintendents to zero in on those areas which provide the greatest opportunity for savings. Manufacturers, for the most part, have continued a policy adopted many years ago: built equipment that will "cut more acres per day per man".

Yet there are other aspects of the cost-benefit relationship in golf course turf maintenance that are often overlooked. Among the more important, for which members and players seem to be more than willing to pay, are playability, aesthetic appeal and pride of belonging, or the sense of satisfaction from being associated with something unique, different and superior. All are facets of superior turf quality with all that the term implies. And, an increasing number of private clubs are funding the production of such turf on fairways from Chicago to New York; from Toronto to Cincinnati.

<u>Poa annua</u> continues to be <u>a</u> (if not <u>the</u>) major weed that infests bentgrass in the cool humid regions and in the transition zones between cool and warm season grasses. Efforts to control or eliminate this pest are legendary, continuing; and, perhaps, never ending.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Vice President, Agronomist, The Toro Company, Minneapolis, MN 55420.

Loss of Poa annua with subsequent invasion of crabgrass is a routine annual occurrence on many fairways in the transition zone, especially those planted to bentgrass - those cut lower than 1 to 1-1/4 inches. Often, when summer stress is extreme, large areas of fairways are devoid of green healthy turf. Golf course superintendents, and research and extension personnel have long sought solutions to this problem with minor success.

Some four (5) to five (5) years ago Cal Gruber, Superintendent, Cold Stream Country Club in Cincinnati, observed a marked decrease in Poa annua with a concurrent increase in bentgrass following use of triplex mowers on approaches formerly cut with 7-gang fairway mowers. In fact, the results were so outstanding that the program was expanded to include two (2) particularly troublesome fairways. And, then almost immediately, to include all fairways! Results of this program have been very significant and of keen interest to golfers and to superintendents from a number of locations. Many clubs have launched similar programs. Cal; Al Muhle, The Country Club, Cleveland; Ted Horton, Westchester Country Club, New York; and others have presented papers and discussions of their programs involving the use of Turf Pro 84's and in some cases, Triplex Greenmasters. Some 12 to 15 clubs in and around Cincinnati, Chicago, Toronto, Cleveland and New York have embarked on the program since Cal's initial success. All have been tremendously pleased and state their memberships would not permit them to return to older programs.

The most significant result in all cases has been a substantial increase in bentgrass at the expense of Poa annua - from 35 to 85% in 2 years for Cal Gruber and a definite "visible increase" in the case of Gordon Witteveen, Board of Trade, Toronto after only one season. Equally important for a number of clubs in the Cincinnati area, fairways have grass, good grass during July and August. As Rick Grote, Terrace Park says, "my members think I am a magician, they are playing on bentgrass in July and August rather than bare fairways with colonies of crabgrass." Paul Meyer, Ft. Mitchell Country Club and Mike O'Connell, Maketewah, have successfully converted extreme slopes to bentgrass; where formerly, Poa annua and crabgrass dominated the sward. Recognize that this area is subject to extreme heat stress and high humidity during the summer; and, that the name "crabgrass belt" was not applied without good reason. Conditions are not as extreme in New York, Cleveland, and Toronto; nevertheless, superintendents report the same golfer satisfaction and similar increases in bentgrass.

Heights of cut vary from approximately three-eights to nine-sixteenths inch. Golfers love the lower height, the enhanced fairway striping and the general "playability" resulting from the use of triplex mowers. They are, obviously, most supportive of the program, and seem to find the additional funds to acquire the necessary equipment. Paul Meyer has had to raise the height of cut on his more severe slopes. Balls hit onto the front slopes were rolling back into the valley and, as a result, an excessive number of divots were being taken - looked like a tee!

In most cases the clippings are collected. This removed the seedheads of Poa and eliminates this source of re-infestation. Also, clipping removal improves the grooming and helps to sanitize the fairways. Some, Paul Meyer for example, believes removal eliminates the heat of decomposition and thus minimizes stress. The loss of nutrients from clipping removal is somewhat inconsequential. The major problem associated with clipping removal is that of disposal. Cal has a very large compost area, Al uses a sanitary dump box and has them hauled away once per week. Gordon Witteveen scatters the clippings in the rough. Space, odor and the sheer volume are problems associated with composting. Collecting from the mowers and transport to compost piles and sanitary dump boxes is time-consuming. Disposal in adjacent turf areas seems to be an ideal solution.

Less soil compaction and reduced sheer or turning friction from the smaller, lighter weight units as opposed to that delivered by the standard fairway mower is given the major credit for the decreases in Poa annua. However, most superintendents also are cutting back on fertilizer and water - as much as 50% in some cases. Gordon Witteveen is applying smaller amounts of fertilizer more frequently to gain better control of growth to avoid growth surges. All of these factors contribute to the increase in bentgrass. The actual impact of each as well as the interacting effects of one on the other need to be researched and documented. Dr. John Street, Ohio State University, has initiated demonstration studies this summer. To date results have not been tabulated.

Most, but not all, are reducing the size of their fairways. Gordon has reduced his fairway area to 17 acres. He cuts a 15 foot intermediate rough at a height of 1-1/4 inches. Ted Horton has reduced his fairways from 30 to 21.5 acres.

Cost of mowing with triplexes rather than standard units appears to average between 7 and 10,000 dollars per season. Most use either 3 or 4 triplexes. Some mow three times per week and some four times. Ted Horton shows a labor cost difference of $6,480.00 ($12,150 vs $5,609) for a total annual cost difference of $9,133.00. Denny Warner at Kenwood employs retired workers, pays them $3,50 per hour, cuts only twice per week and believes that this approach, coupled with the reduction in fertilizer and water, accounts for 80% of the cost differential. He feels the extra 20% is more than justified by the enhanced aesthetic appeal and golfer satisfaction.

While most use TP84's a few use Triplex Greensmowers. Denny Warner uses both, depending upon terrain. Gordon reports that he and Ken Wright, National Golf Course, Toronto, use Greensmowers exclusively. They made the decision this spring and are "glad we decided on Greensmowers." "On the GM3's you can still hear the birds as well as approaching golfers."

One further step that should be mentioned with respect to the Board of Trade. Gordon has been topdressing his fairways with sand since he initiated triplex mowing this spring. He uses 75 tons for each dressing (17 acres). He has made two applications this season and plans a similar program for next year. "Our members are ecstatic; and, when their guests play Board of Trade, keep asking: why can't my club play as well." Gordon believes it is a matter of time until most clubs -- private clubs -- will follow suit.

SUMMARY

Triplex mowing of fairways became reality some 3-4 years ago when Cal Gruber initiated the program at Coldstream Country Club in Cincinnati. Since then many have followed suit.

The major advantages cited by superintendents who follow the program are:

- golfer and membership satisfaction.
- aesthetic appeal - lower height of cut and striping.
- improved playability - smoother, grain-free surfaces.
- better grain control as result of ability to make cross and angular cuts
- reduced soil compaction
- reduced turning friction
- increase in bentgrass
- decrease in Poa annua
- seed removal of Poa
- less fertilizer - favors bentgrass
- less water - favors bentgrass

Disadvantages may be cited as:

- increased cost - upwards of $10,000 per year

- collection and disposal of clippings

- may be need for topdressing

- clipping removal may necessitate additional fertilizer as time goes on.

Triplex mowing of fairways has been quickly accepted on private clubs irrespective of the magnitude of their budget. There is a need to research and to document the "whys" associated with the practices.

PUBLIC FUNDING FOR TURFGRASS PROGRAMS IN DIFFICULT TIMES[1]

Dr. J.C. Engibous[2]

The title of my assignment forces me, at some point, to talk about financing, and I shall, but not without a good deal of apprehension. I have been around the circuit enough years to fully realize that a discussion about funding -- and especially if the picture is far from rosy -- is not one to either bring people flocking in or to remain keenly interested or awake once the story unfolds. Therefore I will tell it like it is, but will keep it mercifully short. In return, I ask you to bear with me, and neither boo nor snore.

There should not be a single individual in the United States past the age of reason who is not aware of the fact that the 1980's are drastically different from the 1970's. Or the previous two decades, for that matter. The differences did not appear suddenly; much advance notice was given for most if not all of them. An example: the steady shift in the age of our population, with people living longer and fewer babies being born. The result: we all now realize that Social Security is in serious trouble and must be drastically revised, if for no other reason than the young people today will fact an outrageous burden to carry the system during their working careers. People with foresight saw it all coming, but most of us woke up in the late innings of the ball game.

In many respects public education rushed into the 1980's without adequately reading the signs. The cooling of the economy that came with confrontation with

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Chairman, Department of Agronomy and Soils, Washington State University, Pullman, WA.

runaway inflation, and the subsequent recession certainly accelerated and deepened public and especially higher education's crisis. But I submit that the warning signs were up several years ago, and the declining birth rate was but one of them.

So much for background. Let me get down to cases, and I'll get to the turf industry in time. I state the following as my own perception of the situation, and am confident that it is not far from the truth. I'll use my own state of Washington as my example, but am fully confident that the other Northwestern states are really no different, and most of the rest of the country is following suit. The situation is this. Our politicians and legislators are hearing a consistent story from the citizens: "I know state revenues are down. Do what you have to do in Olympia to balance the budget. Don't bother me with the details, I've got my own problems. Just remember one thing, don't you raise my taxes."

Given that ultimatum, I wonder why anyone is willing to run for office. Unless John Q. Citizen relents on his tax stance or the politicians gain the courage to administer the castor oil of increased taxes, we will see public services -- including teaching, research and extension -- continue to decline, perhaps even in the face of a national economic upturn. My concern is that our highways, schools, universities and aid to the truly needy -- like the Social Security system -- will deteriorate so far before public awareness of the problem develops, that the cure is too costly. If that happens, the United States will suffer a severe setback, and our children and grandchildren will be unfairly burdened, indeed.

But the facts remain. We in public service, and Higher Education is a public service, have had to adjust to budget reduction after budget reduction for the past few years. Let me take a few moments to relate how Washington State University has reacted to changing times and financing, for it will lead to the College of Agriculture's response, and the impact on turf programs.

Our administration recognizes that, as a comprehensive research, land-grant institution, Washington State University has the three major missions of instruction, research and service to the citizens of the state through agriculture, engineering, and other extension programs. Further, the University accepts its charge and responsibility to provide and maintain excellence in these major functions and their associated activities.

Those of us in Agriculture are indeed heartened by our Central Administration's rededication to its land grant mission and to excellence in performance. The health and success of Agriculture, Washington's largest, fastest-growing and most stable industry, is highly dependent upon the cooperative system of research, instruction and extension within the College of Agriculture and the strong support of the entire University.

Let me remind you of our agricultural research mission, which is to produce new knowledge and applications of existing knowledge that benefit all people of the state. Four major programs are involved:

1. Maintaining an adequate supply of food and fiber
2. Natural resource management and conservation
3. Human resources and community development
4. Maintaining a quality environment in rural areas

Our programs of teaching, research and extension in turf quickly identify with every major program in this definition. That point cannot be dismissed or ignored. But before I discuss the turf program in detail, a word is in order regarding the University and College of Agriculture response to lower funding levels, and yet maintaining selective excellence. The University has initiated some consolidations -- men's and women's athletics were combined, as will be the Colleges of Agriculture and Home Economics. Direct aid to Intercollegiate Athletics and University Development was reduced; these groups were instructed to seek more of their support outside the University. The College of Agriculture cut support to the equitation program. Our own Department of Agronomy and Soils closed out its Soil Testing Service to farmers and gardeners.

Let me return to the examples of athletics and University fund raising, for a similar message relates to Agriculture and to turf management. The message is simply this: there is no longer enough public funding to maintain your level of program, let alone expand it. You must go to the initial recipients of your efforts for equal support or more support than in the past.

We are fortunate in Washington to have a well-organized and functioning commodity structure. The industries associated with tree fruit, potato, wheat and a host of other crops have a history of supporting research -- and to a lesser extent, teaching and extension -- directed towards their immediate self-interest. We are giving the commodity commissions the message of the 1980's: Your support must be increased significantly if programs are to continue in size and quality. We have no choice. Agricultural Research funding a Washington State University during the 1970's decreased 3% annually in constant dollars, and the 1980's look even bleaker.

In turf we have been fortunate. In addition to your steady financial support, we were able to increase the scientist-specialist input at Puyallup to two full time equivalents (FTE). We were able to replace Professor Al Law at Pullman with a turf specialist, Dr. Bill Johnston. Yet, during the six year period 1976 through 1981, before these changes took place, the <u>total</u> funding directed to research projects in turf management dropped from $261,100 to $146,139, or 44%.

Can any of you draw a different conclusion from mine for funding turfgrass programs in these difficult times? Washington State University has redeclared its land grant mission and the College of Agriculture is dedicated to excellence in its programs which embraces turfgrass. But with the mood of the public and the politians, and the slowness of economic recovery, there is no other answer to the question of saving the best turfgrass program in the Northwest, and one of the top ones in the nation, but greater financial and moral support from and through the first recipients of that program -- you, the turfgrass industry. Thank you.

WEED CONTROL IN WOODY ORNAMENTALS[1]

George F. Ryan[2]

Our research on weed control in woody ornamentals has been directed primarily toward control during production in the nursery. However, most of the herbicides that are useful in the nursery are the same ones that are used in a landscape planting of shrubs and ground covers. Also, we had considerable experience with weed control in the landscape during a 5-year period from 1974 to 1979, when we did a cooperative study with the Washington State Department of Transportation on weed control in ornamental plantings in highway rights-of-way. Some of my discussion here will refer to results from that research. My cooperators in that work were Russell N. Rosenthal and Robert L. Berger of the Department of Transportation in Olympia.

One herbicide that has been used for many years in nurseries and landscapes is simazine (Princep). It has been economical to use and has controlled a broad spectrum of weeds when applied preemergence. It is tolerated especially well by narrowleaf evergreens, but also by a large number of broadleaf evergreen and deciduous plants. Susceptible plants include lilac, privet, euonymus, forsythia, sumac, honeysuckle, and azalea.

Simazine is substantially inactivated by adsorption on organic matter, and in our highway right-of-way study we used high rates of application to overcome this effect in areas mulched with bark. Our rates were high enough to cause chlorosis on some of the more susceptible kinds of plants. In some plots we used napropamide (Devrinol) in combination with simazine to broaden the weed spectrum, and we observed that the chlorotic symptoms from simazine were less severe in those plots.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Horticulturist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

Oryzalin (Surflan) had a similar effect. Later greenhouse and laboratory studies with privet confirmed that napropamide reduces the amount of simazine taken up by plants. This information may be helpful around plants that are somewhat susceptible to simazine injury.

Napropamide and oryzalin are two preemergence herbicides that are especially effective against annual grasses. They also control some broadleaf weeds including redroot pigweed (*Amaranthus retroflexus*), lambsquarters (*Chenopodium album*), common chickweed (*Stellaria media*), knotweed (*Polygonum aviculare*) and common purslane (*Portulaca oleracea*). Where either of these herbicides is used alone, without supplementation with another preemergence herbicide, some kinds of annual weeds will appear. This will require mechanical or hand weeding or spot spraying with one of the postemergence herbicides that will be discussed later.

Alachlor (Lasso) and metolachlor (Dual) are other preemergence herbicides with a weed control spectrum similar to napropamide and oryzalin. Registration of the EC formulation of Lasso is limited to juniper and yew because it can cause burning of foliage of broadleaf evergreens or deciduous shrubs if not washed off with irrigation immediately after application. The granular formulation can be used on more kinds of plants because it will not burn if it is applied on dry foliage and the granules are washed off with irrigation. Dual is registered for use on a number of species, either separately or in combination with Princep.

Other herbicides that are registered for use in ornamentals and that control annual grasses and some broadleaf weeds are bensulide (Betasan), chloramben (Ornamental Weeder), chlorpropham (Furloe, Chloro IPC), DCPA (Dacthal), diphenamid (Dymid, Enide), EPTC (Eptam), naptalam (Alanap), and trifluralin (Treflan). Either because of their short period of activity or their lack of control of enough broadleaf weeds, these have been less useful in western Washington than some of the other chemicals discussed here.

Oxadiazon (Ronstar and Ornamental Herbicide 1) is a preemergence herbicide that has been especially useful in nursery containers the past few years because it controls bittercress (Cardamine oligospermum), which at one time was one of our worst weed problems in containers. It is effective against a broad spectrum of weeds but does not control common chickweed, mouseear chickweed (Cerastium vulgatum) or birdseye pearlwort (Sagina procumbens), all members of the pink family. We recommend the combination of oxadiazon plus napropamide for use in nursery containers, and this combination also looked good in a landscape situation in our highway trials. Both chemicals are available in granular formulations, but only napropamide is available as a wettable powder. Oxadiazon must be applied on dry foliage and washed off with irrigation before dew or light rain dissolves the chemical and causes burning.

Oryzalin can be used with oxadiazon in the same way as napropamide for controlling the chickweeds and pearlwort. Control of annual grasses is improved with the addition of napropamide or oryzalin. Instead of applying two herbicides at the same time, application of each herbicide separately at the proper time to anticipate the particular weeds it controls best may be desirable in some cases.

A preemergence herbicide that has become available recently for use in dormant narrowleaf evergreens is oxyfluorfen (Goal). It is especially useful because it controls common groundsel (Senecio vulgaris). This weed is not controlled well by most of the other herbicides. A biotype that is resistant to simazine and other triazine herbicides is present in much of the Pacific Northwest. Oxyfluorfen even has fairly good postemergence activity on small seedlings of common groundsel and several other kinds of weeds. Its registration is limited to dormant conifers because spray applications of the EC formulation may cause leaf burn on other plants or on actively growing conifers, except at very low rates in conifer seed beds.

Ornamental Herbicide 2 is a granular formulation combining oxyfluorfen and another chemical (pendimethalin) to control a broad spectrum of annual weeds. This product has become available for the first time this year. Our research with it this season in nursery containers indicates fair to good control of the weeds included in our trials. These are barnyardgrass (Echinochloa crus-galli), common groundsel, common chickweed, and birdseye pearlwort. There is no phytotoxicity apparent on azalea, rhododendron, cotoneaster, euonymus, or Japanese holly. We have not completed our determination of whether there were any effects on plant growth, as measured by fresh weight at the end of the growing season, but there are no obvious effects so far. As with oxadiazon, it is essential that this granular combination be applied on dry foliage and washed off with irrigation before it becomes wet with dew or light rain.

Another herbicide that has been in use for many years in nurseries and landscapes is dichlobenil (Casoron). It controls a broad spectrum of annual weeds and is tolerated by many woody plants. Some of the kinds that are notably susceptible to injury by dichlobenil include mugo pine, fir (including Douglas-fir), hemlock, Japanese holly, heather and dogwood.

Information about the preemergence herbicides that have been discussed here is summarized in Tables 1, 2 and 3.

In addition to its preemergence activity, dichlobenil has postemergence activity on some weeds. It controls field horsetail (Equisetum arvense) as long as a high enough concentration of the chemical is maintained at the soil surface to prevent growth of the horsetail shoots. A treatment may last two or more years if application is followed by mechanical incorporation or mulching with bark or sawdust.

Horsetail also can be controlled, usually for one season, by spraying with amitrole (Cytrol, Amitrol-T). Amitrole also is useful for controlling established patches of clovers and related legumes, if care is taken to keep the spray off the foliage of ornamental plants, and a minimum amount of spray goes onto bare ground where it could be leached into the shrub or tree root zone.

Many other perennial weeds, including perennial grasses and also woody plants such as blackberry, can be controlled by careful spot spraying or wick application of glyphosate (Roundup). Timing and rate of application are important for success in root or rhizome kill with glyphosate to prevent or minimize regrowth. The label should be consulted for the rate and best timing for a particular weed problem. Contact of the spray with foliage, green bark or root suckers must be avoided to prevent translocation of the chemical to the shrub or tree growing points, where stunting or dieback may result. Not all perennial weeds are equally well controlled by lyphosate. Some require more retreatment than others, and some are controlled better by other herbicides, such as amitrole, which was suggested for field horsetail and clovers.

Quackgrass and other perennial grasses can be controlled by a fall (November) application of pronamide (Kerb). It can be applied over shrubs or ground covers, and allowed to penetrate the grass root zone with winter or early spring and then it will turn yellow and die. Pronamide is strongly adsorbed on organic matter, which makes it ineffective on mulched or highly organic soils.

Paraquat is a postemergence herbicide that can be used as a "chemical hoe" for spot spraying of small annual weed seedlings that have escaped control by a preemergence treatment. It has no more than a temporary effect on most perennial weeds by killing the top growth, but it does kill or severely injure the crown of some kinds.

Glyphosate is useful for preparing a site for planting if enough lead time is allowed. In our highway landscape research we started application of glyphosate in May or June, with one or two repeat applications in July, August or September. Planting was done in October or the following March or April. Perennial grasses and perennial broadleaf weeds such as field bindweed (Convolvulus arvensis) were nearly eliminated from the planting area by this procedure. Field bindweed is one of the more difficult perennial weeds to control, and several repeat applications usually are required.

Information about the postemergence herbicides discussed here is summarized in Table 2.

In every herbicide use discussed here, the label should be read carefully for information on rates, how to apply the material properly, any precautions or limitations on its use, and the need for water following application.

Table 1. Some common annual weeds, with herbicides suggested for control.

Weed species	Herbicides: Control	Herbicides: Partial control
Annual grasses	Casoron, Devrinol, Dual, Lasso, Surflan	Goal, Orn. Herb. 1 & 2, Ronstar
Bittercress *Cardamine oligospermum* (*hirsutum*)	Casoron, Goal, Orn. Herb. 1 & 2	Devrinol
Chickweed, common *Stellaria media*	Casoron, Devrinol, Princep, Surflan	Goal
Chickweed, mouseear *Cerastium vulgatum*	Devrinol, Princep, Surflan	Dual, Lasso
Filaree *Erodium cicutarium*	Goal, Orn. Herb. 1 & 2, Princep, Ronstar	Casoron, Devrinol, Surflan
Fireweed *Epilobium* spp.	Casoron, Devrinol, Orn. Herb. 1, Princep, Ronstar	Surflan
Groundsel *Senecio vulgaris*	Casoron, Goal, Orn. Herb. 2	Devrinol, Orn. Herb. 1, Ronstar, Surflan
Henbit *Lamium amplexicaule*	Casoron, Goal, Orn. Herb. 1 & 2, Ronstar, Surflan	
Knotweed *Polygonum aviculare*	Devrinol, Goal, Orn. Herb. 1 & 2, Ronstar	Casoron, Surflan
Lambsquarters *Chenopodium album*	Casoron, Devrinol, Dual, Goal, Orn. Herb. 1 & 2, Princep, Ronstar, Surflan	
Mustard *Brassica* spp.	Orn. Herb. 1, Princep, Ronstar	Casoron, Devrinol, Goal, Surflan
Pearlwort *Sagina procumbens*	Devrinol, Dual, Lasso, Princep, Surflan	
Pigweed *Amaranthus* spp.	Casoron, Devrinol, Dual, Goal, Orn. Herb. 1 & 2, Ronstar, Surflan	
Pineappleweed *Matricaria matricarioides*	Casoron, Devrinol, Ronstar, Orn. Herb. 1	
Purslane *Portulaca oleracea*	Casoron, Goal, Orn. Herb. 1 & 2, Princep, Ronstar, Surflan	Devrinol, Dual
Shepherdspurse *Capsella bursa-pastoris*	Goal, Orn. Herb. 1 & 2, Ronstar	Casoron, Devrinol, Surflan
Sowthistle *Sonchus* spp.	Casoron, Goal, Orn. Herb. 1 & 2, Ronstar	Devrinol, Surflan

Table 2. Herbicides for use in woody ornamentals, and weeds controlled.

Preemergence herbicides Trade name and common name	Weeds controlled
Casoron (dichlobenil)	Controls many annual grass and broadleaf weeds. Does not control clovers and related legumes. Controls horsetail.
Devrinol (napropamide)	Controls annual grasses, lambsquarters, chickweeds, pearlwort, sowthistle, pineapple weed, and knotweed.
Dual (metolachlor)	Controls annual grasses, pigweed, purslane.
Goal (oxyfluorfen)	Controls many annual weeds, including common groundsel, knotweed and purslane. Weak against chickweeds and annual grasses.
Lasso (alachlor)	Controls annual grasses, pigweed and purslane.
Ornamental Herbicide 2 (oxyfluorfen + pendimethalin)	Controls many annual weeds.
Princep (simazine)	Controls many annual weeds. Groundsel, pigweed, lambsquarters are resistant in some areas.
Ronstar and Ornamental Herbicide 1 (oxadiazon)	Controls many annual weeds, including bittercress. Does not control chickweeds and pearlwort. Weak against annual grasses and groundsel.
Surflan (oryzalin)	Controls annual grasses, filaree, knotweed, lambsquarters, oxalis, pearlwort, pigweed and purslane.
<u>Postemergence herbicides</u>	
Amitrol-T, Cytrol (amitrole)	Spot spraying on clovers and related legumes. Seasonal control of field horsetail.
Kerb (pronamide)	Fall application on perennial grasses such as quackgrass.
Paraquat (paraquat)	Spot spraying for control of annual weeds missed by preemergence treatments. Kills tops of perennial weeds but not much translocation to underground parts.
Roundup (glyphosate)	Spot spraying of perennial grases and broadleaf weeds - quackgrass, Canada thistle, bindweed and blackberry.

Table 3. Preemergence herbicides suggested for use in various kinds of ornamental shrubs and ground covers.

Kind of plant	Herbicide
Most woody broadleaf evergreen and deciduous shrubs.	Casoron, Orn. Herb. 2, Princep, or combinations of Ronstar or Orn. Herb. 1 with Devrinol, Dual or Surflan. Check labels for specific information.
Arborvitae, juniper, pines (except mugo), yew	Casoron, Devrinol, Goal, Orn. Herb. 1 and 2, Princep, Ronstar. Surflan.
Douglas fir, true firs, hemlock, mugo pine	Devrinol, Goal, Orn. Herb. 1, Princep, Ronstar.
Spruce	Casoron, Devrinol, Orn. Herb. 1, Ronstar
Ground covers	
Ajuga	Devrinol, Orn. Herb. 1, Ronstar
Arctostaphylos	Orn. Herb. 1, Ronstar, Surflan
Cotoneaster	Dual, Orn. Herb. 1, Princep, Ronstar
Euonymus	Casoron, Devrinol, Orn. Herb. 1 and 2, Ronstar, Surflan
Hedera	Casoron, Devrinol, Dual, Orn. Herb. 1, Ronstar, Surflan
Hypericum	Devrinol
Pachysandra	Devrinol, Dual, Orn. Herb. 1, Ronstar
Vinca	Devrinol, Orn. Herb. 1, Ronstar

POA ANNUA CONTROL IN TURF WITH NORTRON[1]

Tom Cook and Carol Maggard[2]

Nortron (ethofumesate) has been used successfully for *Poa annua* control in seed fields for several years. It has also been used successfully in the south for overseeding putting greens with perennial ryegrass. Tests at OSU during the past two years indicate Nortron may have potential for use in selective establishment of perennial ryegrass turf during renovation of areas infested with *Poa annua*. Two separate trials are reported below and include preliminary data we have developed thus far.

I. Preemergence tolerance of perennial ryegrass to Nortron.

Ten perennial ryegrass cultivars and a common type of *Poa annua* were seeded in flats in rows containing 50 seeds each. Planting media was a sandy loam and all seeds were covered by 2 mm of soil. After planting, flats were irrigated and treatments applied. Emergence of the grasses was measured two and four weeks after treatment. Ryegrass was considered emerged if the first leaf was 2 or more cm tall. *Poa annua* was considered emerged if the first leaf was 1 or more cm tall.

Data in Table 1 indicate surprising differences in tolerance of perennial ryegrass to preemergence applications of Nortron. In particular, Derby and Regal were retarded severely by Nortron treatments while Palmer and Prelude were quite tolerant. Additional tests will soon be underway to determine tolerance of additional turf cultivars planted in several different soil types. If the observed trends are substantiated, they could significantly affect selection of ryegrasses for use in renovation procedures where Nortron is included preemergence.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Department of Horticulture, Oregon State University, Corvallis, OR.

Table 1. Nortron effects on emergence.

	% Emergence at four weeks	
		Nortron treatments
Cultivar	Check	0.6 kg/ha
Barry	96	47*
Citation	80	32
Derby	72	16
Elka	87	51
Palmer	92	78
Omega	85	27
Prelude	90	62
Premier	94	51
Regal	83	9
Yorktown II	80	37
Poa annua	45	0

* Statistical analysis not completed in time for this presentation.

II. Nortron effects on field establishment of perennial ryegrass planted via slicer seeder.

A turf area consisting of *Poa trivialis*, *Poa annua* and *Holcus lanatus* was sprayed in early September 1981 with glyphosate. After death, the area was vigorously dethatched and scalped with a rotary lawn mower to remove organic debris. Overseeding was achieved via a Rogers slicer seeder using a blend of Fiesta, Blazer, and Dasher perennial ryegrass. The test area was seeded on September 18 in two directions to insure uniform seed distribution. Nortron treatments were applied as indicated below. The area was watered regularly to insure adequate turf establishment. Data in Table 2 indicate the relative ryegrass stand on 4/30/82 and the percentage of *Poa annua* in each plot.

Table 2. Nortron effects on perennial ryegrass establishment.

kg/ha	First spray	% Poa annua	Perennial rye stand
.6,.6,.6	Before seeding	5	4.3*
.6,.6,.6	After seeding	5	4.7
.6,.6,.6	Rye at one leaf	6.7	6.3
.6,.6,.6	Rye at one tiller	10	6.0
Check		82	4.0

* Statistical analysis not completed in time for this presentation.

Poa annua control was quite good for all treatments when compared to check plots. The primary problem at present is the poor establishment of the perennial ryegrass. In no treatment was the perennial ryegrass stand adequate for quality turf at the time ratings were made. In all treated areas ryegrass germination and establishment was slower than might be expected. Additional fertilizer treatments were not effective in improving rate of development. Additional tests are underway to explore possiblities for maintaining *Poa annua* control and developing better stands of perennial ryegrass.

SUMMARY

Data generated so far indicate great potential for Nortron in *Poa annua* control during reestablishment. Much more work is necessary, however, before a functional program is available.

WATER USE BASICS[1]

Dr. Roy L. Goss[2]

Water down the drain is money down the drain, and this equates to cold, hard cash - and worse. What if water should be short in supply or your supply virtually dried up? How would your grass survive? There are things you could do now to educate yourself, your employees, and employer if this happens. There are things you can do even if this doesn't happen and still have good turf - even healthier - and save a bundle on water or pumping bills and reduce soil problems. There are a few basic principles that should be practiced if you want to become better water managers.

THE SOIL FACTOR

The knowledge of your soil texture is important. Soils hold variable amounts of water depending upon texture and depth. The following table will provide some guidelines.

Table 1. Plant available water per foot of soil.

Soil texture	Available water (inches/foot soil)
Sand	0.4-1.0
Sandy-loam	0.9-1.3
Loam	1.3-2.0
Clay loam	1.8-2.1
Clay	1.8-1.9

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

As you can see from the table, sands have a greater variability in available water per foot than heavier textured soils. This is due to a wide variability in the particle sizes for sand. This is one good reason why sand particles should be in the medium to medium-fine range. It is apparent from these data that you should strive to induce maximum rooting of grasses to extend the frequency between irrigations for the grass to survive between rains. The available water holding capacity of the soil may be increased through compaction by the elimination of large pores which normally hold air. This is an undesirable characteristic and should be avoided. At field capacity about 25% of a typical loam soil volume is filled with water, 25% with air, and 50% with soil particles.

The rate at which water enters the soil surface, measured in inches or centimeters per hour, is called the infiltration rate. Water should never be applied at a rate faster than its infiltration rate. If the rate of application is faster than the infiltration rate, water may run off into low spots where it will saturate the soil or percolate too deeply to do the plant any good or may stand impounded on the surface totally saturating and sealing the soil and evaporate at a much faster rate and is wasted. Compaction, puddling and the accumulation of partially decomposed organic matter will significantly decrease infiltration rate of water. On sloping to steep ground, the infiltration rate of water is only about one-half to one-third the rate on level topography. Compound this problem with compaction and other surface problems, and the infiltration would be almost anybody's guess, although significantly reduced. The rate at which water moves through the soil profile after entering the surface is called the percolation rate. Layers of soil, sand and organic matter can significantly reduce the permeability or percolation rate of soil. Infiltration rate can be enhanced through surface management of aerification and thatch removal. Judicious use of the area from all forms of traffic when surfaces or saturated or they are thawing will help to maintain better infiltration rates of water. When all gravitational water has drained through the root zone, the soil is at field capacity moisture. Each time the soil is irrigated, you should strive to achieve field capacity moisture throughout the active root zone. Do not re-water until near 50% of the water has been removed through evapotranspiration.

THE PLANT FACTOR

The most effective watering programs can be achieved with turfgrasses having maximum root development. Some of the factors influencing root growth can be listed as follows:

1. Soil compaction - results in impaired air and water movement through the soil surface and increases soil density which impedes root growth.

2. Excessive leaf growth - reduces root carbohydrates and can cause death of the root system.

3. Deficiencies of any nutritional element, but especially phosphorus and potassium will inhibit root development. Iron may be limiting in many instances and should be carefully guarded as well. Turfgrasses grown on sandy soils may become quickly deficient in potassium.

4. Thatch accumulations - roots will frequently concentrate in thatch layers and not extend into the lower soil profile for the removal of water and nutrients.

5. Lack of oxygen and the increase of toxic gases in the soil will severely inhibit root production.

6. Temperature - cool season turfgrasses essentially cease root growth when temperatures rise above 75°F; whereas the optimum range is about 50-60°F.

7. Soil pH - root growth may be restricted when soil pH values are less than 5.3 or 5.4.

8. Mowing height - the higher the grass is mowed the greater the root system within genetic limitations of the plant. Higher mowing is definitely not a water saving process in spite of increased root mass.

CONSUMPTIVE USE OF WATER BY TURFGRASSES

This value cannot be defined unless we describe the quality of turf we wish to achieve. Turfgrasses that must be maintained at a much higher level of aesthetic acceptance will require significantly more water than turfgrasses at a lower level of maintenance.

Consumptive use values for turfgrasses are derived from evaporation pan data. The amount of water evaporated from a pan approximately 4 feet in diameter on a daily basis represents daily evaporation. The combined losses of water from plants and the soil surface is called evapotranspiration and is somewhat less than open pan evaporation. Lysimeters are commonly used for determining water loss from soil through evapotranspiration. According to Kneebone and Pepper (1) in their tests at Tucson, Arizona, they found that the consumptive use values can range from 50 to 80% of a Class A evaporating pan depending on the quality desired. In general, if we accept a value for evapotranspiration of approximately 60% of open pan, we will have a reasonably good estimate of what the turfgrasses actually require. Open pan evaporation data are available from the U.S. Weather Bureau and is usually found in most daily newspapers near your locality.

Kneebone and Pepper further reported that water use by Kentucky bluegrass increased with increase in mowing height and there were also significant increases in water use from ryegrass when the mowing height was increased from 1-1/2 to approximately 2.5 inches.

According to Beard (2) the typical range of water use rate for most turfgrasses across the United States is between 0.1 and 0.3 inch per day. Water use rate, however, can vary greatly from one location to another and can amount to as much as .4 to .5 inch per day.

Rates of 0.45 inch per day have been reported from Colorado and Wyoming. Some of the factors affecting water use rate will be relative humidity, temperature, wind and sunlight.

Water is lost from the plant through the transpiration process which can be both cuticular and stomatal.

THE MANAGEMENT FACTOR

The manner in which we manage our turfgrasses can have some important affects on water use. Some areas you should consider are:

1. Frequency of mowing. It has been reported by Beard and others that water use rate increased 41% on creeping bentgrasses when the mowing frequency was increased from 1 up to 6 times per week. Water loss from grass leaves can occur through wounds. Cut blades will lose water rapidly through this wound. Dull mowers will have an even more significant effect due to excessive damage to the leaf tip.

2. Height of cut. This has been previously discussed and is obviously an important factor. The higher the cut the greater the water use rate.

3. Nitrogen rates can influence water use also. Plant shoot density increases with increasing rates of nitrogen application. Turfgrasses receiving low levels of nitrogen will have less shoot density; therefore, less water use.

4. Irrigation frequency can significantly affect water use rate. Studies have shown that irrigation scheduled 3 times a week vs. only when turf wilt is evident can result in a 33% increase in water use when this is practiced on a regular schedule.

5. Other injurious factors may include damage to grass leaves from cleats, spikes under heavy traffic. This would be an extremely difficult factor to access. but nonetheless represents increased water use by the plant.

In summary, the turfgrass manager should consider all of these points and strive to do a better job of irrigating. It is generally agreed that thorough watering to service the entire root zone on an infrequent as required basis is more acceptable than light frequent waterings. Grasses such as the fine leaved fescues have a lower water use rate than Kentucky bluegrasses and bentgrasses, and these factors should also be considered by the turfgrass manager.

KENTUCKY BLUEGRASS TURF PERFORMANCE[1]

R.D. Ensign[2]

Kentucky bluegrass, Poa pratensis L., is the most widely used cool-season turfgrass in the U.S.A. and other similar climates of the world. It was introduced from the cool, humid climates of Europe to Asia in the mid 1600's.

The wide distribution of this species in the U.S. is due to the favorable cool seasonal temperature (optimum 60-75°F); adequate and well-distributed rainfall or supplemental irrigation during most of the year; and relatively fertile, well drained soils. Under these conditions the grass has a strong perennial growth habit due to a vigorous stem or rhizome system which allows the plant to reproduce and spread as much as 30-40 feet annually. Fast-growing tillers and roots emerge from these underground stems to produce an extensive sod system which makes the grass durable and persistent under some of the most severe wear and stress conditions. Although there is considerable variation in turf quality, most improved varieties or cultivars have excellent uniformity, texture, density and green color. The grass is relatively easy to establish by seed or sod and will maintain a reasonable good turf with minimum cultural practices of watering, fertilizing, mowing, and pest control.

The success of this important turf species in the U.S. can be credited, in part, to the extensive research to seek improved ecotypes, and develop better cultural practices under various environmental conditions. In addition, since this grass species is primarily propagated by seed, many new varieties have been developed with improved seed productivity. Also

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

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seedsmen, primarily in the northwest states of Idaho, Oregon, and Washington, have developed considerable expertise in the production of the seed crop which is distributed worldwide.

Turf managers for home lawns, parks, golf courses and other turf users are fortunate to have such a plant with outstanding functional, recreational, and aesthetic uses. Nevertheless, improvements can be made in the species, especially in seeking better information of the general and specific adaptability of the many new varieties. Currently there are more than 100 varieties available for use in the U.S. Researchers and distributors of seed have limited information of their performance in our various climatic and soil conditions. Therefore, in 1980 a program was established to evaluate the many Kentucky bluegrass varieties in the U.S. Replicated field experiments have been established in 36 states in 51 locations with approximately 90 varieties to measure performance in many turf situations, including the warm season turf areas. Extensive notes important to the species and the various areas are taken in a standardized fashion. This national evaluation program is under the overall coordination of a committee with Dr. Jack Murray of Beltsville, Maryland as Chairman. Data are forwarded to him each year for summarization. Performance data at the completion of the 3-5 year study should reveal considerable information about the best adaptability for the varieties as well as learn more about diseases and pests, cultural requirements, projected uses, and relative value of the varieties in comparison to other turf species. Such information should be of value to turf managers, seedsmen, and other turf industries. This report will give a few highlights of the research information obtained in 1982 with 90 Kentucky bluegrass varieties at Moscow, Idaho. More detail performance data are being compiled for computer processing.

Management of the Plots

All grasses were sown in a silt-loam soil on 5 September 1980 in replicated 1 x 2 m plots. A balanced fertilizer was worked into the soil before seeding. In

1981 and 1982 an annual application of 6 lb N, 2 lb P, 4 lb K, and 4 lb S were applied per 1000 ft^2. The nitrogen was a mixed blend of ammonium nitrate, ammonium sulfate, and urea. The experimental area is covered with a pop-up irrigation system and supplemental water is applied during the season as needed. The grass is mowed to a 2-inch level weekly and clippings remain. No pesticides for weeds, diseases or insects have been applied. Notes are recorded in accordance with the national plan.

Turf Quality

All grasses are rated monthly for quality. This is an overall visual estimate of all factors, such as color, texture, density, freedom of diseases and general appearance. Quality index changes from variety to variety as well as from season to season. Most Kentucky bluegrasses reach their best quality in mid-summer at this location. The outstanding quality readings for 1982 are given in Table 1. Most of these grasses were excellent in quality during 1981. Quality and color appear to be highly correlated. The grass that exhibits an excellent color usually gives a good quality index. Quality may change with age of the turf, especially those varieties which are susceptible to plant pests.

Color

There is considerable variation in color among these Kentucky bluegrass varieties. We call this genetic color variability and not caused by nutrition although there is evidence to show some varieties of bluegrass are more efficient in nitrogen utilization than others. Merion, for example, requires more nitrogen to maintain color and quality than other varieties. Many of the new selections and varieties in this test were selected for a dark green color whereas others were not selected for color. The common type varieties frequently do not exhibit green color as well as most improved varieties.

Frequent color readings were taken on these grasses at least each month during the growing season. All 1982 data have not been computer processed at this writing, but the outstanding ten varieties in color during May and August are given in Table 2. Varieties 1528T, CEB-VB-3965, Baron, and MLM-182 were among the outstanding varieties for both months. These varieties were also excellent in color during the previous 1981 season. The selected 10 in 1982 were all superior to the variety Merion.

Late Season vs. Early Spring Color

An outstanding characteristic of a turfgrass is its ability to exhibit an excellent color from early spring to late fall. Some turfgrasses are slow in greening up in the early spring. Also some grasses lose green color in early fall, at this location. Temperature and light intensity affect chlorophyll development and chlorophyll degradation. The phenomena of fall dormancy and spring green-up was observed with 90 varieties of Kentucky bluegrass.

Color readings were recorded on December 9, 1981 and it was observed that some grasses exhibited excellent green colors at this late date (Table 3). Many varieties, however, lost color early in the fall and appeared dormant. During this fall and early period there had been 28 days below freezing (32°F) during October and November and to the 9th of December. The mean November temperatures were 35.6°F with a low of 24°F. Thus, during these temperatures several varieties were able to retain an acceptable green color.

Early Spring Green-Up

All grasses became dormant and the leaves lost all chlorophyll during the cold temperatures of December to February. During the following spring, in early March 1982, new growth and green-up was observed from many varieties. Varieties with best March color were Nassau, Bristol and 225 (Table 4). It was noted that these varieties also exhibited an excellent green color in late December 1981. None of the varieties in this test, which had high winter green color gave low spring readings. There were some varieties which did not give particularly high color during the previous December but gave excellent green-up readings.

In summary we not that some Kentucky bluegrass varieties will exhibit excellent color in the early spring and retain this color well into the cool fall to early winter periods. These varieties may have some special characteristics which will be favorable for turf purposes in this climate. Additional information will be collected to ascertain performance in subsequent years.

Table 1. Varieties of Kentucky bluegrass with the best overall quality in mid-summer 1982.

Variety	Rank
RAM I	9.0[1/]
1528T	8.7
N535	8.7
Victa	8.7
PSU 150	8.3
Merit	8.0
Adelphi	7.7
Bristol	7.7
Nassau (243)	7.7
PSU 173	7.7
Merion	7.0

1/ Ratings 1-9; 9 best quality.

Table 2. Kentucky bluegrass cultivars showing a dark green color.

May 1982		August 1982	
Variety	Rank	Variety	Rank
1528T	8.8[1/]	1528T	9.0[1/]
Emundi	8.3	RAM I	9.0
Nugget	8.2	Victa	8.7
MLM-1822	8.1	N 535	8.3
CEB-VB-3965	8.0	WW AG 478	8.3
Bristol	8.0	PSU 150	8.3
Merit	8.0	MLM-1822	8.3
Baron	8.0	CEB-VB-3965	8.0
MER pp 300	7.9	Adelphi	7.7
IDA Sel 22C	7.9	Baron	7.7
Merion	5.0	Merion	6.7

1/ Color ratings 1-9; 9 = dark green.

Table 3. Early winter color readings for the top Kentucky Bluegrass varieties[1].

Variety	Color score[2]
Bristol	8.3
Lovegreen	8.3
Birka	7.7
Glade	7.7
225	7.7
Admiral	7.3
CEB-VB-3965	7.3
RAM I	7.3
Barblue	7.0
Nassau (243)	7.0
Merion	4.0

1/ Color readings taken 9 December 1981.

2/ Score 1-9; 9 best green.

Table 4. The best early spring green-up scores for Kentucky bluegrasses[1].

Variety	Scores[2]
Nassau (243)	6.5
Bristol	6.2
225	6.2
K3-178	6.0
Bonnieblue	6.0
Columbia	6.0
239	5.9
Admiral	5.9
Shasta	5.8
PSU 173	5.8
Merion	3.0

1/ Readings taken early March 1982.

2/ Score 1-9; 9 = best green-up.

DEVELOPMENTAL CHARACTERISTICS OF TALL FESCUE/ANNUAL RYEGRASS MIXTURES IN THE WILLAMETTE VALLEY[1]

Tom Cook and Geoff Wickes[2]

With the development of improved turftype tall fescues, interest in their use has increased dramatically. Many new seed fields have been planted in the Willamette Valley in Oregon in areas where annual ryegrass has been grown for many years. As a result, young tall fescue fields are often heavily infested with annual ryegrass. At harvest time these fields may yield as much as 50% annual ryegrass. The question that arises is what is the critical level of annual ryegrass in a tall fescue seeding that prevents adequate establishment of a tall fescue turf? This study was initiated to partly answer that question and to characterize the establishment pattern of various mixtures of tall fescue and annual ryegrass.

PROCEDURE

The test area was an established stand of perennial ryegrass free of broadleaf weeds. The area was sprayed with Roundup in mid-September, and two weeks later was repeatedly scalped with a rotary lawnmower and dethatched vigorously until bare soil was visible in all portions of the plot area. The entire area was fertilized with 15-15-15 at 1.5 lb N/1000 ft^2, plots were seeded by hand, and 1/2 inch of fine grade fir bark was applied as a mulch. Seed mixtures were prepared on a percentage-by-weight basis to achieve a total rate of 8 lb mixture/1000 ft^2. The experimental design was a randomized complete block with eight treatments and three replications. Plots were seeded on October 2, 1981. The entire area

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1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Department of Horticulture, Oregon State University, Corvallis, OR.

was fertilized with 1 lb N/1000 ft^2 from ammonium sulfate on April 2, May 25, and July 15 in addition to the fertilizer applied at the time of seeding. Plots were mowed weekly at 1.5 inches with a mulching-type rotary lawnmower. Data was based on visual ratings of factors such as germination, plot density, plot quality, and relative stand proportions of tall fescue and annual ryegrass. All ratings were made on a 1 to 9 scale with 1 = poorest and 9 = best.

RESULTS AND DISCUSSION

Results of the test thus far are shown in Table 1. The basic pattern of development was quite interesting to observe. During establishment, the weather was quite cool and rainy. This definitely favored initial development of the annual ryegrass as indicated by the mean germination scores and the plot density ratings. During this period tall fescue developed very slowly and essentially remained in the seedling stage during the entire winter period. Plots with high percentages of annual ryegrass severely restricted development of the tall fescue.

By mid-spring, the annual ryegrass entered its flowering period and plot densities in general decreased. At the same time, the tall fescue began more vigorous vegetative growth and was more apparent in all plots. Mid-July quality ratings reflect this trend dramatically. Almost on a monthly basis, significant changes in tall fescue density could be observed.

By mid-August it was possible to assess the transition that had occurred during the summer. Because of color and appearance differences it was possible to rate each plot for relative stand density for tall fescue and for annual ryegrass. Both ratings are included in Table 1. Although there appeared to be a trend toward reduced stands of tall fescue as annual ryegrass increased, differences were not statistically significant. In our opinion, all plots except the 50/50 mixture contained enough tall fescue to provide acceptable turf. Plots containing from 0 to 20% annual ryegrass were virtually free of annual ryegrass by the August ratings.

From an appearance standpoint, only the 40 to 50% annual ryegrass plots had noticeable levels of ryegrass remaining by August 18.

Several factors probably influenced the relatively rapid conversion of these plots from annual ryegrass to tall fescue. The relatively low mowing height and the weekly frequency appeared to allow greater survival of tall fescue seedlings initially than might have been expected, since each mowing removed large amounts of the fast growing annual ryegrass and exposed the young tall fescue seedlings to light. Likewise when the annual ryegrass began flowering, mowing caused drastic thinning by removing elongating culms and attendant leaves. The strong summer fertilization program also appeared to favor vegetative growth of tall fescue at a time when the annual reygrass was flowering and losing density. The end result was a nearly perfect stand of tall fescue in most plots after less than one year. Observations of this trial will continue for one more season to determine the ultimate fate of these mixtures.

CONCLUSIONS

Under the mild winter conditions in the Willamette Valley it was possible to develop acceptable tall fescue turf when mixed with up to 30% annual ryegrass at the time of planting. If trends continue, it appears that eventually even plots containing up to 50% annual ryegrass will produce acceptable tall fescue turf. This indicates that contaminated tall fescue seed could be used for turf plantings as long as attention is paid to culture, and owners understand what to expect. This also has implications for "cheap seed" mixtures which often contain high percentages of annual ryegrass as filler material. It may be possible to formulate these mixtures so that enough good grasses are present to provide acceptable turf after the annual ryegrass dies out.

Table 1. Plot development characteristics of Tall fescue/Annual ryegrass mixtures planted on October 4, 1981 in Corvallis, Oregon.

TRT % TF/AR.	$\bar{x}$ PLOT GERM 10/14/81	$\bar{x}$ PLOT DENSITY 11/23/81	$\bar{x}$ TURF QUALITY 7/16/82	$\bar{x}$ STAND TF 8/18/82	$\bar{x}$ STAND AN.R. 8/18/82
100/0	2 a [x]	2 a [x]	8.7 a [x]	9 a [x]	1 a [x]
95/5	2 a	2.7 a	7.7 a b	9 a	1 a
90/10	2 a	3 a b	6.3 b c	9 a	1 a
85/15	3 a b	4.3 b c	5.7 b c	8.7 a	1.3 a b
80/20	4 b c	5 c d	5 c	8.7 a	1.3 a b
70/30	5 c	6.3 d	4.3 c d	7.7 a	2.3 b c
60/40	5.3 c	6.3 d	3.3 d	7.3 a	2.7 c d
50/50	7 d	6.3 d	3.3 d	6.3 a	3.0 d

[x] means in a column followed by different letters differ significantly at the 1 percent level according to the new Duncan's multiple range test.

TURF RESEARCH IN EASTERN WASHINGTON[1]

William J. Johnston[2]

After a lull of several years, turfgrass research is again underway at the New Turfgrass Research Area at Washington State University in Pullman. Presently we have approximately 2.5 acres of turf under automatic irrigation. In 1983, we will add an additional 1.5 acres.

Research is being conducted in three major areas: 1) cultivar evaluation; 2) fertilizer evaluation; 3) perennial ryegrass cold tolerance.

CULTIVAR EVALUATION

A. Kentucky bluegrass. In September 1981, 85 cultivars of Kentucky bluegrass were seeded at the Turfgrass Research Area in Pullman. This test is part of the National Kentucky Bluegrass Trial that is being conducted by 36 scientists at 52 locations. The individual plots were 1 x 2 m, seeding rate was 2.5 lb per 1000 ft^2, and each plot was replicated three times. Plots were mowed at 1.5 inches (bench setting) approximately once a week. Plots received a total of 3 lb nitrogen per 1000 ft^2 as ammonium sulfate in 1982. Soil tests indicated adequate levels of P and K.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Assistant Agronomist, Washington State University, Pullman, WA.

Table 1 gives the turfgrass quality rating for all 85 cultivars during 1982. Of prime consideration in the quality rating were cover, color, uniformity, and lack of weeds and diseases. Early quality ratings tended to be dominated by the percent cover shown by the cultivars. Therefore, cultivars with the best rate of cover received the highest rating. For example, the three best cultivars (considering the overall mean for the year)--Mona, WW Ag 463, and Mosa-- had percent cover in May of 83%, 88%, and 72%, respectively. The two best cultivars in September--Ram I and 1528-T--had only 65% and 50% cover, respectively, in May; and, thus, their overall performance for the year tended to be lower.

The September ratings (Table 2), when the plots were fully established, are a better indication of the long-term performance of these cultivars. The validity of the September ratings are supported by research conducted by Dr. Ron Ensign on the National Kentucky Bluegrass Trial at the University of Idaho and reported at this Conference. After two years of testing, the best performing bluegrasses on Ron's plots were also Ram I and 1528-T. Also, five of the best cultivars at the U. of I. plots after two years of testing appear in our list of the top 11 cultivars (September 1982 rating).

It would appear that after only limited testing several Kentucky bluegrass cultivars show excellent adaptation to eastern Washington and northern Idaho. These cultivars will be evaluated for several more years. Of particular interest will be their spring and fall color and their disease resistance.

B. Perennial ryegrass. Replicated 8 x 10 ft plots of seven ryegrass cultivars were seeded at 3 lb per 1000 ft^2 in September 1981. Plots were mowed weekly at 1.5 inches and received a total of 3 lb nitrogen per 1000 ft^2 as ammonium sulfate in split applications during 1982.

Preliminary results based on one year's data indicated that Blazer and Loretta had the best turf quality during 1982 (Table 3).

Thirteen additional ryegrasses were seeded in replicated 4 x 5 ft plots in July 1982. Turfgrass quality of these cultivars during seedling establishment are given in Table 4.

C. Fescues. In June 1982, 17 fescues were established in replicated plots. All fescues including tall fescue were seeded at 4 lb per 1000 ft^2 and received a total of 3 lb of nitrogen as ammonium sulfate in split applications during 1982. Plots were mowed at 2 inches. A preliminary rating for turfgrass quality, color, and texture is given in Table 5. The best creeping red, chewings, tall, and hard fescues were Ensylva, Agram, Koket, Rebel, and Biljart, respectively.

These plots will be evaluated for the next several years. IN 1983, The National Fescue Turfgrass Trial will also be planted in Pullman.

FERTILIZER EVALUATION

In 1982 a test was begun to evaluate nitrogen fertilizers on a bluegrass/ryegrass turf at Pullman. The objectives of the study were:

A. Evaluate different nitrogen sources with varying nitrogen release characteristics on growth and quality of turfgrass.

B. Evaluate the effects of timing of fertilizer application on the growth and quality of turfgrass.

In April 1982, a 6400 ft^2 area was seeded at 3 lb per 1000 ft^2 with a 60:40 mix of Kentucky bluegrass (Victa and Bristol) and perennial ryegrass (Derby and Loretta). The area was fertilized with 1/2 lb N per 1000 ft^2 in early

June. Nitrogen source was ammonium sulfate. Fertility treatments (Table 6) and programs for application (Table 7) were initiated in Late June. Individual plot size for fertility treatments was 7 x 13 ft and all plots were mowed at 1.5 inches.

The effects of nitrogen source, rate, and time of application on quality and color are given in Table 8. Due to the initial applications of fertilizer to aid grass establishment there were no great differences among N sources or programs on turfgrass quality or color during the early phase of this test. This effect can readily be seen in the check plots which scored a 7.3 for quality in August. However, check plots are now declining in quality and color and in October (data not presented) rated 5.7 in quality and 6.0 for color. The results of this test should be much more meaningful next year.

I would like to acknowledge the O. M. Scott & Sons Company for partial support of this project.

PERENNIAL RYEGRASS COLD TOLERANCE

Perennial ryegrass is an especially desirable turfgrass on sports turfs, playgrounds, or other heavy use areas where its use would enhance the wear tolerance of a Kentucky bluegrass turf. However, perennial ryegrass has the poorest cold tolerance of any turfgrass presently recommended for use in Washington. Although used in western Washington, this lack of cold hardiness has prevented perennial ryegrass from becoming a valuable turf species in eastern Washington.

During 1982 several growth chamber experiments were conducted and a long-term field study was initiated. Twenty-one perennial ryegrass cultivars were screened in a laboratory cold chamber test for seedling cold tolerance. Four cultivars (GT II, Fiesta, Barry, and Derby) showed excellent cold tolerance. Four others (Yorktown II, Manhattan, Elka, and Dasher) showed good cold tolerance. Cold chamber studies also indicated that perennial ryegrass required a cold hardening period of approximately six weeks to attain maximum cold tolerance. Little tolerance to freezing temperatures was noted in perennial ryegrass cold hardened for less than three weeks. One annual ryegrass selection was included in these tests and consistently performed as poor as, or poorer than, any of the perennial ryegrasses tested.

Field tests were initiated at the Turfgrass Research Area in Pullman in September 1981 with eight cultivars based on their reported cold tolerance. Five others were planted in the spring 1982 based on the results of the previously described laboratory tests. Over the next several years the effects of mowing height and fertility on the winterhardiness of these cultivars will be evaluated.

The preliminary results of these studies indicated that among perennial ryegrass cultivars several possess excellent cold tolerance. Laboratory tests also indicated that perennial ryegrass should be planted approximately seven weeks (one allowed for emergence) prior to anticipated freezing temperature to avoid winter injury. Continued field testing will help define the best cultural practices for the management of perennial ryegrass in eastern Washington.

Table 1. Turfgrass quality of Kentucky bluegrass cultivars during 1982 at Pullman, Washington

	Quality rating (9 = excellent)					
Cultivar	May	June	July	Aug	Sept	Mean
1. Mona	7.7	8.0	7.0	7.7	7.0	7.5
2. WW Ag 463	7.3	7.3	7.3	7.3	7.0	7.3
3. Mosa	6.0	7.7	7.7	7.7	7.3	7.3
4. Cello	7.3	7.7	6.7	7.3	7.0	7.2
5. WW Ag 478	6.7	7.3	7.3	7.7	7.0	7.2
6. Rugby	6.7	6.3	7.0	7.7	7.7	7.1
7. Welcome	6.7	6.3	7.0	8.0	7.0	7.0
8. RAM I	5.3	5.0	8.0	8.0	8.3	6.9
9. Trenton	6.7	6.3	6.7	7.7	7.0	6.9
10. Barblue	5.7	6.0	7.7	7.7	7.3	6.9
11. Majestic	6.0	5.7	6.7	8.0	8.0	6.9
12. Flyking	6.0	6.7	7.0	7.3	7.0	6.8
13. 225	6.7	6.3	6.7	7.3	7.0	6.8
14. Banff	6.0	6.7	6.7	7.7	7.0	6.8
15. Charlotte	7.0	6.7	6.7	7.0	6.7	6.8
16. Shasta	5.3	6.3	7.7	7.3	7.3	6.8
17. WW Ag 480	5.3	6.0	7.7	7.7	7.3	6.8
18. K3-162	5.7	7.0	7.3	7.3	6.7	6.8
19. Plush	5.3	6.3	7.0	8.0	7.3	6.8
20. Parade	5.7	7.0	6.7	7.3	7.0	6.7
21. Monopoly	6.3	7.0	6.7	7.0	6.3	6.7
22. Holiday	5.7	6.7	6.7	7.3	7.0	6.7
23. Kimono	5.3	5.0	7.3	7.7	7.7	6.6
24. Sydsport	5.3	6.0	7.0	7.0	7.3	6.5
25. America	5.0	4.3	7.3	7.3	8.3	6.5
26. K3-178	5.7	5.7	6.7	7.0	7.0	6.4
27. K1-152	6.0	6.0	6.7	6.7	6.7	6.4
28. Glade	3.7	4.7	7.7	8.0	8.0	6.4
29. Victa	5.3	5.3	7.0	7.0	7.0	6.3
30. Bayside	5.7	5.3	6.3	7.3	7.0	6.3
31. P141 (Mystic)	5.3	5.0	6.7	7.3	7.3	6.3
32. PSU 150	4.7	5.0	6.7	7.7	7.7	6.3
33. Aspen	5.0	4.7	6.7	8.0	7.3	6.3
34. 1528 T	4.7	4.0	6.7	8.0	8.3	6.3
35. Columbia	5.3	5.3	6.7	7.0	7.0	6.3
36. PSU 190	5.3	5.0	6.3	7.3	7.3	6.3
37. Vanessa	5.3	5.3	6.7	7.0	7.0	6.3
38. Merit	5.3	5.0	7.0	7.0	7.0	6.3
39. CEB VB 3965	4.3	5.3	6.7	7.3	7.7	6.3
40. K3-179	4.3	5.0	7.3	7.7	7.0	6.3
41. Geronimo	5.7	5.3	6.3	7.0	6.7	6.2

Table 1 (cont.)

Cultivar	Quality rating (9 = excellent)					
	May	June	July	Aug	Sept	Mean
42. SV-01617	5.3	5.3	6.0	7.3	7.0	6.2
43. SH 2	5.0	5.7	6.3	6.7	7.0	6.1
44. Harmony	5.0	5.3	6.3	7.0	7.0	6.1
45. PSU 173	5.3	5.0	6.3	7.0	7.0	6.1
46. Bonnieblue	5.0	5.0	6.3	7.0	7.3	6.1
47. A20-6A	5.3	5.3	6.3	6.7	6.7	6.1
48. BA-61-91	5.3	4.7	6.0	7.3	7.0	6.1
49. Bono	5.7	4.0	6.0	7.3	7.3	6.1
50. Baron	5.0	4.7	6.3	7.0	7.3	6.1
51. MLM-18011	5.7	5.3	5.3	7.0	7.0	6.1
52. Vantage	5.3	5.0	6.3	7.0	6.3	6.0
53. Apart	4.7	5.7	5.7	7.0	7.0	6.0
54. Nugget	5.3	5.0	6.7	7.3	5.7	6.0
55. Birka	4.3	4.7	6.7	7.3	7.0	6.0
56. S. D. Common	5.0	5.3	6.3	6.7	6.3	5.9
57. Kenblue	5.3	4.3	7.0	7.0	6.0	5.9
58. Piedmont	5.0	5.7	5.7	7.0	6.3	5.9
59. Wabash	4.3	4.3	6.0	7.3	7.7	5.9
60. N 535	4.7	4.0	5.7	7.3	8.0	5.9
61. A 34	4.7	5.3	6.6	6.7	6.7	5.9
62. 239	5.0	4.7	6.0	6.7	7.0	5.9
63. Merion	4.3	5.0	5.7	7.3	7.0	5.9
64. Cheri	4.3	5.0	6.3	6.7	6.7	5.8
65. Admiral	4.3	4.3	6.3	7.0	7.0	5.8
66. Dormie	5.0	4.3	6.3	6.7	6.7	5.8
67. Mer PP 43	5.0	5.0	5.0	6.7	7.0	5.7
68. Lovegreen	4.7	5.0	6.0	6.7	6.3	5.7
69. Touchdown	5.3	4.3	6.0	7.0	6.0	5.7
70. A20-6	4.0	4.0	6.7	7.0	7.0	5.7
71. Adelphi	4.3	4.0	6.0	7.0	7.3	5.7
72. NJ 735	4.7	4.7	6.0	6.3	6.7	5.7
73. Argyle	5.0	4.3	6.0	6.3	6.3	5.6
74. Escort	4.0	4.3	5.7	7.0	7.0	5.6
75. Mer pp 300	4.0	4.7	6.0	6.7	7.0	5.6
76. Enoble	4.0	4.0	5.7	6.7	7.3	5.5
77. I-13	3.3	4.0	6.3	7.0	7.0	5.5
78. Enmundi	3.3	3.7	6.3	7.3	7.0	5.5
79. S-21	4.3	4.3	5.3	7.0	6.0	5.4
80. MBA-52	4.0	4.3	5.3	6.7	6.7	5.4
81. A20	4.3	4.0	6.0	6.3	6.0	5.3
82. Bristol	3.7	3.7	5.0	6.7	7.7	5.3
83. Eclipse	2.7	3.3	5.3	7.7	7.3	5.3
84. 243	4.3	3.7	4.7	6.0	6.0	4.9
85. H7	2.7	2.7	5.0	5.0	5.0	4.1

Table 2. Best Kentucky Bluegrass Cultivars, September 1982

Cultivar	Quality	Cultivar	Quality
Ram I	8.3	Rugby	7.7
1528-T	8.3	Bristol	7.7
Glade	8.0	Wabash	7.7
Majestic	8.0	PSU-150	7.7
N 535	8.0	CEB VB 3965	7.7
Kimono	7.7		

Quality 1 to 9 with 9 = excellent

Table 3. Turfgrass quality of perennial ryegrass cultivars during 1982 at Pullman, Washington

	Turf quality rating (9 = excellent)				
Cultivar	June	July	Aug	Sept	Mean
Blazer	6.8	6.8	7.8	7.0	7.1
Loretta	6.5	6.3	7.8	7.0	7.0
Dasher	6.0	6.0	7.5	6.8	6.4
Citation	5.0	5.5	7.8	7.0	6.3
Fiesta	5.8	5.5	7.0	6.8	6.3
Regal	5.0	5.0	6.8	6.0	5.7
Caravelle	5.8	4.0	6.5	5.5	5.5

Table 4. Turfgrass quality of perennial ryegrass cultivars, September 1982 at Pullman, Washington

Cultivar	Sep. quality rating (9 = excellent)
GT II	8.5
Barry	8.0
Yorktown	8.0
Acclaim	7.8
Derby	7.7
Elka	7.7
Diplomat	7.5
Manhattan	7.5
YorktownII	7.5
Sprinter	6.8
Perfect	6.5
Score	6.3
Ninak[1]	4.0

[1] Annual ryegrass

Table 5. Turfgrass quality, color, and texture of fescue cultivars, September 1982 at Pullman, Washington

Cultivar	Type	Quality[1]	Color[2]	Texture[3]
Ensylva	Creeping red	8.0	7.0	8.5
Agram	Chewings	7.7	7.3	9.0
Koket	Chewings	7.7	7.0	8.7
Rebel	Tall	7.3	7.3	1.7
Bar Frc Wb	Chewings	7.0	8.0	8.5
Clemfine	Tall	7.0	7.0	1.5
Banner	Chewings	6.7	7.7	9.0
Jamestown	Chewings	6.7	7.3	9.0
Kentucky 31	Tall	6.7	7.0	1.7
Biljart	Hard	6.3	7.3	9.0
Bar Frc WA	Chewings	6.0	8.0	8.5
Bar Frc 80WA	Chewings	6.0	8.0	9.0
Highlight	Chewings	6.0	7.0	9.0
Tournament	Hard	6.0	7.3	9.0
Pennlawn	Creeping red	4.7	6.7	8.7
Bar Frt GB	Creeping red	4.5	7.0	8.5
Bar Frc Z	Chewings	3.0	8.0	8.5

[1]Quality 1 to 9 with 9 = excellent

[2]Color 1 to 9 with 9 = dark green

[3]Texture 1 to 9 with 9 = fine

Table 6. Fertilizer formulations and programs for tests on the effect of nitrogen source, rate, and time of application on a bluegrass/ryegrass turf at Pullman, Washington

Fertilizer	Analysis	Programs
Methylene Urea	40-0-0	1,2,3
IBDU	31-0-0	1,2,3
Sulfur Coated Urea	38-0-0	1,2,3
Ammonium Sulfate	21-0-0	1,2,3,4
Complete Formula B	34-3-7	1,2,3
Complete Formula C	21-3-5	1,2,3
Check	--	--

Table 7. Programs and rates for test on the effect of nitrogen source, rate, and time of application on a bluegrass/ryegrass turf at Pullman, Washington

Date of Application	Program # 1	2	3	4
	lbs. N/1000 ft^2			
April	1.8	.7		
May			.9	
June	.7	.7	.9*	
July				
August	.45	.45		
September				1.0
October	.7	1.8	1.4	
November				2.0

*Applied 1982 only

Table 8. Effect of nitrogen source, rate, and time of application on quality and color of a bluegrass/ryegrass turf during 1982 at Pullman, Washington

		Quality (9 = excellent)			Color (9 = dark green)		
Fertilizer	Program	Aug	Sept	Mean	Aug	Sept	Mean
Methylene urea	1	7.7	7.0	7.3	6.7	7.0	6.8
	2	7.7	8.7	8.2	6.7	8.3	7.5
	3	7.7	7.7	7.7	6.7	7.3	7.0
IBDU	1	7.0	7.7	7.3	7.3	8.0	7.7
	2	7.7	7.7	7.7	7.0	7.3	7.2
	3	8.0	8.0	8.0	7.3	7.7	7.5
SCU	1	8.0	7.7	7.8	7.0	8.7	7.8
	2	7.7	7.7	7.7	7.0	8.3	7.7
	3	7/7	7.3	7.5	7.0	7.0	7.0
Ammonium sulfate	1	7.7	8.3	8.0	7.0	8.7	7.8
	2	7.7	7.7	7.7	7.0	8.3	7.7
	3	7.3	8.0	7.7	6.7	7.7	7.2
	4	7.7	7.3	7.5	6.3	7.3	6.8
Complete B	1	8.0	7.3	7.7	7.0	7.7	7.3
	2	7.7	7.7	7.3	6.3	8.0	7.2
	3	7.3	7.0	7.2	7.0	7.0	7.0
Complete C	1	7.7	8.0	7.8	7.0	8.7	7.8
	2	7.7	8.3	8.0	7.0	8.3	7.7
	3	7.7	7.0	7.3	7.3	7.0	7.2
Check	-	7.3	6.7	7.0	6.7	6.7	6.7

TURFGRASS CULTIVAR EVALUATION IN CENTRAL WASHINGTON[1]

William J. Johnston and Dave Evans[2]

Extensive turfgrass cultivar evaluations have been conducted for many years in western Washington at Puyallup and in eastern Washington at Pullman; however, only limited turfgrass trials have been performed to determine the best adapted turfgrass species and cultivars for central Washington. Dr. Dave Evans, Agronomist at the Irrigated Agriculture Research and Extension Center at Prosser, Washington, and I have recently begun a series of turfgrass trials at Prosser to evaluate turfgrasses for the Columbia Basin. Information gained from these studies will permit Extension Service personnel to make the best possible turfgrass species and cultivar recommendations for this region.

RESEARCH PROCEDURE

In August, 1981 a lawn area of approximately 8000 ft^2 located adjacent to the main building at the Irrigated Agriculture Research and Extension Center was sprayed with glyphosate. After the grass had died, the area was rototilled and N, P, K, and S at approximately 1.3, 2.4, 3.1, and 1.5 lb per 1000 ft^2, respectively, were incorporated. On September 14, 1981, the area was seeded with 27 bluegrasses, 16 fescues, and 13 ryegrasses. Bluegrasses and fescues were seeded at 3 lb per 1000 ft^2 and ryegrasses were seeded at 5 lb per 1000 ft^2. Individual plot size was 6 x 7 ft.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Assistant Professor, Washington State University, Pullman, WA, and Agronomist, Irrigated Agriculture Research and Extension Center (WSU), Prosser, WA.

There were three replications of all but a few plots for which limited seed were available.

In August 1982, '328' and '419' bermudagrass and 'Meyer' zoysiagrass, both warm season turfgrass species, were established. These grasses were established from two-inch plugs planted on six-inch centers into a sod that had been previously sprayed with glyphosate. Plot size was 6 x 7 ft and there were three replications.

RESULTS

The turfgrass species and cultivars at Prosser, Washington were rated for overall turfgrass quality August 12, 1982. After one year of growth the best appearing bluegrasses were Kimono, Glade, and Geronimo (Table 1); the best ryegrasses were Citation, Regal, and Acclaim (Table 2); and the best fescues were Rebel and Erika (Table 3). Additional ratings of these plots will be conducted over the next several years to determine the best turfgrass cultivars for central Washington.

The bermudagrasses and zoysiagrass were beginning to send out runners early this fall; however, no data has yet been collected on these plots.

Table 1. Turfgrass quality of Kentucky bluegrass cultivars August 1982 at Prosser, Washington.

Cultivar	Quality	Cultivar	Quality	Cultivar	Quality
Kimono	9.0*	A-20	6.7	Touchdown	6.3
Glade	8.0	Ram I	6.7	Majestic	6.3
Geronimo	8.0	Bonnieblue	6.7	Merit	6.0
Baron	7.3	Holiday	6.7	Brika	6.0
America	7.3	Sydsport	6.7	Monopoly	6.0
Vantage	7.0	Vanessa	6.7	Enmundi	5.7
Parade	7.0	Adelphi	6.3	Nugget	5.3
Garfield	7.0	Bensun	6.3		
AG 463	7.0	Cougar	6.3		
		Victa	6.3		

*Quality 1 to 9 with 9 = excellent

Table 2. Turfgrass quality of ryegrass cultivars August 1982 at Prosser, Washington.

Cultivar	Quality	Cultivar	Quality
Citation	8.0*	Blazer	6.7
Regal	7.7	Manhattan	6.7
Acclaim	7.7	Dasher	6.3
Fiesta	7.0	Loretta	6.0
Diplomat	7.0	Caravelle	4.7
Pennfine	7.0		
Yorktown II	7.0		
Paramount	7.0		

*Quality 1 to 9 with 9 = excellent

Table 3. Turfgrass quality of fescue cultivars August 1982 at Prosser, Washington.

Cultivar	Quality	Cultivar	Quality
Rebel	6.0*	Novarubra	5.0
Erika	6.0	Ensylva	5.0
Pennlawn	5.3	KY-31	5.0
Koket	5.3	Jamestown	4.0
Highlight	5.3	Barfalla	4.0
Ruby	5.0	Waldorf	4.0
Dawson	5.0	Biljart	4.0
Illahee	5.0	Banner	3.0

*Quality 1 to 9 with 9 = excellent

TAKE-ALL PATCH (*OPHIOBOLUS* PATCH) ON BLUEGRASS TURF IN WASHINGTON[1]

Gary A. Chastagner and Roy Goss[2]

Since the early 1960's, take-all patch (formerly called Ophiobolus patch) caused by the fungus Gaeumannomyces graminis var. avenae has been recognized as an important turfgrass disease in the Pacific Northwest. This disease frequently appears where soil has been fumigated with methyl bromide before planting or where turf is established on previously undisturbed soil such as cleared forest land.

Take-all patch is favored by cool, wet weather, but initial symptoms appear during early or mid summer. Initial symptoms generally appear one to three years after the turf is established and appear as a thinning and/or dying of the grass in rings or arcs. Both the roots and shoots of infected plants eventually die. Infected turf is easily lifted from the soil because of the weakened or dead root system. Doughnut shaped rings from several inches to several feet in diameter are formed as the disease symptoms develop and active rings have margins which are light reddish-brown in color. The centers of rings are usually invaded by weeds and annual bluegrass.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Assistant Plant Pathologist and Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup, WA.

The fungus which causes this disease produces structures known as runner hyphae on the roots and crowns of infected plants and may or may not produce fruiting structures known as perithecia during the fall.

Kentucky bluegrasses are considered to be more resistant to take-all patch than are bentgrasses. However, during the past several years a problem resembling take-all patch has been observed on Kentucky bluegrass turf in eastern Washington and to a limited extent in western Washington. Symptom development is similar to take-all patch on bentgrass turf and Gaeumannomyces-like runner hyphae are commonly found on the roots and crowns of diseased plants. In most cases, affected turf was established as sod. 'Baron' Kentucky bluegrass has been commonly used in most of the sodded turf examined in eastern Washington and pathogenicity studies indicate that the fungus isolated from diseased bluegrass is pathogenic on this cultivar of bluegrass. We are currently trying to identify this fungus to determine if this disease is take-all patch.

Once this fungus has been identified, additional work which needs to be completed includes determining the susceptibility of Kentucky bluegrass cultivars to this pathogen and the effectiveness of management, chemical and biological methods of controlling this disease.

Additional information about take-all patch can be obtained by requesting Extension Bulletin No. 713 and Extension Bulletin No. 0939 from Publications, Cooperative Extension, Washington State University, Pullman, WA 99164.

EVALUATION OF PERENNIAL RYEGRASS CULTIVARS IN SHADE ENVIRONMENT[1]

Stan Brauen[2], Ray McElhoe[3], and R.L. Goss[2]

INTRODUCTION

Perennial ryegrass (Lolium perenne L.) is commonly used in overseeding of tees, fairways, and sports fields in the Pacific Northwest. In the area of the best adaptation for perennial ryegrass, west of the Cascades, these overseeded areas include large shaded environments. Red and chewings fescue (Festuca spp. L.), long considered the best adapted cool season turfgrasses for shaded areas, are often included in these overseeding programs, but is always less effectively established.

Most of the recently released and available perennial ryegrass varieties have not be comparatively observed in shaded environments and not under use conditions here. Too, we would expect turfgrass varieties to perform differently in a shaded environment as compared to an open area. In the past, Vargas and Beard have shown Kentucky bluegrass disease resistance of certain varieties in the full sun cannot be extrapolated to shade environments.

MATERIALS AND METHODS

Forty-six perennial ryegrass varieties plus five two-cultivar blends and 21 mixtures of Kentucky

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3/ Superintendent, Everett Golf and Country Club, Everett, WA.

bluegrass, perennial ryegrass and fine fescue were seeded at the Everett Golf and Country Club on September 1, 1982. The research area is irrigated and on an Everett gravelly sandy loam soil in the shade of tall Douglas-fir trees and distant from the influence of the tree root zone. Plot size is 1.2 x 2 m with 3 replicates. Lime was applied at 54.8 lb per 1000 ft^2 and the area fertilized with 1.23 lb of nitrogen, P_2O_5, and K_2O per 1000 ft^2 prior to seeding. Seeding and early culture was excellent and uniform establishment was achieved. Plots were rated for early vigor and emergence at 14 days and percent cover evaluations were made at 14, 17, 29, 49, and 72 days. Seedling density was evaluated at 17, 29, and 72 days.

RESULTS AND DISCUSSION

One of the several factors altered in the shade environment is the interception of direct radiation by trees, shrubs or structures. Other microenvironmental factors such as restricted air movement, alteration of relative humidity, differential extremes in diurnal and seasonal temperatures and nutrient and water competition are often altered. September mid-day direct solar radiation under clear skies was estimated at 7-8,000 foot candles at the turf surface. This shade environment reduces the light intensity to 800-900 foot candles at this same time. On clear days, the plot area receives approximately 1.5 hrs of direct sunlight (mid-September) and 12.5 hrs of shade or altered sunlight. The light intensity in early morning and later evening hours is below 400 foot candles.

Of the currently available cultivars, Elka, Diplomat, Palmer, Yorktown II, plus the Derby-Elka and Diplomat-Yorktown blends achieved greater than 68% cover by 49 days. The cover achieved by Manhattan, Pennfine, Regal, Dasher, Delray, Acclaim, Citation, Linn, Prelude and blends of Barry-Prelude and Premier-Pennant were below 60% on the same date.

Seventy-two days after seeding Elka, Diplomat, Palmer, Yorktown II, Manhattan II, Omega, Pennant, Barry and blends of Derby-Elka and Diplomat-Yorktown II were in excess of 77% cover. Prelude, Citation, Linn, Delray, Acclaim, Dasher, Regal and Premier were below 68% cover. Pennfine, Manhattan, Fiesta, Derby, Blazer, Palmer and blends of Prelude-Palmer, Barry-Prelude and Premier-Pennant were intermediate.

Evaluations of seedling density indicated the superior cover of Elka, Diplomat, Palmer and blends of Derby-Elka and Diplomat-Yorktown II were partially related to higher seeding densities which may be correlated with a higher number of seed per pound of those varieties.

TABLE 1. Early vigor, cover and seedling density of perennial ryegrass in shade environment at Everett, WA.[1]

Cultivar	Cover 49 days	Cover 72 days	Seedling density 49 days	Seedling density 72 days	Vigor 14 days
	--------(%)------				
Elka	74	85	7.7	6.3	6.0
Diplomat	72	77	6.8	6.0	5.0
Derby-Elka	71	87	7.3	7.0	4.7
Palmer	71	73	7.3	6.0	5.7
Yorktown II	69	77	6.7	5.7	5.7
Diplomat-Yorktown II	68	80	6.3	6.0	4.7
Prelude-Palmer	66	73	6.3	5.0	5.7
Manhattan II	66	77	6.5	5.7	5.7
Omega	64	78	6.2	5.3	5.0
Blazer	63	72	5.8	5.3	4.7
Pennant	63	82	7.3	6.3	5.0
Barry	63	82	6.2	5.7	4.3
Derby	63	72	6.0	5.3	4.3
Premier	63	68	6.7	4.0	4.7
Fiesta	61	75	6.8	5.3	4.3
Manhattan	59	72	6.2	6.3	6.7
Pennfine	59	70	5.5	4.7	4.0
Regal	58	65	6.3	4.7	5.0
Barry-Prelude	58	73	6.3	5.0	5.0
Dasher	57	68	6.5	4.0	4.3
Delray	57	52	6.3	3.3	4.7
Acclaim	56	65	6.2	5.0	4.0
Citation	56	57	5.8	3.3	4.0
Premier-Pennant	52	70	6.3	5.3	4.7
Linn	50	60	5.7	4.0	5.0
Prelude	45	60	4.8	4.3	3.0

[1] Vigor recorded 14 days after seeding with 9 = best vigor. Percent cover recorded at 49 and 72 days after seeding. Seedling density recorded 49 and 72 days after seeding, 9 = best density.

AVAILABLE ADAPTED CULTIVARS FROM REGIONAL CULTIVAR EVALUATIONS[1]

Stan Brauen and Roy Goss[2]

We have evaluated many of the cultivars of Kentucky bluegrass (Poa pratensis), perennial ryegrass (Lolium perenne) and fine fescue (Festuca spp.) that have been developed in the past few years. These developments have made available to turfgrass growers a large selection of cultivars from which to chose. Quite often, then it becomes difficult for users to find specific varieties available to them. Too, seed suppliers often have difficulty attempting to fill seed requests for high performance varieties when primary seed production responsibility rests with several companies.

I have recently checked with major suppliers of turfgrass seed in the Pacific Northwest to determine availability of seed varieties during this coming year. The following analysis may help to sort out some of the confusion and at the same time provide some direction toward variety use.

In western Washington our studies have shown that Sydsport, Bensun (A-34), Bristol, Baron, RAM I, Bonnieblue, Parade, Touchdown, Glade, America, and Birka have usually been in the top performance group of available Kentucky bluegrasses. However, Sydsport, Bensun, and Bristol have commonly received our highest average ratings from all studies. Thus, these varieties could be used in blends with other available Kentucky bluegrass varieties listed in Table 1 to provide good blend or mixed components.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

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Likewise, there are many available perennial ryegrass varieties that have performed well in our tests. These have generally been Barry, Blazer, Derby, Diplomat, Elka, Fiesta, Dasher, Manhattan II, Prelude, Omega, Premier, Pennant, Loretta, Regal, Yorktown II, Palmer, Princess, Citation, Manhattan, and Pennfine. Usually several of these varieties are produced by the same seed producer and most seed suppliers cannot and do not wish to stock all of these varieties. Consequently, it may be easier and more convenient to look for varieties produced by a common seed producer. For example, Table 2 lists the currently available perennial ryegrass varieties and their major seed producer. By the use of this information and that gathered by you through your seed supplier, many good species/variety combinations are available.

TABLE 1. Available Kentucky bluegrass varieties in the Pacific Northwest.

Suggested base variety	Suggested blend variety	Seed producer
Sydsport	Merit	International Seed
Bensun (A-34)	Touchdown	Pickseed
Bristol	America	Pickseed
	RAM I	Great Western
	Parade	N-K
	Bonnieblue	Burlingham
	Glade	Jacklin
	Trampas	Pacific Seed

TABLE 2. Available adapted perennial ryegrass varieties in western Washington.

Variety blend	Seed producer
Blazer-Fiesta-Dasher	Pickseed
Derby-Diplomat-Yorktown II	Great Western
Omega-Citation-Manhattan II	Turf Seed
Derby-Regal-Elka	International Seeds
Premier-Pennant-Pennfine	Ag. Services
Prelude-Derby-Palmer	Great Western

ENDOTHAL, BENSULIDE AND Nortron ALONE AND IN COMBINATION TO CONTROL *POA ANNUA* IN LOW MAINTENANCE TURFGRASS[1]

S.E. Brauen and R.L. Goss[2]

Most of us realize the availability of natural resources and monetary resources for maintenance may be low in the future. We must ask ourselves the question, will this lack of resources alter the use of other management practices that are now commonly used. In the past, Tom Cook and Roy Goss have demonstrated that the use of endothal has less adverse effects on bentgrass if the bentgrass is vigorously growing. This will normally mean the encouragement of vigorous growth through the use of nitrogen fertilizer prior to endothal application.

In the future, would the lack of available nitrogen or a reduced fertility program seriously predispose the bentgrass turf to serious injury in subjected to the endothal program.

MATERIALS AND METHODS

In 1981 a program was set up to study the influence of repeat applications of pre and postemergence chemicals on plant stress, vigor, turf quality and rooting of bentgrass, perennial ryegrass, Kentucky bluegrass and fine fescue. Monocultures of these four species were treated with the herbicides listed in Table 1. Treatments were applied at three low levels of nitrogen to simulate low nitrogen maintenance. Sub-treatment plots were 1.5 x 3 m and

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main nitrogen plots were 6 x 6 m. Plots were evaluated for turf quality, color and density as needed in 1981-82. Root mass was determined in February 1982. *Poa annua* was determined by seedhead population and by point quadrant analysis in August 1982.

RESULTS AND DISCUSSION

Under these low nitrogen fertilization levels endothal reduced turf color by 5 points within one week after application as compared to the control (Table 2). Bensulide decreased color 1 point. The application of Nortron in the fall reduced quality and color 3.5 points as compared to no treatment.

By seedhead count, bensulide was effective in reducing *Poa annua* in bentgrass by 50% while the combination of bensulide plus endothal, endothal alone or endothal plus Nortron produced total control. Nortron by itself was only slightly effective in reducing *Poa annua*. Late summer *Poa* counts by point quadrant plant identification showed only endothal plus bensulide was effective in near total control of annual bluegrass.

Endothal was most effective in reducing annual bluegrass from turf areas, but discoloration was severe for 3 to 4 weeks following application. Appearance may not be acceptable for many turf uses. An application of a turf colorant alleviated the color objections, but increased cost of treatment. Turf thinning and injury initiated by the Nortron fall application was unacceptably severe throughout the fall and winter.

No reduction in root mass could be detected in the first year sampling although the root masses associated with endothal were usually numerically lower. At present the use of endothal alone or combinations of endothal and bensulide appears to be acceptable on minimally maintained turf. Because recovery is slow following endothal application on low nitrogen maintained turf, reduced use may be appropriate where possible.

TABLE 1. Pre- and post-germination herbicide treatments used in low nitrogen maintained turf study.

Herbicide	Rate oz/1000 ft^2	Time of application
No treatment	-	-
Bensulide	5.51	April
Bensulide Repeat	4.41 + 1.47	April & Sept.
Endothal	0.82	April
Endothal + Bensulide	0.82 + 4.41	April
Endothal + Nortron Repeat (3X)	0.82 + 0.18	Jun,Jul,Aug.
Nortron Repeat (3X)	0.18	Jun,Jul,Aug.
Nortron Repeat (3X)	0.18	Aug,Sep,Oct.

TABLE 2. Effect of bensulide, Nortron and/or endothal on color and *Poa annua* levels in bentgrass putting turf.

Herbicide	May color[1]	Jan. color[1]	Poa seedhead[2]	Poa count[3]
No treatment	7.5	5.0	38	6.3
Bensulide (15)	6.3	4.5	16	6.6
Bensulide (12 + 3)	6.7	4.8	24	6.6
Endothal	3.1	5.3	1	4.2
Endothal + Bensulide	2.5	5.3	0	1.7
Endothal + Nortron	3.3	5.0	1	5.2
Nortron (summer)	7.3	5.0	27	7.9
Nortron (summer + fall)	7.7	1.5	26	6.7

1 Rating 1 to 9; 9 = darkest color.

2 Number of *Poa annua* seedheads per quadrant.

3 Number of *Poa annua* point quadrant contacts/30 points.

THE EFFECTS OF GROWTH REGULATOR COMBNATIONS ON TURF QUALITY AND GROWTH OF MIXED TURF[1]

Stan Brauen, Roy Goss, S. Orton and M. Abraham[2]

Mowing of quality turf is costly and the reduction of mowing frequency would reduce costs of turfgrass maintenance. In the hopes of realizing this concept and practice, chemical development and testing have continued for the past 30 years. Still registered effective growth regulants do not exist that do not limit use capability of quality turfgrass or adversely reduce the quality of high value turf. Still newer compounds are under development nationwide which show advances are being made toward the realization of growth regulator use.

There are several growth regulators that are currently being studied at Puyallup to establish their potential use on turf. Initially, the common effects of growth regulants under test in turfgrass are discoloration, chemical injury, uneven growth suppression, loss of turf density, while some may provide seedhead suppression. With some regulants, color and growth enhancement may occur later. Dissimilar growth regulation or even kill between species or even cultivars may occur. Currently we are studying various facets of growth regulation by EL 500, PP 333, Embark, MBR 18337, MON 4621, and MON 4622.

1/ Presented at the 36th Annual Northwest Turfgrass Conference, Yakima, WA, September 21-23, 1982.

2/ Associate Agronomist, Extension Agronomist, Agric. Research Tech. II, and Agric. Research Tech. II, Western Washington Research and Extension Center (WSU), Puyallup, WA.

The effects of these growth regulants on turfgrass species as related to rate and timing and growth regulant cross compatibility in the Pacific Northwest is unknown. The influence of growth regulation application on plant nutrition, root development or predisposition to disease and stress is unknown.

MATERIALS AND METHODS

Table 1 lists the growth regulators, rates and combinations of growth regulators that were studied in the study. The purpose of the study was to determine the rates and combinations most effective in the control of growth, seedhead development, and maintenance of turf quality, density and color of mixed lawn turf. The study was a completely randomized design with plots measuring 1 x 2.5 m with three replications per treatment. Growth regulators were applied on April 30, 1982 with a CO_2 backpack pressure sprayer at 35 psi and 2 gallon water per 1000 ft^2. The plots were mowed at 4 cm prior to growth regulator application. The area was seeded to a mix of 73% fescue made up of Checker chewings fescue, Fortress red fescue, and Scaldis hard fescue in a ratio of 3:1:1 plus 28% P3 perennial ryegrass made up of Premier, Pennant and Pennfine at a ratio of 1:1:1. The research area was fertilized with 1 lb of nitrogen per 1000 ft^2 from ammonium sulfate source two weeks prior to growth regulator application.

Experimental plots were mowed with a 20 inch California Clipper front reel mower every 14 days from May 15 until July 22. Clippings were collected, dried at 120°F and weighed. Ratings of turf quality and percent stand loss were taken prior to clipping. Plant height, growth uniformity and turf density were rated on May 15 and May 28.

RESULTS AND DISCUSSION

All growth regulants significantly decreased clipping yield, height and quality for a period of 4 weeks following application. Any growth regulant used alone reduced quality to a lesser degree than if used in combinations. EL 500 and PP 333 used alone generally did not reduce quality as much as Embark used alone. Two weeks following application quality was always decreased as rate was increased (Fig. 1).

Like quality, the percent stand reduction generally increased as the rate of growth regulant increased, but the percent stand reduction was not proportional to rate. The maximum percent stand reduction seemed to be more immediate with single and combination applications of PP 333 while stand reductions associated with EL 500 alone and in combination were not as immediate but occurred for a longer period.

Growth control with all growth regulants as measured by clipping yield was characterized by low growth during the first 2 to 4 weeks following application as compared to the control followed by a flush of growth which was often in excess of the control. The addition of Embark to either EL 500 or PP 333 increased the growth control of these two growth regulants and provided effective control of seedhead emergence. With EL 500 plus Embark the flush following growth control appeared at about 5 weeks following application. With PP 333 plus Embark this flush appeared to occur at about 6 weeks.

For effective evaluation of these growth regulants, future studies should include the application of nitrogen at various rates and times during growth control to better understand their growth control properties. In this study available nitrogen had probably become deficient in the untreated control at about 6 to 7 weeks following applications of the growth regulants. It would appear that lower nitrogen fertilization requirements could be associated with the use of growth regulants. But the timing of the nitrogen application as compared to the time of application of growth regulant could be strongly associated with the retention of turf quality or the maintenance of turf stands.

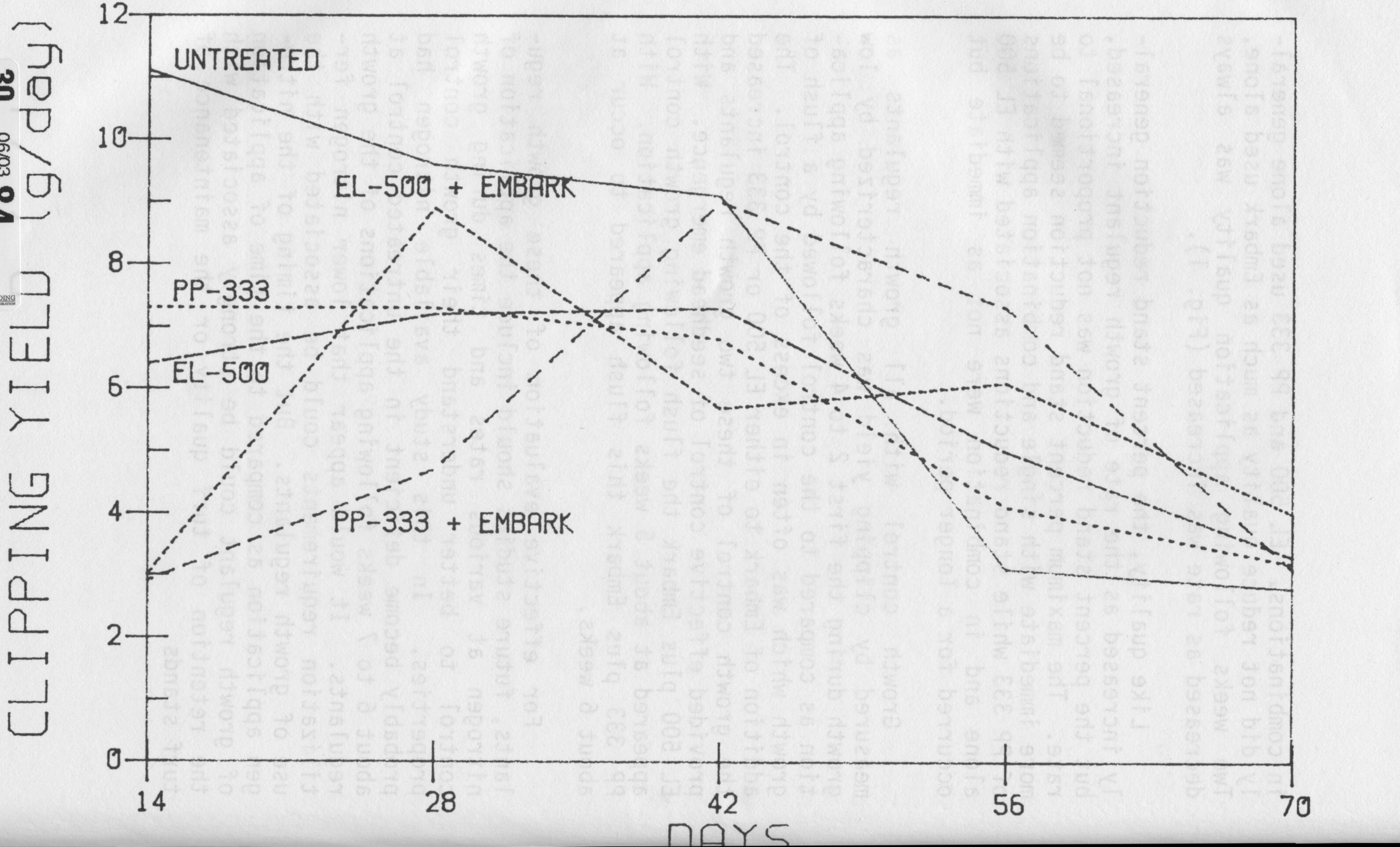
CLIPPING YIELD (g/day)
DAYS
UNTREATED
EL-500 + EMBARK
PP-333
EL-500
PP-333 + EMBARK
12
10
8
6
4
2
0
14
28
42
56
70

TABLE 1. Growth regulator chemicals and application rates.

Chemical	a.i./A
EL-500	0.75
EL-500	1.0
EL-500	1.25
EL-500	1.5
PP-333	0.375
PP-333	0.5
EL-500 + Embark	0.75 + 0.068
EL-500 + Embark	1.0 + 0.068
EL-500 + Embark	1.25 + 0.068
EL-500 + Embark	1.5 + 0.068
EL-500 + Embark	0.75 + 0.125
EL-500 + Embark	1.0 + 0.125
EL-500 + Embark	1.25 + 0.125
EL-500 + Embark	1.5 + 0.125
PP-333 + Embark	0.375 + 0.068
PP-333 + Embark	0.5 + 0.068
PP-333 + Embark	0.375 + 0.125
PP-333 + Embark	0.5 + 0.125

TURFGRASS RESEARCH SUPPORT

The following is a list of companies and associations that have generously supported the turfgrass research program. Their present and continued support is greatly appreciated and essential to the continued development and distribution of information beneficial to the turfgrass industry in the Pacific Northwest.

Andersons
American Hoescht
BFC Chemicals Inc.
Diamond Shamrock
Elanco
Emerald Turfgrass Farms
Great Western Seed Co.
Hemphill Brothers
Highland Bentgrass Commission
International Seeds
Lilly-Miller
Lofts Pedigreed Seed
Mallincrodt Chemical
Mobay Chemical Corp.
Monsanto Company
Northwest Mowers
O. M. Scott & Sons
Ortho
PBI/Gordon Corp.
Pennwalt
Pickseed West, Inc.
Puget Sound Seed
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Turf and Toro Supply
Turfgo Northwest
Union Carbide
W. A. Cleary Chemical