Proceedings Of The 37th Northwest Turfgrass Conference

Sept. 19-22, 1983
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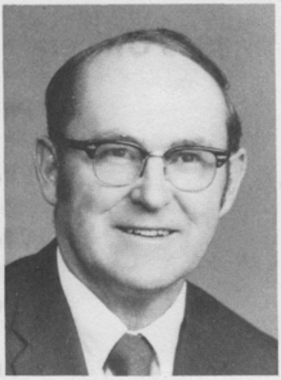

PRESIDENT'S MESSAGE

Richard Malpass

Included in these Proceedings of the 37th Northwest Turfgrass Conference held at the Kah-Nee-Ta Resort at Warm Springs, Oregon, September 19-22, 1983 will be found virtually all of the presentations made during the course of the Conference. In keeping with the desire of the Board of Directors of the NWTGA, split sessions were again utilized to present subjects of specific interest both to golf course superintendents and to grounds managers for schools, parks or other installations. Favorable response was the general reception of such a program with the request that it be continued and even expanded. Over the years our association has developed a wealth of information regarding grounds and turf management practices. We are happy to share it with all who are interested. Additionally, we assist with on-going research projects in this field and make results available as quickly as possible. Too, we have available many speakers from other areas willing to share their expertise with us. We encourage turf managers to share their problems with us and are happy to help in finding solutions for those problems.

We would encourage anyone interested in the maintenance of athletic fields, grounds, parks, and golf courses to make plans to attend the 38th Annual NWTGA Conference next fall in Coeur d'Alene, Idaho. We speak from many years attendance at these conferences that it is a great learning experience and hope that you can attend.

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EFFECTIVE USE OF EFFLUENT WATER FOR TURFGRASSES[1]

Dr. M. Ali Harivandi[2]

The concept of irrigation with reclaimed water is increasingly attractive in arid and semi-arid regions and in highly populated metropolitan areas, as shortages and/or costs of fresh water increase, and as more and better quality treated water is becoming available for re-use.

Most reclaimed water not dumped into the ocean and to fresh water streams or spread on land, is used for ground water recharge, industrial use, control of saltwater intrusion or agricultural use. Agriculturally used reclaimed water is applied to 1) pasture; 2) fodder, fiber, and seed crops; 3) crops that grow well above the ground, such as fruits, nuts, and grapes; 4) crops that are processed so that pathogenic organisms are destroyed prior to human consumption; and, 5) parks, roadsides, landscapes, golf course, cemeteries and athletic fields.

Although there is not much competition for use of effluent water at this time, such competition is anticipated in the near future. Parks, golf courses, and other turfed areas will then be in a better position to compete with prior water use sources for reclaimed water, than for fresh water. Although the ultimate users of effluent water will be influenced greatly by federal, state, and local laws and regulations; there are, however, several arguments favoring use of this water on golf courses, parks, cemeteries, etc., over using it in food-related agriculture. Among these arguments are the following: 1) Turfgrasses are generally "heavy feeders", requiring relatively large amounts of nitrogen and other nutrients. 2) Reclaimed water is produced continuously and any use of it, therefore, also

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ University of California Cooperative Extension, Hayward, CA.

needs to be continuous. A turfgrass "crop" is continuous, i.e., is not interrupted by cultivation, seeding, or harvest, all of which mean stopping irrigation for considerable periods. 3) Most irrigated turf sites are located adjacent to cities where the effluent water is produced, thus transport costs will be minimal. 4) Potential health problems related to the use of reclaimed water are lower when the water is applied to turf than when it is applied to food crops. 5) Soil-related problems which might develop due to the use of reclaimed water will have less social and economic impact if they develop where turf is cultivated than if they develop where food crops are grown.

The concept of effluent water irrigation for turf and landscape is not new. Many turf and landscape managers have been using this water for the past two decades and have demonstrated its suitability if proper application procedures are followed. What follows is a discussion of the various facts involved in effective use of effluent water for turfgrass irrigation.

Healthy Considerations

The biological composition of effluent water is of great concern because of pathogenic bacterial and viruses. Effluent waters are not generally released for irrigation without prior approval of public health authorities. Since the effluent water released for turf and landscape irrigation is generally secondary effluent, it may contain some harmful chemical and biological substances and irrigation practices should, therefore, avoid direct human contact with the water and pollution of surface or ground waters. In addition, an entirely separate delivery system must be constructed to carry the effluent; there must be no possibility of accidental contamination of the domestic water system.

Seasonal and Annual Variation

Seasonal variation in reclaimed water quality can be significant. For example, the water discharged to a city sewage system from a processing plant operated during a portion of the year, may vary considerably in a specific mineral content in that specific portion of the year from the water released during the rest of the year.

Annual variation in water quality is as important, if not more important, than seasonal variation. As an example, increased levels of boron and/or phosphorus could be detected annually in a city's sewage system due to the population growth resulting in greater amounts of detergent in the city's sewage system.

Constancy of Supply

Effluent water, after a contract has been signed, will keep coming regardless of time of year, time of day, whether or not it is raining, and whether or not you need it. Water supply is continuous, while turf needs are variable. There must, therefore, be some type of water storage available. Since most contracts for waste water required that a specific amount be accepted each day, regardless of weather conditions, the storage requirement is a common feature of systems using effluent water.

Soil Factors

Soils vary widely in the physical and chemical properties important in effluent water irrigation of turfgrasses. Cation exchange capacity, infiltration rate, percolation rate, and water holding capacity of the soil are among the more important soil factors which should be considered before applying reclaimed water.

Coarse textured soils such as sandy loams are best for the use of reclaimed water, heavier soils are all right as long as changes in soil chemical properties are evaluated regularly.

Water holding capacity of soil is also important in suitability for reclaimed water irrigation. Frequent application of reclaimed water on soils with high water holding capacity, such as clay soil, will contribute significantly to the accumulation of salts and heavy metals.

Shallow soils overlaying rock, hard pan or clay pan, restrict water percolation and drainage. The resultant perched water tables will promote accumulation of soluble salts and toxic ions considerably.

In sum, although soil factors should not preclude the use of effluent water, they must be considered in any management program where reclaimed water is to be used for irrigation.

Irrigation System Factors

Because of potential clogging of sprinkler nozzles, due to algae, a good filter is suggested where the effluent water enters the sprinkler system to prevent clogging.

Also, because both harmful and beneficial substances may be applied with irrigation water, irrigation pattern uniformity is of prime importance.

Disadvantages of Effluent Water Use

A-Salinity: Salinity problems occur when the total quantity of soluble salts in the grass root zone is high enough to adversely affect the turfgrass. Most effluent waters are high in salts and, especially in heavy soils, the salt might accumulate to levels intolerable to most turfgrasses.

If salinity is a problem in using effluent water, the following management practices should be considered.

- Irrigate more frequently to maintain a higher soil moisture content.
- Plant salt tolerant grasses.
- Apply extra water to leach excess salts.
- If a hard or clay pan is present, modify soil profile to improve water percolation.
- Install artificial drainage if shallow water tables are a problem.
- Blend effluent water with a less salty water.

B-Permeability (S A R): Reduced permeability problems may occur if the effluent water contains high levels of sodium. Relative permeability is often expressed as S A R (Sodium Adsorption Ratio), the ratio of sodium to calcium and magnesium. A high ratio - above 9 - indicates potential permeability problems in the future.

Carbonate and biocarbonate content can also affect soil permeability and must be evaluated along with the calcium, magnesium, and sodium content of both soil and effluent water.

Typical symptoms of reduced permeability include waterlogging, slow infiltration, crusting or compaction, poor aeration, weed invasion, and disease infestation. Reclamations for correcting or preventing a permeability problem include:

- Applying soil amendments such as gypsum, sulfur or sulfuric acid.

- Blending reclaimed water with water containing little or no sodium.

- Applying irrigation water at a slower rate over a longer period.

- Aerifying on a regular basis.

C-Toxic Elements: Effluent waters usually contain a wide variety of elements in small concentrations. Problems can occur when certain elements accumulate in the soil to levels toxic to turfgrass and other plants. Toxicities can occur due to an accumulation of boron, chloride, copper, nickel, zinc, or cadmium. Boron concentration can vary from 0.5 to 1 ppm. Although this range by itself is not toxic to many plants, on heavy soils higher levels may build and present problems, especially for trees and shrubs. Turfgrasses are usually much more tolerant of boron than other plants if they are mowed and clippings are removed regularly.

Chloride is not particularly toxic to turf, but most trees and shrubs are quite sensitive to a chloride content of 10 m eq/1 (355 ppm). Copper, nickel, zinc, and cadmium are heavy metals that, in some instances, build to high levels in reclaimed water. High concentrations of zinc and copper are usually beneficial to turf; nickel and cadmium are a concern only if the land will be used for other agricultural purposes (e.g., crop production). Practices that reduce the effective concentration of toxic elements include:

- Irrigating more frequently.
- Applying additional water for leaching.
- Blending reclaimed water with better quality water.
- Planting more tolerant species.
- Applying lime if heavy metal toxicity is due to low pH.

Advantages of Effluent Irrigation

A-Conservation: Reclaimed water provides an additional water source when the supply of fresh water is short.

B-Cost: Reclaimed water is often much less expensive (usually 1/3 cost domestic water) and in some instances is free.

C-Nutrient Content: Reclaimed water can be high in nutrients. This is usually quite beneficial in turfgrass management programs. Although quantities are low, because nutrients are applied on a frequent and regular basis, they are efficiently used by the plants. In most cases, turf and trees will obtain all the phosphorus and potassium they need and a large part of their nitrogen will also be supplied. Sufficient micronutrients are also supplied by most reclaimed waters.

Plant Factors

Depending on the quality of the water, irrigation of different plants may not be equally desirable. In general, turfgrasses may be the best plants for effluent irrigation. They take up large amounts of nitrogen, phosphorus, and potash found in the water. They will also accumulate large amounts of boron without showing toxicity symptoms. However, some turfgrasses are better adapted to this use than others. If salinity is expected to become a problem, salt tolerant cool season grasses such as "Fults" alkaligrass (Puccinellia distans) and tall fescue (Festuca arundinacea) or warm season grasses such as seashore paspalum (Paspalum vaginatum), hybrid bermudagrass (Cynodon spp.) or St. Augustinegrass (Stenotaphrum secundatum) should be selected.

INTEGRATED PEST MANAGEMENT FOR TURFGRASS[1]

S.G. Fushtey[2]

Integrated Pest Management (IPM) is the catchword of modern pest control. Be definition, IPM is the combined use of chemical, cultural, genetic and biological methods for effective economical control of pests with minimum interference of non-target organisms. It is a concept which combines the use of many strategies and tactics in efforts to keep pest problems below levels which cause economic damage. Most of these strategies are not new but the concept of applying them together according to plan is a fairly recent development brought about by economics and other problems arising from increased use of chemical pesticides. Increasingly high cost of chemicals and ecological considerations have accelerated the implementation of IPM as an alternative to pest control programs which depended heavily on intensive use of chemicals.

Pest Control Strategies

The various pest control strategies evolved through the ages. Burning of fields to destroy weeds, insects and other pests is an age-old practice dating to times B.C. as is the use of natural enemies to control pest organisms. The Chinese were responsible for the first application of biological control. In records dated 300 A.D. the Chinese were reported to be establishing colonies of predatory ants in their citrus orchards to control caterpillars and boring beetles. They also recognized the beneficial effects of lady bugs which ate aphids. Substances with pesticidal properties such as pyrethrum, arsenic and sulfur were used from the time of the Greek and Roman Empires but the development of chemical pesticide use really belongs to the twentieth century. However, until the years immediately preceding World War II the use of

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Canada Department of Agriculture, Agassiz, BC, Canada.

chemical pesticides was limited due to the hazardous nature of the chemicals, their expense and their ineffectiveness in many situations. Pest management still depended to a large extent on environmental manipulation, sanitation, natural biological control and luck. The discovery of DDT in the 1940's changed all that. This miracle insecticide led to an explosion of interest in development of new insecticides, herbicides, fungicides, etc. Techniques for application were improved and control by chemicals became so effective that other means of pest control were nearly forgotten. Pesticides were applied according to schedule with little regard to whether pests were present, or in what density or what effects the pesticides had on other organisms. The object was insurance against pest damage but the result was a new set of problems. Quite suddenly, certain pests, such as spider mites, whose populations were generally small, became major pests. Two things happened:

1. Excessive use of pesticides destroyed the pest's natural enemies.

2. The pests developed resistance to the pesticides.

Freed of their natural enemies and tolerant of pesticides these pests survived and multiplied at incredible speed. To quote Flint and Bosch (1) in their book <u>Introduction to Integrated Pest Management</u>, "These problems, including environmental contamination, were predictable, but somehow these questions were pushed aside, and most pest managers and researchers of the 1940's and 1950's, mesmerized by the seeming simplicity and efficiency of pesticidal control, forgot the laws of ecology and stumbled into chaos." Quoting further, "Thus it is of critical importance to remember that pest management is basically an ecological matter. Man wants to secure as much of a given resource as possible with minimum competition from other organisms in the ecosystem. This demands an ecological outlook." Hence, Integrated Pest Management (IPM) which is an ecologically based pest control strategy that relies heavily on natural mortality factors and seeks out control tactics that disrupt these factors as little as possible. IPM uses pesticides but only as one of many tactics and then only after such use is justified by careful monitoring of the pest problem.

Basics of IPM

IPM programs rely on five basic tactics for plant protection, namely, regulatory, genetic, cultural, biological and chemical. By employing all of these, IPM programs are designed to reduce dependency on pesticides and this reduce overall pesticide usage.

Regulatory. Examples of regulatory tactics are certifications of seed and plant material, quarantines, seed inspection and elimination of highly susceptible species. Although these are largely the responsibilities of government agencies and industry the turf manager needs to be aware of these actions in order to be able to take full advantage of their objectives, which are directed against the introduction of pest problems.

Genetic. Genetic resistance is probably the oldest and most basic method of fighting pest problems. Turfgrass managers should acquaint themselves with, and select, resistant turfgrass species and cultivars and use them in mixtures or blends, or both. Vigorous, well adapted turfgrasses are less troubled by stress and more suited to resist pest problems. Although not always complete, information on resistance can be obtained from researchers, universities and industry.

Cultural. Probably the most important of IPM strategies. Turf that is weakened by soil compaction, improper fertility, and other neglect, will be less able to resist pest injury. Cultural practices may influence susceptibility to pest injury or they may affect the environment that favors development of the pest.

Mowing, fertilizing and watering practices have been well documented in their influence on the development of disease, insect and weed problems in turf. A healthy, vigorous turf requires mowing at the appropriate height and frequency; fertilizing to meet its nutritional needs and no more, and watering to meet its evapotranspiration requirements. Managing for thatch control, coring and topdressing contribute to an environment that favors healthy turf and reduced risk of damage by disease and other pests.

Biological. Although a very important tactic in control of a number of pests in crop plants there is not much in the way of effective biological control of turfgrass pests although studies on biological control of weeds and insects, which do occur in turfgrass are in progress. Biological control involves the use of natural enemies to eliminate pest problems. Microbial agents (bacteria, viruses and fungi) are most frequently used, eg, myxomatosis virus was introduced into Australia to control rabbits. Bacillus thuringiensis, a bacterial pathogen infecting a broad spectrum of insect pests is produced commercially and registered for use on a number of crops including vegetables and tree fruits for control of a variety of caterpillars and worms. According to Flint and Bosch (1), classic biological control has been applied successfully against well over 100 pest insect and weed species worldwide.

Chemical. Chemical pesticides have been developed for just about every group of plants, micro-organisms and animals that have ever been considered undesirable. Over a thousand different materials are registered in the United States as pesticide active ingredients. These, in turn, are formulated into many times that many commercial products.

Chemical pesticides are among the most useful pest control tools but they need to be used with great care. In an integrated pest management program they are used only when justified by careful sampling and with a consideration of the natural control factors operating in the ecosystem. The object of IPM is to not only control existing pests but to prevent the development of future pest problems. The solution of immediate problems with chemicals alone has proven to be rife with dangers as this often opens doors for greater problems ahead.

An Example of Effective IPM

Integrated Pest Management in Apples in Nova Scotia. Because of the high value and low tolerance for wormy apples in the marketplace, orchards were among the few agricultural ecosystems to receive regular, heavy pesticide applications even before the pesticide explosion of the 1940's. In Nova Scotia apple orchards in the 1920's and 1930's more frequent and heavier dosages of insecticidal chemicals were required to control insect pests as time went on. Among these pests were the codling moth, oystershell scale and the European red mite.

The Nova Scotia program developed a step at a time beginning with the oystershell scale. Previous to 1930, this pest was no problem, presumably kept in check by naturally occurring biological agents. Studies in the 1940's revealed that the predator and parasite populations were depleted to such a low level that they could not exert effective biological control. It was further discovered that the beneficial insects were not the victims of insecticides but they were being killed off by sulfur-based fungicides applied for disease control. The substitution of copper-based or ferbam fungicides for the sulfur-based ones resulted in restoration of natural control agents and effective biological control.

The same kind of approach was taken for the European red mite and codling moth with the result that effective control of these pests was achieved by restoring natural control agents and using a minimum of well-timed, selective insecticides. To develop this program took years of careful study but it paid off in effective pest control with much reduced use of pesticides.

<u>IPM in Turf</u>. With programs like the one just described being developed for pest control in crop plants, why not in turf? Maybe the problems with chemicals in turfgrass are not as acute as they are in crop plants so there isn't the same urgency for change. However, the problems are certainly there and the need for reduced dependency on chemicals for pest control is certainly recognized for both economic and ecological reasons. In his keynote address to the plant protection section at the 4th International Turfgrass Research Conference held in Guelph, Ontario in 1981, Dr. Al Turgeon (2) stated that "while pesticide use is an important component of a turfgrass program, pest management also includes selecting pest resistant turfgrasses that are well adapted to natural environmental and cultural conditions, following proper establishment procedures and performing cultural operations that favorably influence turfgrass growth and development." Good turfgrass managers do all these things without calling it integrated pest management, but we need to

learn how all these things can be used to the best advantage in the total picture of management for pest control.

Earlier I mentioned the basic tactics for plant protection in a general way. At the risk of repetition, I would like to elaborate on these as they relate more directly to turfgrass management.

1. Turfgrass Selection (genetic)

Many turfgrass pest problems can be substantially reduced by selection of superior, well-adapted grasses. Environmental adaption is particularly important. We have cool-season grasses which do best within a temperature range of 16 to 24°C and warm-season grasses which do best at 26 to 30°C. Prolonged exposure outside these ranges results in unthrifty growth and proneness to damage by pests such as disease, insects and weeds. Winter cold tolerance is important if a good stand of turf is to survive from year to year.

An important objective of turfgrass breeding is superior resistance to common diseases. Table 1 shows disease reaction of Kentucky bluegrass cultivars derived from trials at Agassiz.

One of the objectives of the National Turfgrass Trials sponsored by the USDA is to identify resistance to the various diseases across the nation in the cultivars under test. The results are tabulated at the end of each season, analyzed, and made available to the cooperators. If you have a particular disease, or other pest problem in your area, it is important to seek out and use those cultivars which possess the most resistance to that pest, be it disease, insect, weed or whatever.

2. Turfgrass Environment (cultural)

Cultural operations have substantial effects on pests and the grass which they damage.

Irrigation. Excessive irrigation increases susceptibility to compaction under traffic, also reduces tolerance to stress, hence greater proneness to pest problems. Specific problems known to be more serious under conditions of excessive irrigation are diseases such as Pythium blight, Rhizoctonia brown patch and weeds such as Poa annua.

Fertilization. Some nutrients to supplement native soil fertility are necessary to sustain growth of grass at a level which meets the demands of its use. However, excessive fertilization, especially with nitrogen, renders turfgrass more susceptible to many diseases, especially Helminthosporium melting-out, Fusarium blight and Rhizoctonia brown patch. It also reduces tolerance to environmental stress. As with water supply, nutrients should be supplied only as needed with special attention given to the kinds as well as amounts of nutrients required.

Mowing. Closely mown turf is more susceptible to diseases such as Rhizoctonia brown patch and Sclerotonia dollar spot than is turfgrass mown at moderate heights, eg., Kentucky bluegrass at 3/4 inch vs 1-1/2 inch. But, you will say, "I can't mow my fairways at 1-1/2 inch or I'll be thrown out on my ear." That's where the know-how comes in. You can't use Merion Kentucky bluegrass if you are going to mow at less than 1 inch height, but you can use something else. Research is needed to develop the kinds of grasses that meet the needs of the industry, and Education to teach turfgrass managers what to use and how to use it properly. The demand for lower-cut fairways brought with it a host of problems. Some years ago I was called to advise on a serious Dollar Spot problem at a golf course near Hamilton, Ontario. The fairways were being wiped out with disease. A few years earlier they had beautiful Kentucky bluegrass fairways. Then they lowered their mowing height to less than 1 inch. With lower mowing height and frequent irrigation the Kentucky bluegrass was soon replaced by annual bluegrass. Annual bluegrass is highly susceptible to Dollar Spot and other diseases to which Kentucky bluegrass is much more resistant. More fungicide was needed to keep the disease in check. Suddenly the fungicide they were using failed to work. The fungus had become resistant to benomyl. Other fungicides needed to be applied more frequently at greater cost, - all because of reducing mowing height without considering its implications.

Thus, proper mowing practice is an important cultural operation in the overall picture of management for pest control.

Cultivation. This would not seem to enter the picture in established turf but it certainly does in the establishment phase and some aspects later. Proper preparation of the seedbed can minimize problems with weeds, especially grassy weeds. A form of cultivation is later involved in the control of thatch. Thatchy turfs are more susceptible to diseases such as Helminthosporium melting-out and stripe smut, also to damage by environmental stresses which could lead to loss of turf, followed by weed invasion. Timely verticutting, coring and topdressing can keep thatch at optimal levels.

3. Pesticides (chemical)

Effective practical control of pest organisms with pesticides does not mean eradication; it means reduction of the pest population or its activity to a level that does not cause damage to the turfgrass, and does not reduce turf quality. The presence of a few potentially damaging insects in a turf may not require treatment with an insecticide; it is only when insect populations approach a level which has the potential to cause significant damage that pesticides need to be applied. Hence the need for knowledge of potential pest problems, recognizing potentially damaging pests and knowing how to monitor pest populations and at what level chemical treatment is necessary.

Hopefully the use of pesticides on a prescribed schedule where a pesticide is used on a regular basis for the prevention of damage by a particular pest is a thing of the past. With IPM the application of a chemical pesticide is determined by the progress of events in the field rather than by prescription.

Outlook for Turfgrass IPM

There are many reasons why IPM should be the way to go in turfgrass management but the main one is the need to reduce dependency on chemical pesticides. The reason for this need is two-fold: (1) Economics. With increasing energy costs many pesticides are becoming prohibitively expensive; (2) With pressures from environmentalist groups and concerned public about the harmful effects of pesticides in the environment the need to minimize pesticide use is obvious.

But are we ready for IPM in turfgrass management? When we look at the components of IPM we can see that the good managers have been using many of the strategies of IPM all along. However, some of the most important components are not being used because the information is not there. We know practically nothing about the natural agents that keep harmful fungi, insects and weeds under control and why these natural controls so often fail. Much fundamental research into the biology of the turfgrass environment is needed to determine interactions among organisms and develop methods of helping the good guys do their job. These interactions need to be determined for each pest organism separately and the knowledge used to develop management systems that would take advantage of natural controls as much as possible.

The same holds true for genetic methods of control. We have many turf cultivars that possess various degrees of resistance to disease and other pests but this approach is not being fully exploited. The use of resistant cultivars is undoubtedly the simplest and most economical means of pest control as far as the turf manager is concerned but our pool of resources in this area is small. We need to encourage turfgrass breeders to put greater emphasis on incorporating resistance into the genetic makeup of the cultivars they produce. Most of the newer cultivars which we test in our trials these days are sorely lacking in this respect.

Finally, there is the matter of putting all of these strategies together into a system that works. Who is supposed to do the integrating? The turfgrass manager? The research scientist? Or the extension person? Perhaps all three. The manager is the one nearest the problem but he or she is not likely to have access to enough information. The research scientist may have access to information but he is usually a specialist, tends to view problems within a particular discipline and does not have the time to investigate the total picture. That leaves the extension person as the most likely key to the situation. He can talk to both managers and research scientists, tie things together and connect problems with solutions. We have a few such people among us, people like Dr. Roy Goss who are admirably equipped for just this kind of function.

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1. Flint, Mary Louise and Robert van den Bosch. 1981. Introduction to integrated pest management. Plenum Press, New York.

2. Turgeon, A. J. 1981. Turfgrass pest management. In Proceedings of the Fourth International Turfgrass Research Conference, July 19-23, 1981. Chapter 40: 351-368.

Table 1. Disease reaction of Kentucky bluegrass cultivars licenced for sale in Canada - 1982

Cultivar	Leaf Spot	Powdery Mildew	Stripe Rust
Adelphi	R	S	S
America	R	R	RR
Banff	-	S	RR
Baron	RR	S	R
Birka	RR	RR	S
Bono	R	RR	S
Bristol	RR	R	RR
Cheri	R	S	R
Dormie	R	RR	SS
Enumndi	RR	R	SS
Fylking	R	S	R
Geronimo	S	S	RR
Glade	S	RR	S
Haga	S	S	-
Majestic	R	SS	RR
Merion	RR	S	S
Nugget	RR	R	SS
Park	SS	S	R
Plush	S	-	R
Prato	S	S	S
Primo	R	S	S
Ram 1	S	R	R
Regent	-	SS	R
Sydsport	R	S	RR
Touchdown	RR	RR	S
Victa	R	S	R
Windsor	S	R	R

RR = highly resistant
R = resistant
S = susceptible
SS = highly susceptible
\- = no information available

VARIETAL VARIATION ON SPRING AND FALL COLOR OF KENTUCKY BLUEGRASSES[1]

R.D. Ensign and T.J. Bakken[2]

Color is one of the most distinctive characteristics among Kentucky bluegrasses. Researchers consider color, for attractiveness of the grass, an important criteria in evaluating new cultivars. Usually those selections that have a medium to dark green hue are choice selections, although some people select grasses having a soft, light green hue. Color, texture, and density are characteristics which contribute to overall quality of turfgrasses. But other characteristics may be equal or even more important in selecting a turfgrass variety for your area. These may include disease resistance, winter hardiness, wear tolerance, persistence, and aggressiveness.

The University of Idaho is cooperating with a number of other states in the U.S.A. and in Canada to evaluate selected Kentucky bluegrass varieties. Eighty-five (85) varieties, common to each location, are being systematically evaluated by each state to assess their adaptability to climatic and soil conditions. It is assumed that some varieties will perform better in some areas than others.

Color differences of grass blades in a turf ecosystem has been very striking in the Idaho test. Close observation gives one the opinion that each variety has its own distinctive color and they may change from month to month. Some varieties retain acceptable color well into early winter while others lose green color quite early in the fall at Moscow, Idaho. Also, scientists have noted that some varieties green up in early spring while others will not. Physiological reasons

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Professor and Agronomist; Research Associate, respectively, University of Idaho, Moscow, ID.

for these growth response are not completely understood. Climatic conditions in the late fall and in the spring affect chlorophyll development or degradation in the leaf tissue. Loss of color early in the fall is referred to as senescence, chlorophyll degradation, and early dormancy. If the process continues, the leaves usually die. Loss of color may be due to a combination of low daylight intensity and/or quality as well as low daily temperatures.

To determine varietal response, color readings were taken during late fall of 1981 and 1982 and continued through mid-March of the following years. This report summarized the varieties which best hold their green color late in the calendar year and also those varieties which green up in early spring.

The varieties were planted in September 1980 in three replications and fertilized annually with 4 lb of actual N per 1000 ft² and irrigated by an underground sprinkler system. The silty loam soil had adequate moisture during the growing season and into the winter and spring periods. Daily temperatures were recorded.

Early Winter Color Retention

Color readings were taken in December 1981 and January 1983. The average minimum temperature in December 1981 was 27.2°F. The 1982 December average mean temperatures were 23.5°F (see Fig. 1).

Early winter color retention for the two years are reported in Table 1.

The high 10 varieties on color readings for both years were: Bristol, Admiral, Barblue, Nassau. Varieties Lovegreen, CEB VB 3965 and Ram I, were also in the top 50% of all varieties for the second year. Color readings for the early winter of 1982-83 were generally higher than for 1981-82. This could not be explained by temperature since November-December temperature for the two years were quite similar (see Fig. 1).

Varieties which were among the top 10 in spring of 1982 and in 1983 are reported in Table 2. These were: Nassau, Shasta, and Admiral. The varieties Bristol, 129, K3-178, Bonnieblue and 225 appeared in the top 50% of all cultivars for good color in 1983.

Superior Green Color in Early Winter and the Following Spring

Varieties Bristol, Nassau, Admiral, and 225 had excellent early winter color as well as early spring green up the following spring in 1981-82. In 1982-83, Shasta, Admiral, Bristol, Barblue, and Nassau retained color well into early winter and also showed good spring green up.

During the winters, all cultivars lost color after mid-January and into February.

Conclusions

These data indicate that some Kentucky bluegrass varieties retain acceptable green color well into early winter at Moscow, Idaho. Color is usually lost from the leaves in mid-January and February. Thus, temperature as well as low light conditions, play an important part in chlorophyll degradation. Some Kentucky bluegrass varieties such as Shasta and Nassau green up early in the spring as daylight and temperatures increases, whereas other varieties such as Nugget, with Antarctic germ plasm, green up 2-3 weeks later.

Turf managers may consider the importance of green color in November and December as well as early spring green up in their landscape plans. If grass color is important, then varieties of Kentucky bluegrass may be available for you locally.

Table 1. Kentucky bluegrasses with highest green color readings in early winter.

December 1981		December 1982	
Varieties	Mean[1]	Varieties	Mean[1]
Bristol	8.3[2]	Bristol	8.2[2]
Lovegreen	8.3	Barblue	8.3
Birka	7.7	Admiral	8.3
Glade	7.7	WWAG 478	8.0
225	7.7	Harmony	7.7
Admiral	7.3	225	7.3
CEB VB 3965	7.3	Shasta	7.3
Ram I	7.3	Challenger (N535)	7.3
Barblue	7.0	Nassau	7.3
Nassau (243)	7.0	Mono, MER PP 47, Bonnieblue, Majestic	7.0

[1] Average of 3 readings on Dec. 9, 1981.

[2] Color readings: 9 = dark green; 1 = light.

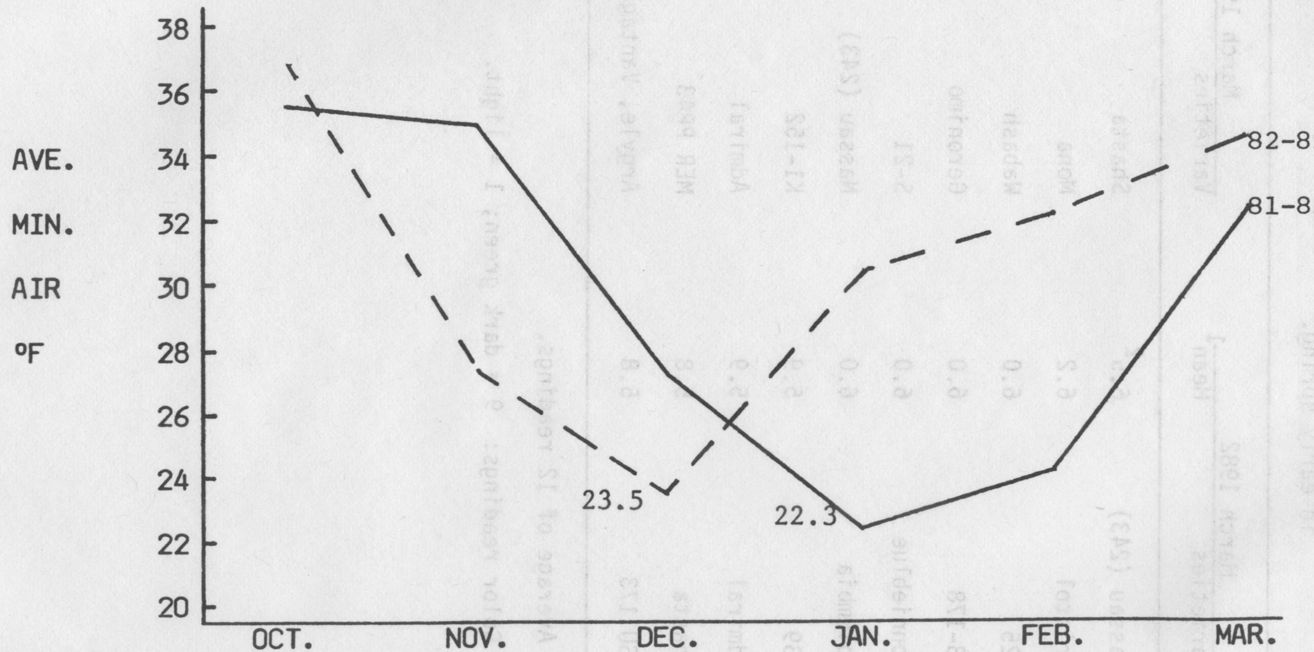
Table 2. Kentucky bluegrasses with highest green color readings in early spring.

March 1982		March 1983	
Varieties	Mean[1]	Varieties	Mean[1]
Nassau (243)	6.5[2]	Shasta	7.7[2]
Bristol	6.2	Mona	7.0
225	6.0	Wabash	7.0
K3-178	6.0	Geronimo	6.3
Bonnieblue	6.0	S-21	6.3
Columbia	6.0	Nassau (243)	6.3
239	5.9	K1-152	6.0
Admiral	5.9	Admiral	6.0
Shasta	5.8	MER PP43	5.7
PSU 173	5.8	Argyle, Vantage	5.7

[1] Average of 12 readings.

[2] Color readings: 9 = dark green; 1 = light.

Fig. 1. The average minimum Air Temperature for October to March at Moscow, Idaho



TURFGRASS MANAGEMENT IN SOUTH AFRICA[1]

Warren Bidwell[2]

As Gary Player began to emerge as a rising star from far below the Equator in the Republic of South Africa, by the way of the American Professional Golf Tour events, golfers from his homeland became aware that there as a turfgrass culture in the States far superior to their Cynodon and Kikuyu playing surfaces. For the first time golfers of South Africa learned that our Bermuda turf was being overseeded for a superior playability during our winter months that was available to them during their winter period; that because of this, there were literally thousands of playing facilities with far better putting surfaces than was available to them back home.

Having won the major events in his homeland, Gary qualified very handily to compete on the Professional Tour here in the States, winning the PGA, the Open and lesser event and became known as Gentleman Gary, having sustained his dignity under rather trying circumstances because of South Africa's apartheid political structure as related to their native population. He became a Golfer of the World, a star athlete, rich beyond belief for one so young.

Gary's success gave great impetus to those golfers in South Africa who desired better turf for their golf course. The old playing surfaces provided by their native Cynodon and Kikuyu, imported from Australia, was no longer good enough. The turning point came as the direct whim of Nature injected her influence into the golfing scene of Johannesburg at the time of the 1974 PGA Championship, always played at the famed Wanderers Club, a club of some ten thousand members from around the world with varied interests in Rugby, Bowls, Cricket, Yatching, Tennis and Golf. Literally, you had to

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, Septem= ber 19-22, 1983.

2/ Tee-2-Green, Matteson, IL.

be a Who's Who if you wanted to become a member of The Wanderers Club, a spin-off of British Colonialism.

Fortunately, the success story of Gary Player served as an impetus to the South African golfing scene. I was on my first trip for the Penncross people at the time of the PGA Championship, which is held annually at The Wanderers, usually in early November, the beginning of their spring blossom period featuring their famed Jacaranda trees.

The press was having their usual field day by quoting various Golf Professionals on the condition of the course. Spring was late that year, warm enough to promote Poa annua blooming, but not enough soil temperature to motivate the Cynodon to turn green. The greens were in the usual spotty condition, providing the Pros with their usual gripes, always in the presence of the sports writers who hung on every word.

Having been billed as an American Super having tournament experience, I was invited by Jimmy Hempell, Executive Director of S. A. PGA, and Ritchie Adderly, Superintendent, to tour the course with them and to offer comments for the good of the cause. You can easily believe that I was very careful in expressing my observations.

As we concluded the tour, Ritchie mentioned that he was experimenting with an American bentgrass on his small putting green called Penncross; that this bentgrass was already green and growing, wishing that he had eighteen greens of it at that time for the tournament. During the discussion that followed, he confessed his disappointment in that, under their climatic conditions of 6000 foot elevation, more time was needed for the Penncross to develop than they could afford.

Fortunately for golfers and greenskeepers in South Africa, Dr. Jim Watson and Dr. Jim Beard had preceded my visitation by three or four weeks and had suggested to Ritchie that making a mixture of fine leaf perennial ryegrass, fescue and Penncross would provide sufficient protection of the bent to develop, for eventually the other two grasses would give way to the necessary short cut for the putting surface. Thus, a new concept was introduced that continues in force today. You see, Watson and Beard had been observing and assisting some of the same procedures initially right here in the Deep South transition zone where our supers wanted something better than the old domestic ryegrass overseeding of years gone by. The two Dr. Jim's have and continue to leave their mark on the South African turf scene.

My role in returning to South Africa for the fourth time this past month is one of continuing effort to see that the turfgrass is cared for by the greenskeepers, once the overseeding has been accomplished. The seed growers of the States of Oregon and Washington don't want failures. The greenskeepers continue to learn new and important lessons in the care and maintenance of the overseeding mixtures in a land where golf is played twelve months of the year. The most common mistake if overwatering, then comes attention to the many details of maintenance not encountered with Cynodon grasses.

Ignorance of the necessity of fungicides during the brief summer heat is one of the lessons that must be learned, for with their tendency to overwater, plus an abundance of decaying Cynodon stems that lie buried beneath the overseeding strata, the putting surface becomes very vulnerable to fungus. Most of the chemicals available to us here in the States are available to them, but under different trade names.

Along with Pye Bredenkamp. seed importer for South Africa, we have established a routine or rather severe thatching of the old greens, as much as six different directions, bring soil to the surface, in an effort to destroy as many Cynodon underground stems as possible prior to dropping the seed mixture on the surface and dressing with sand.

Presently, there are about fifty of the 250 courses in the country that have been overseeded by the Bredenkamp organization. He offers a complete package plan of dethatching, soil testing, especially where mine water is used for irrigation, and seeding of the greens. Only his own course, Rand Park Golf Club, has been dethatched and overseeded in all three areas; greens, tees and fairways. The dethatching alone for the fairways was a truly monumental job in that Kikuyu turf is heavy in thatch. He used two Jacobsen 548's and a Mott Flail mower, burning the refuse on the spot. This seeding period is carried out between March 1 and May 1.

Golf course management in South Africa today, with but few exceptions, is a maze of antiquated controls vested in the Secretary/Manager (we recognize him as General Manager). He is truly the General Manager by powers vested in him by the Board of Directors, a duly elected body from within the membership. Their concept, even today, remains the same as it did fifty years ago: Golf must be cheap, sustain the financial integrity of the club by making the money at the bar and off the catering effort in the clubhouse during social functions. Always show a profit at the close of the calendar year, even if the Greenskeeper must continue to apply fungicides by using a knapsack sprayer for the entire eighteen holes.

The Greenskeeper is not a trained individual except by virtue of having been a farmer or a mine worker who is no longer capable of breaking his back in the mines. The work force is composed of native (Bantu) people having no education, speaking various bush languages and having more superstitions than can be believed humanly possible.

But, this low cast role of the greenskeeper is beginning to change. It must. For now, with an accelerated acceptance of the American grasses which provides them with greens they dearly love, the technology so necessary to manage these grasses is not to be found within the present system.

Ritchie Adderly, of Wanderers, has set the pace for the "new" greenskeeper by coming to the States on three or four occasions to study our system of turf management. Having visited the Masters Course, Texas A & M, and California clubs, he has taken back ideas and a knowledge of the way we do things to the extent that The Wanderers Club is modern in selection of grasses, having done a methyl bromide treatment last fall and complete overseeding of all greens. He is a graduate of an agricultural college near Capetown. There are others beginning to emerge into the modern school of thought of turf management by attending some of our winter schools. It is considered a definite plus that the more progressive clubs recognize the need for change.

But change within itself is not always complete unless all facets of the club structure are examined to complete the circle that brings about a complete change, a workable change that frees the greenskeeper from the control of the Secretary/Manager whose power, along with his ignorance, is delegated by the Board. This will change too, in time, or the progress that is beginning to surface will collapse and fall back into the abyss that has mired their system for half a century.

Golf is cheap in South Africa. The clubs use the "pay as we go system", a minimum of $2.50 to $4.50 for eighteen holes. Not enough to sustain an American way of turf management for any club. But, the old addage will prevail -- if you want something bad enough, eventually you will find a way to pay the freight.

LOW TEMPERATURE SURVIVAL OF TURFTYPE PERENNIAL RYEGRASS CULTIVARS[1]

William J. Johnston[2]

Perennial ryegrass (Lolium perenne L.) is an especially desirable turfgrass on sports turfs, playgrounds, or other heavy use areas where its use would enhance the wear tolerance of a bluegrass turf. With the recent availability of numerous improved perennial ryegrass cultivars, this species is becoming more important as a turfgrass management tool. However, perennial ryegrass has the poorest (along with tall fescue) cold tolerance of any turfgrass presently recommended for use in the Pacific Northwest. Although extensively used along the coastal areas of Washington and Oregon, this lack of cold tolerance has prevented perennial ryegrass from becoming a valuable turf species east of the Cascade Mountains.

To better understand the variability that might exist among perennial ryegrass cultivars, several growth chamber experiments were conducted and a long-term field study was initiated. The objectives of the study were fourfold. One, to screen perennial ryegrass cultivars (20 perennial ryegrasses and one annual ryegrass, Ninak, were screened) for survival of seedlings when exposed to subfreezing temperatures. Two, evaluate the perennial ryegrasses showing the best low temperature survival for the ability to germinate at low temperatures. Three, to evaluate these same cultivars for their ability to grow at low temperatures. Four, determine turfgrass quality and winter survival of perennial ryegrasses under field conditions.

The experimental procedure is outlined in Table 1. Basically, seedlings were grown for 21 days at cold temperatures to cold harden them, exposed to subfreez-

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

ing temperatures for a brief period, and then rated for survival 21 days later.

Table 2 lists the cultivars having above average percent survival for each low temperature exposure group. Cultivars which appeared in all three groups, and thus determined to have the best overall survival, were Dasher, Yorktown II, Elka, Derby, and Fiesta. Those cultivars having percent survival below average are given in Table 3. Again, those cultivars that appeared in all three groups were determined to have the overall poorest seedling cold tolerance. Poor cold tolerance was shown by Perfect, Ninak, Caravelle, Barry, and Score. Based on this study, five cultivars showing good seedling cold tolerance (Dasher, Yorktown II, Elka, Derby, and Fiesta) and one cultivar having poor cold tolerance (Perfect) were chosen for further testing.

In addition to a cultivar being able to survive at low temperatures, its ability to germinate a low temperatures is also important. The ability to germinate at low temperatures would favor such cultivars during late fall seeding when adverse climatic conditions might occur. Table 4 gives the results of this study. It appears that Dasher and Yorktown II, and possibly Derby, possess good low temperature germination.

If a cultivar was not only able to germinate and survive at low temperatures, but also showed good seedling vigor or growth at low temperatures, an excellent cultivar for late fall planting would be available to turfgrass managers. Table 5 gives the three temperature regimes at which low temperature seedling growth was evaluated in this study.

It would appear that none of the cultivars tested had exceptionally good low temperature seedling growth (Table 6). Of the low temperature tolerant cultivars, Dasher, Elka, and Fiesta did appear to have slightly better low temperature seedling growth than Yorktown II or Derby. Perfect, a cultivar showing poor cold tolerance, also showed good low temperature growth.

Due to a mild winter during 1982-83, adequate field testing of these cultivars for winter survival has not yet been possible. However, the overall turfgrass quality ratings for the cold tolerant cultivars appears quite good in field testing (Table 7). Dasher, in particular, was showing good turfgrass quality during 1983.

In summary, it appears that among the numerous perennial ryegrass cultivars on the market today, several area available that show good low temperature germination, seedling growth, and survival. These cultivars should be excellent management tools available to turfgrass personnel trying to establish perennial ryegrass in the late fall when adverse weather is likely to occur.

Table 1. Material & Methods

Cold hardening:	21 days 15 C day 5 C night 12 hour photoperiod		
Preconditioning:	18 hours 1 C		

Freeze:	Hours	Temp, C	Removal
	0	+1	
	2	-2	
	2:45	-3.25	
	3:30	-4.50	Group I
	4:15	-5.75	Group II
	5:00	-7.00	Group III

Table 2. Survival Above Average

I. Ave. 85%		II. Ave. 46%		III. Ave. 31%	
Acclaim	Blazer	Dasher	Fiesta	Dasher	GT I
Citation	Derby	York.II	GT I	York.II	Blazer
Dasher	Regal	Citation	Loretta	Elka	Yorktown
Manhattan	Sprinter	Elka	Blazer	Derby	Diplomat
Fiesta	York.II	Regal	Sturdy	Fiesta	Acclaim
Diplomat	Elka	Derby	Manhattan	Loretta	Manhattan

Table 3. Survival Below Average

I. Ave. 85%	II. Ave. 46%	III. Ave. 31%
Caravelle	Diplomat	Ninak
Perfect	Sprinter	Score
Barry	Score	Sprinter
GT I	Barry	Barry
Score	Caravelle	Citation
Sturdy	Nimak	Caravelle
Ninak	Perfect	Perfect
Yorktown		

Table 4.

Effect of Temperature on Germination (13 days)

Cultivar	Temperature, C 21	18	15	12	7
	%				
Dasher	90	100	100	80	0
Yorktown II	100	95	75	75	0
Elka	75	95	90	45	0
Derby	85	98	80	60	0
Fiesta	90	95	85	40	0
Perfect	95	93	95	50	0

Table 5. Low Temperature Seedling Growth

Temperature Regimes:

	Day	Night
I	15 C (59 F)	10 C (50 F)
II	15 C (59 F)	5 C (41 F)
III	15 C (59 F)	0 C (32 F)

12 hour photoperiod

Table 6. Low Temperature Seedling Growth (14 days)

Cultivar	Temperature regime 15/10	15/5	15/0
	-----------	mm	-----------------
Dasher	33	6	8
Yorktown II	26	8	6
Elka	32	8	6
Derby	25	5	6
Fiesta	35	11	9
Perfect	32	9	10

Table 7.

Turfgrass Quality Rating (1 to 9; 9 = excellent)

Cultivar	1982	1983
Dasher	6.4	7.8
Yorktown II	6.0	7.0
Elka	5.0	6.7
Derby	7.0	7.0
Fiesta	6.0	6.8
Mean of 17 c.v.	6.5	6.9

THE PRESENT AND FUTURE OF TURFGRASS VARIETIES[1]

Dr. William A. Meyer[2]

There has been a tremendous increase in cool season turfgrass breeding in the United States in the past twelve years. The major increase has been in the number of private companies as a result of the passage of the U.S. Plant Variety Protection Act in 1971. This Act allows the breeder and owner of a newly developed variety to obtain exclusive U.S. production and marketing rights. Other individuals cannot produce or market a protected variety without the permission of the owner. Many improved varieties of Kentucky bluegrass, perennial ryegrass, tall fescue and fine fescue are now on the market as a result of the many breeding programs.

NATIONAL TURFGRASS EVALUATION PROGRAM

In 1982, Jack Murray, a turfgrass specialist of the USDA, Beltsville, MD, initiated the development of the National Turfgrass Evaluation Program (NTEP). This program will develop and coordinate uniform evaluation of turfgrass varieties and blends for the U.S.

This program will be a self-supporting, non-profit program sponsored by the Beltsville Agricultural Research Center and the Maryland Turfgrass Council. It is not a federal program. A policy committee made up of members from the different regions of the U.S. will administer the trials.

Each year the NTEP will send out different turfgrass species to be planted in uniform trials throughout the U.S. The owner pays a fee to cover the distribution costs of the seed, and the accumulation and analysis of the data. The yearly summaries from each test will be available upon request.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Turf-Seed, Inc., Hubbard, OR.

The NTEP has already released the first 2 years of data from the 1980 Kentucky bluegrass trials that included eighty-four varieties. In 1982 a perennial ryegrass trial with forty-seven varieties was distributed for trials. The 1982 NTEP trials included thirty tall fescue varieties, and forty-seven fine fescue varieties. The NTEP program will provide excellent information to the turfgrass industry as to which varieties are widely adapted to the diverse environments of the U.S.

KENTUCKY BLUEGRASSES

Many new improved varieties of Kentucky bluegrass have been developed and released in the U.S. during the past 10 to 12 years. There appears to be a reduced interest in bluegrass breeding and variety release at the present time in favor of other species such as ryegrass and fescue.

Leaf spot, caused primarily by Helminthosporium vagans in the Northwest, can severely damage common type varieties (characterized by narrow leaves and erect growth habit) such as Park, Kenblue, Bayside, Geary and Delta. The varieties A-34, Adelphi, America, Bonnieblue, Challenger, Columbia, Fylking, Majestic, Midnight and Sydsport are examples of new lower growing turf-types with improved resistance to leaf spot. The turf-type varieties Baron, Glade, Merit, Ram I and Victa would be considered as having intermediate resistance. Leaf spot is especially serious in poorly drained areas, and in shady areas.

Stripe rust, caused by Puccinia striformis, is the other serious disease of Kentucky bluegrass in the Northwest. The improved varieties Shasta, America and Mona have shown good resistance, followed closely by Bristol, Columbia, Geronimo, Majestic, Challenger, Sydsport and Trenton. This disease is most severe in the spring and fall, and can be reduced by irrigation and increased fertility.

The number of new bluegrasses to be released in the near future will be much less than the number released in the past twenty years. There is a need for bluegrass varieties with greater drought tolerance, insect resistance and improved performance at low fertility.

PERENNIAL RYEGRASSES

Since Manhattan perennial ryegrass was released in 1967 as the first improved turf-type perennial ryegrass, there have been many other improved turf-types. These varieties such as Birdie, Blazer, Citation, Dasher, Derby, Diplomat, Fiesta, Omega, Pennfine, Pennant and Yorktown II have displayed the excellent establishment rate and persistence of Manhattan.

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

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

TALL FESCUES

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

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

There will be many new tall fescue varieties released in the near future. Improvements are still needed in leaf spot resistance, dark leaf color and density. All of the new turf-type varieties showed superior traffic tolerance compared to the old tall fescue varieties. They did rate somewhat lower than the best perennial ryegrass varieties, however.

<u>FINE FESCUES</u>

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

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

The creeping fescue varieties generally perform better under a higher cutting height. The U.S. variety Fortress has performed similar to the European varieties.

Boreal or Common Canadian Creeper is sold in large quantities in the U.S. for mixtures. These two grasses have very poor leaf spot resistance and persistence, but are competitive because of their low prices. Flyer is a new variety of creeping fescue with improved turf quality compared to most other varieties.

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

SUMMARY

There are many new improved proprietary turfgrass varieties on the market that are performing much better than the more cheaply priced common varieties. It is encouraging to see a shift in present buying patterns toward the better named varieties. The increased level in turfgrass breeding activities in the U.S. should continue to result in better turfgrasses at competitive prices in the future.

PREPARING YOUR COURSE FOR A MAJOR TOURNAMENT[1]

Mike Bauman[2]

The golf course is one of the most important ingredients in any golf tournament. A well-conditioned golf course is an obvious plus. Good course conditioning is the result of careful planning and hard work.

The following are some general guidelines concerning the preparation of your course for an LPGA Tournament.

Golf Course Conditioning

In the player's view, the condition of the course is the most important element in a tournament. A well-prepared course gives the players the best opportunity to display their skill. It tends to reward good play and helps to produce a good winner.

The preparation of the following areas of the golf course and grounds are of great importance to the success of any tournament:

1. Teeing Grounds - Level and close-cropped, particularly in the areas for the location of tee markers for tournament play. These locations should be protected from normal play for several weeks prior to the tournament. This will avoid sparse grass cover.

   Follow a regular program of aerating, verticutting and topdressing to eliminate thatch. Spongy turf presents a real problem for the player.

1/ Presented to the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Superintendent, Meridian Valley Country Club, Kent, WA.

2. Fairways - The importance of close-cropped fairway turf cannot be overemphasized. Fluffiness in fairway turf is undesirable. The tendency should be toward firm, tight turf with overwatering to be avoided. Mowing heights for tournament play should be established weeks in advance. Last minute reductions in mowing heights could cause "yellowing" and uneven cuts.

   Fairways should be crosscut if necessary. During the week of the tournament, fairways should be mowed daily and usually in late afternoon when the grass is dry.

   Be prepared to drag heavy dew from the fairways prior to play each morning by suspending a long rope or hose between two golf carts and dragging the hose or rope along the fairway.

3. Putting Greens - Firm, fast greens provide the best test for both approach shots and putts. The great tendency is to overwater. This is bad for longterm health of the turf as it produces shallow roots in the grass. Soft greens do not reward the skillful shot over the inferior.

   Establish a program of protecting areas of the greens to be used for cup settings for the tournament. Use front of greens for member play approximately three weeks prior to the tournament.

   Check on all greens for old cups which are sunken or raised and repair, when changing holes, use the pie-slicing technique and knead edges with a fork-type instrument. Replace any dead plugs from a nursery or from extremities of the green which are out of play.

4. Roughs - If the tournament is to provide a true test, it is very important that roughs be established in accordance with proper cutting heights. Roughs should be fertilized if necessary, to achieve this condition. Overseeding should be considered.

5. Practice Areas - Practice areas should be maintained similarly to comparable areas on the course.

Practice tees should be mowed daily at the same height as fairways. In those instances when the practice area has been heavily used, loose divots should be collected immediately following the last afternoon tee time.

Because of heavy use, which creates sparse grass coverage, it may be necessary to institute a program of topdressing, seeding and proper watering.

For several weeks in advance of the tournament, arrange to locate practice play away from the areas to be used during tournament week.

6. Cutting Heights and Widths - The following are average heights and widths of cut which are required. Density can sometimes be more important than height. These heights provide not only the best conditions for tournament play, but for regular membership play as well.

In addition, experience has shown that these heights are also best for turfgrass maintenance.

	Height	Width
Tees	Not over 1/2"	---
Fairway areas		
Fairway	Not over 5/8"	30 to 40 yds
Collar off fairway	1"	4 to 6 ft
Primary rough	1-1/2 to 2"	---
Putting Green areas		
Putting green	1/8 to 3/16"	---
Collar off green	Same as tees	30 to 36 in
Light rough off collar-	Same collar off fairway	2-6 ft

7. Bunkers - Any fresh sand needed in bunkers should be put in a full three months in advance of the tournament so that it may become well settled. If there is not adequate rain to pack it, water it artificially.

Suitable sand includes what is known as plasterer's sand, mason's sand or brick sand, sand which will pass through a one-eighth inch sieve opening and which has had salt and very fine sand particles removed by washing will resist packing. Sand particles which are round in shape tend to shift under a player's feet, whereas sand with angular particles is more stable. Bunkers should not contain stones.

Sand in the face of bunkers must be shallow enough and firm enough to prevent a ball from becoming lost in it.

Rakes should not leave furrows and should be provided at each bunker. It is preferable that bunkers be maintained by hand raking during the tournament. If machine raking is necessary, then go over each bunker by hand raking any irregularities. Before using a mechanized sand rake, make sure the machine is performing satisfactorily. Players should not be able to putt out of greenside bunkers. To prevent this, have a "lip" about three to four inches high on the bunker margins facing greens. There should be no lip on sides of bunkers, otherwise balls may become unplayable under such lips.

8. Flagsticks and Flags - Standardization of flagsticks and flags among tournaments is important to the player who must play a different course every week.

Material	Fiberglass
Height	Eight feet
Diameter	Not more than 3/4 inch from a point 3 inches above the ground to the bottom of the hole.
Color	Bright yellow, preferably solid

9. Cup Liners - Provide cup liners that are in good condition so that the flagstick will stand straight in the hole.

In the event the tournament is televised, supply a small can of latex base white paint, and a one inch paint brush, so that the inside of the cup can be painted at the televised holes.

10. Filling Divots - Certain areas of the course, particularly short par 4 holes, required the filling of divots. A mixture of fifty (50) percent sand and fifty (50) percent topsoil properly applied and tamped down makes for a well-conditioned course. Care should be taken so that the filled divot is level with the surrounding ground. Otherwise, a bad lie may be created.

11. Trees - Consider filling tree basins (or wells) after trees are well established. Also, remove support wires and tree wrappings.

    Prune low-hanging branches to facilitate gallery movement and where they might be unfair in the playing of a shot. Low-hanging branches should be cleared from areas near the teeing ground.

12. Vehicles - Control vehicles on course and limit to necessary work. Suggest times and routes to avoid congestion and noise while play is in progress. Recommend routes for vehicles used by concessionaires, television, etc. Careful attention is necessary when the course is soft or wet as ruts will result from traffic.

13. Extra Maintenance Equipment - Two fairway mowing units are a "must". Often we encounter weather problems which give little time for mowing. Also, time of year is a factor as well as the use of two starting tees.

14. Ground Crews - Arrange to have hours of work conform with starting and finishing times for the tournament. During the tournament, the LPGA tournament official will establish priorities regarding mowing, hole changing, trap raking, etc. Be prepared to contact area superintendents for additional men and equipment during an emergency.

<u>Setting Up the Golf Course for Tournament Play</u>

The LPGA advance tournament official is responsible for seeing that the golf course is set up properly for tournament play. He will arrive at the tournament site approximately one week before the competition is scheduled to start.

During this prior week, he will work closely with the golf course superintendent and grounds crew to see that roughs, fairways, greens and tees are all being properly maintained. He will also supervise the marking of all hazards and boundaries, as well as mark all areas of ground under repair.

To accomplish these tasks, he should have the following materials waiting for him:

1. Boundary Stakes - 4 feet tall, 1 inch by 2 inch stakes painted white.

2. Water Hazard Stakes - 2 feet tall, 1 inch by 2 inch wooden stakes painted yellow.

3. Lateral Water Hazard Stakes - 2 feet tall, 1 inch by 2 inch stakes painted red.

4. Marking Paint (white, red and yellow) and three spray guns.

During the tournament, he will place all of the pins and position the tees. These tasks are usually done in the late afternoons. The advance tournament official will require the assistance of a member of the grounds crew.

<u>Equipment Requirements for Tournament Preparation</u>

1. Two (2) mowers for cutting tees.

2. Two (2) fairway mowing units.

3. Five (5) single mowing units or two (2) triplex greens mowers.

4. One (1) mower for cutting secondary rough.

5. Two (2) mowers for cutting primary rough.

6. One (1) mechanized sand trap rake.

7. Two (2) sets of cup changing equipment.

8. New paint, extra stakes, flags, flag poles, tee markers and adequate paint and spray guns.

It is important that the above equipment be in good condition. All mowing equipment should be sharp, adjusted properly and set at specified heights of cut. It is especially important with triplex greens mowers that they be set slightly lower than specified heights of cut and checked daily for adjustment.

Cup changing equipment should be sharpened before the tournament to insure clean-cut, even holes.

If new cup liners and flag poles are used, check that the flag pole pulls free from the cup without sticking, causing the liner to be pulled from the hole.

In summary, using these guidelines and specifications and starting your conditioning program as early as possible, one should not encounter any problems in being ready for the tournament.

PREPARING FOR A MAJOR TOURNAMENT[1]

Harvey Junor[2]

Preparing a golf course for a major tournament requires scheduling all of the regular maintenance procedures to peak, to a desired condition, on a specified date. Due to changing weather conditions, it seems impossible to anticipate the rate of growth and desired lush color for a date months ahead.

The tees require the least change from our regular maintenance program. A dry level tee, mowed to a height of 3/8 inches or less meets the requirements of most tournaments. We are on a regular schedule of aerification, topdressing and overseeding the tees. Six to eight weeks prior to the tournament we do the final aerification and seeding. The topdressing is continued every second week up to three weeks before starting date. Low rate, monthly applications of a slow release fertilizer is applied, with final application two weeks prior to tournament. The end results are a slow growing tee with good color.

An intensive program of raising and topdressing all low areas in the fairways was started eight months prior to tournaments. Topdresser and drags were used, finally all small holes were hand sanded and leveled with rakes. Fairways are fertilized at full rate six months, decreased to 1/4 rate two months prior to the tournament. The low rate was used so the peak was reached just before tournament time. The fairway mowing was increased to daily mowing and cross cutting twice a week. This daily mowing at 5/8 inch resulted in dense, tight turf for good lies.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Superintendent, Portland Golf Club, Portland, OR.

The rough was normally fertilized in the spring for a dense growth. To anticipate the height of the rough at tournament time was a real challenge. Mowers were set at 2 inches and the last six weeks rotary mowers were used, topped off at 4 inches. All rough mowing stopped one week prior to tournament.

The greens are the most criticized and controversial area on the golf course during a tournament or regular play. Required changes of mowing schedules and height of cut are necessary at tournament time. For tournament play today, fast greens with a stimpmeter reading of ten or more is required. To obtain this type of putting green surface, we first ground down the bed knives of the putting green mowers where they became weak and flexible. Greens were double cut daily with walking greensmowers until a reading of 9'6" was reached a week prior to the tournament and over 10' for the week of tournament play. Greens were fertilized with 1/4 lb of actual nitrogen per 1000 ft^2 per month. Light verticutting, in two directions, was done twice a week and light topdressing of sand was scheduled every three weeks. Topdressing was terminated two weeks prior to tournament.

The preparation of the sand traps involved the addition of sand in areas where it had become shallow or washed down. The biggest project was the reshaping of the edges where sand buildup and erosion had broken down the turf. In these areas all turf and sand was removed down to the original soil line and then replaced with new sod and soil, to form a definite line to define hazard.

The final weeks were spent marking hazards, building or refurbishing bridges for spectators, preparing signs, roping, placing extra restrooms, setting up bleachers and preparing parking lots.

The changes on the putting green surfaces and raising the height of cut around the greens, the narrowing of fairways and increasing the length of rough from 4 to 6 inches were the areas that tightened up the course for tournament play.

SHATTERCORE AERIFICATION[1]

Larry Gilhuly[2]

An American on a business trip to England was given the privileges of a London club. When he entered the lounge one afternoon, only one other man was there. He decided to strike up a conversation.

"Would you care for a cigar?" he asked the Englishman.

"No, thank you," the Englishman replied. "I tried one once and I didn't like it."

"I'm a stranger here," the American said. "Would you like to join me in the bar for a drink?"

"No, thank you," the Englishman said. "I tried drinking once and I didn't like it."

"Well, how about a game of billiards?" the American said.

"No," the Englishman said. "I tried that once, too, and I didn't like it."

As the American started to turn away, the Englishman relented. "My son will be here in a few minutes," he said, "and I'm sure he'd enjoy a billiards game with you."

"The American turned back. "Your son?" he said. "An only child, I presume."

Just as the Englishman's mind was closed to attempts to open it, so shattercore aerification is to many turf professionals. The final conclusions on shattercore will be drawn a few years down the road by Dr. Goss and others, so I can't give you solid statistical data that it is beneficial. What I will attempt to show are the results Seattle Golf Club has seen after 9 months of use and results other clubs are getting from this method of aerification.

1/ Presented to the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Assistant Superintendent, Seattle, Golf Club, Seattle, WA.

Before we go any further, shattercore aerification should be defined. Shattercore aerification is solid tine aerification using a walking Ryan greens aerifier. The concept first came to our attention at last year's national conference. Mr. Leonard Schnepf, Superintendent, Chevy Chase Golf Club, Wheeling, Illinois, presented the idea. If I may quote Mr. Schnepf: "My first experiment was on a beat to death tee with about 30% bare ground. While coring, the ground felt like a small earthquake was occurring around my Ryan WG-24. The soil was totally fractured, and the bare areas became perfect for overseeding. The process not only left the ground slick with round holes, but fluffy as well."

I and others would totally agree with this statement. We have tried shattercore on straight sand, pitrun sand, thatch over pitrun, thatch over soil, hardpan clay and those fun burned out areas around tees and greens. In all cases where sufficient soil moisture was present, the shattercore did exactly what Mr. Schnepf refers to. It totally loosened the top 3 inches of soil. More importantly, visual fracture lines could be seen extending below the bottom point of the tine. Again quoting Mr. Schnepf: "The practice works on the principle of ballistics, shattering the entire area around the hole, and believe me, there is no compaction due to the type of tine. The surrounding ground explodes and becomes soft and fluffy, while taking water normally and the turf responds far better. The practice even works for wear and tear areas from the headache of golf cart traffic. We can make any size tine you desire."

The standard 5/8 inch cold roll, steel rod needed to make the tines is available at your local hardware store. All you need to do is cut the rods to the same length as a standard tine and put a rounded tip on one end with a grinder. It takes about 20 minutes to make one tine. With a lathe, you can make any size tine you desire.

Now let's take a closer look at what happens. With a standard hollow tine, you remove a nice clean core, leaving the surrounding ground very firm. Poa annua seed heads are also being propagated throughout the surface area, and the cores must be broken up or taken off the green.

With a solid tine, the speed the soil is being penetrated produces shock waves like a miniature earthquake, breaking up the area around the tine penetration and between the other tines, slightly raising the surface area. The surface area becomes soft like a plush carpet. (ZYGOMORPHIC QUAKING ACTION).

This uneven turf is the only reason we have not done the greens at Seattle Golf Club. Surface evenness is not as critical in other areas of the golf course. Once the area has been shattercored, sanded, and seeded, it takes two or three triplex mowings to return the surface to its former condition.

At Seattle, we have many areas with excessive thatch over pitrun. When hollow tines are used, the plugs quite often stay in the ground. This results in a frustrating inability to get a sand column into the pitrun. A great example of this was our 15th fairway. We shattercored 3/4 acre on July 11, sanded and seeded with 2 men and took a total of 6 man hours to complete. On August 11 we had 1+ inches of rain and the area we aerified was firm and dry. This area always gets mushy with standing water after a hard rain.

Another plus with shattercore is the obvious speed with which you can aerify. On September 7 we mowed out our winter greens (average size of 1000 ft^2). On September 8 we shattercored, sanded, seeded, and drug the sand on all 18 greens with 3 men in 8 hours. Without shattercore, we would never have done it due to labor restrictions.

The only negative aspect of shattercore is the idea of compaction. Many turf professionals fear that compaction will occur at the bottom of the tine. What we have seen is the exact opposite. We have seen the soil become loose around and under the tine. Also, the tine works its way to a point through continued usage. Although I have no facts, if the total surface of the end of a shattercore tine were compared to the surface area of the end of a hollow tine, these areas would be close to equal. Until results are in from Farm 5, a combination of shattercore and hollow tine may be the most prudent way to go.

Three men were engaged in one of those profitless conversations that involve all of us at one time or another. They were considering the problem of what each would do if the doctor told him he had only six months to live.

> Said one man, "If my doctor said I had only six months to live, the first thing I would do would be to liquidate my business, withdraw my savings, and have the biggest fling on the French Riviera you ever saw. I'd have girls, girls, and more girls."
>
> Said another, "If my doctor said I had only six months to live, the first thing I would do would be to visit a travel agency and plot out an itinerary. There are a thousand places on earth I haven't seen, and I would like to see them before I die: the Grand Canyon, the Taj Mahal, Angkor Wat, all of them."
>
> Said the third, "If my doctor said I had only six months to live, the first thing I would do would be to consult another doctor."

Before you make an opinion on shattercore aerification, ask someone who has done it before and then at least try it yourself. At that point, the decision is yours.

THE EFFECTS OF INTENSIVE FAIRWAY AERIFICATION ON TURFGRASS DENSITY AND QUALITY[1]

John Monson and Roy Goss[2]

Beginning in May, 1982 and aerification project was undertaken to determine the effects of multiple aerifications on turfgrass quality and relief of soil compaction on the first fairway at Broadmoor Golf and Country Club.

The first fairway was chosen because of its lack of response to normal spring and fall aerification, weak, thin grasses, and summer burnout caused from poor water infiltration rates, apparently induced by compaction. The dominant grass is Poa annua mixed with bentgrass and has inadequate density to hold the ball up properly on the fairway. The traffic pattern is poor with all equipment and play constantly funneled into the same area with no feasible alternate route.

The fairway was divided into 15 plots, each plot crossing the entire fairway area. Figure 1 shows the plot and treatment layout.

Before initiating any aerification treatments soil compaction was measured with a Proctor Model CN-419 penetrometer in the surface 2 inches. The plots were sampled in three locations, the righthand edge, center and lefthand edge of the fairway, and three readings were taken at each station.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Superintendent, Broadmoor Golf and Country Club, Seattle, WA, and Extension Agronomist, Western Washington Research and Extension Center (WSU), Puyallup WA.

A double ring infiltrometer system was used to measure water infiltration rates at three locations in each plot, namely, righthand edge, center and lefthand edge of the fairway. The infiltrometer was made up of two steel rings, 6-inch and 4-inch diameter. The 4-inch ring was driven approximately one inch into the thatch and soil surface then the 6-inch ring was placed over that and driven to the same depth in the soil. The rings were made as nearly level as possible to receive the water. Both rings were filled with water but only the 4-inch or center ring was measured for rate of falling head of water to determine the rate of infiltration. The rings were left in place for 2 hours, the outer ring constantly being kept full of water and the inside ring refilled as it emptied. At the end of the 2-hour period the total number of inches of water which had been applied to the center ring were calculated to determine the infiltration rate per hour.

After the penetrometer and infiltration readings were taken aerification was started. An 8-foot Jacobsen fairway aerifier with 3/4 inch open tines was used. Since each plot was approximately 24 feet wide, the fairway aerifier could easily be maneuvered within each plot. The treatments consisted of a single pass spring and fall up to a double pass 4 times annually.

Along with the aerification overseeding with turf-type ryegrass and Highland bentgrass was practiced immediately following aerification.

Table 1 shows the effects of aerification after one year. We feel that it is too soon to make many conclusions, hopefully after the second year some pattern will develop.

The last step in our analysis was determining bulk density within each plot and each sampling area. Bulk density samples were taken at 0-2 and 2-4 inches from each plot (right side, center and left side) during August of 1983.

The following are some observations after the first year.

1. Water infiltration rates are reduced in the center of the fairway in all cases as compared to the sides.

2. There were no differences in the bulk density readings with the exception that the left side has more gravelly or sandy type soil which results in greater bulk density. The interesting thing is that that was no difference in bulk density in the center as compared to the right side.

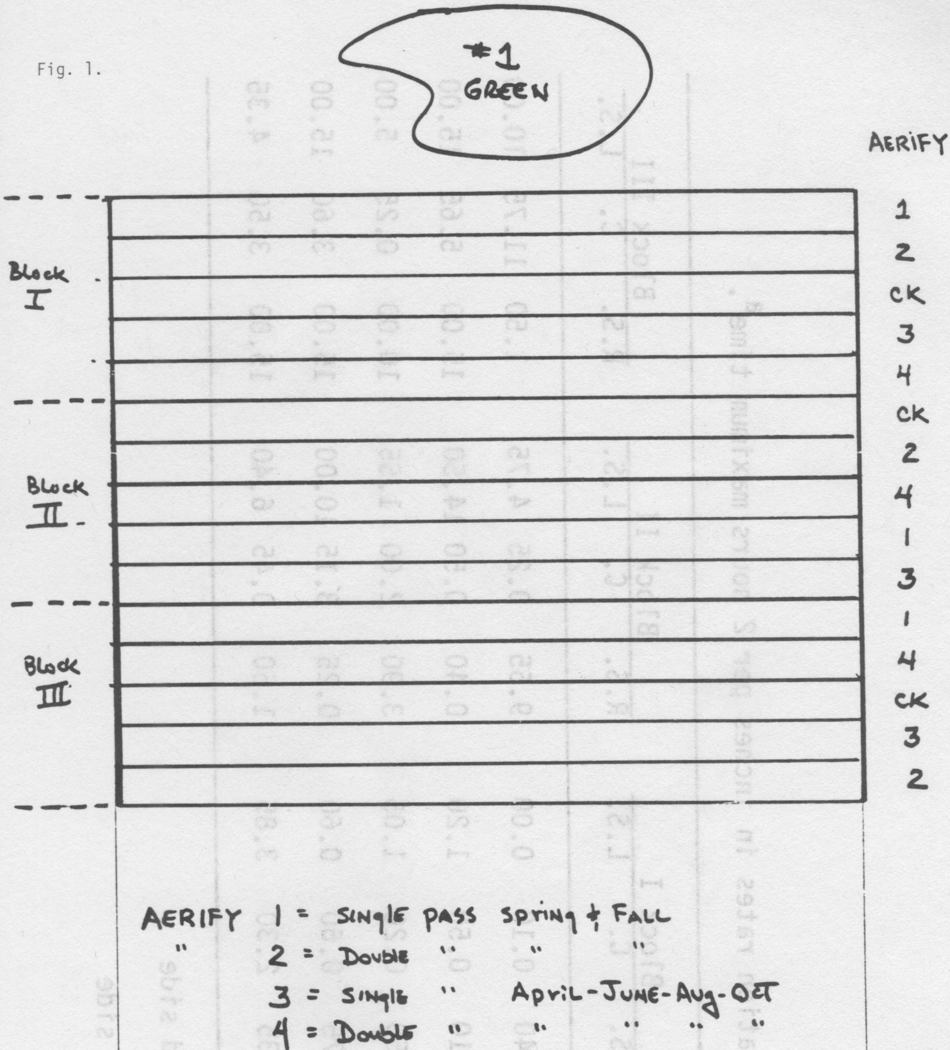
3. There is some reason why the infiltration rate is slower down the center of the fairway compared to the sides although it is not accounted for in bulk density. Thatch and organic matter may have become more compacted without significantly effecting the bulk density of the soil which would, in turn, effect the infiltration rate. As mentioned earlier, another year of gathering data will be necessary to start drawing definite conclusions.

CONCLUSIONS TO DATE

It appears that multiple aerification will increase infiltration rates. Four aerifications per year was better than one and once spring and fall was better than the check in most cases.

The bulk density readings were lower in the 2-4 than in the 0-2 inch layer which verifies that the significant amount of problem occurs in the immediate surface. Possibly by changing irrigation practices using multiple cycles along with wetting agents may help induce better water penetration. More data, of course, are necessary and will be available at the end of 1984.

Fig. 1.



#1 GREEN
AERIFY
Block I
Block II
Block III
1
2
CK
3
4
CK
2
4
1
3
1
4
CK
3
2
AERIFY 1 = SINGLE PASS SPRING & FALL
" 2 = DOUBLE " " "
3 = SINGLE " APRIL-JUNE-AUG-OCT
4 = DOUBLE " " " " "

Table 1. Infiltration rates in inches per 2 hours maximum time[a].

Treatment	Block I R.S.	Block I C.	Block I L.S.	Block II R.S.	Block II C.	Block II L.S.	Block III R.S.	Block III C.	Block III L.S.
Aerify 1	0.40	0.10	0.00	9.55	0.25	4.75	1.50	11.75	10.00
Aerify 2	0.10	0.50	1.20	0.40	0.50	14.50	15.00	5.65	15.00
Check	0.50	0.20	1.05	3.90	2.00	1.55	10.00	0.25	5.00
Aerify 3	4.75	0.60	0.60	0.25	3.15	10.00	15.00	3.60	15.00
Aerify 4	1.35	2.30	3.85	1.50	0.45	6.40	15.00	3.50	4.35

[a] R.S. = righthand side
C. = center
L.S. = lefthand side

MAINTAINING PUTTING GREENS WITH MINIMUM PRACTICES[1]

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

Pre-emergence herbicides to prevent germination and establishment of annual bluegrass have received much attention from product development interest and researchers. We have continued our annual bluegrass control program on turf maintained with minimum levels of nitrogen. The only treatment combination which continues to provide control of annual bluegrass is endothal plus bensulide. Endothal without bensulide does lower the level of annual bluegrass percentage in all turfgrass types, but bensulide applied by itself without endothal does not appear to be effective at all in keeping the annual bluegrass composition low. Likewise, our reapplication treatments of Nortron in June, July and August do not lower the level of annual bluegrass in the turf, but they are reduced somewhat when they are preceded with a treatment of endothal. This reduction in annual bluegrass composition does not appear to be different from the reduction provided by a single application of endothal. Repeat applications of Norton in August, September and October have not reduced the Poa annua composition of turf and has often caused a high and inconsistent level of phytotoxicity to the desirable turf species when applied in October.

Turfgrass fertilized at the lowest nitrogen levels undergoes more discoloration with both the application of Nortron in the fall and endothal in late spring, and the recovery and development of density is prolonged (Table 2). At this point we have not been able to detect consistent differences in the level of annual bluegrass in turf treated with different levels of nitrogen that received similar pre- and post-emergence control treatments.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

Table 1. Effect of pre- and post-emergence chemicals on control of Poa annua in low N maintenance putting green.

	Poa annua[1] 1983	1982
	(%)	(counts)
No treatment	10.0	6.3
Bensulide (15 lb)	10.0	6.6
Bensulide Repeat (12 + 3 lb)	9.0	6.6
Endothal	8.0	4.2
Endothal + Bensulide	2.33	1.7
Endothal + Nortron Repeat (JJA)	7.0	5.2
Nortron Repeat (JJA)	10.7	7.9
Nortron Repeat (ASO)	13.7	6.7

[1] Average percent cover and number of Poa annua hits from 30 point quadrant observation per plot.

Table 2. Turf quality as affected by pre- and post-emergence chemical application under low nitrogen use.

Treatment	Quality Spring	Quality Summer	Quality Fall
No treatment	5.1	6.3	5.3
Bensulide	4.7	6.3	5.1
Bensulide repeat	5.0	6.5	5.4
Endothal	5.4	5.9	5.7
Endothal + Bensulide	5.0	6.4	5.3
Endothal + Nortron	5.4	6.4	5.8
Nortron - Summer	4.5	5.9	5.1
Nortron- Fall	2.2	5.7	2.0

* 9 = best

ENHANCEMENT OF PUTTING GREEN BENTGRASS POPULATION WITH RUBIGAN[1]

Mike Bauman[2]

What is Ribigan?

Rubigan is a new turf fungicide with broad spectrum control allowing the flexibility to manage a disease prevention program and at slightly higher rates, provide curative action.

Rubigan has a mode of action involving three or more sites of inhibition, meaning that susceptible fungi commonly found in turf have not been able to develop resistance to it.

It is a long lasting concentrated product, with rapid leaf penetration.

Precautions

Applications of Rubigan to turfgrass areas containing Poa annua (annual bluegrass) may result in the gradual reduction of this species from the turfgrass area. Cumulative dosage of 5 lb of Rubigan 50W per acre or 2 oz per 1000 ft^2 are usually necessary for this response to occur. Turfgrass areas containing Poa annua which cannot tolerate its reduction should not be treated with Rubigan.

With this thought in mind I would like to tell you a little story.

In the years 1965 and 1966 Meridian Valley was constructed. The greens at Meridian Valley were stolonized with Old Orchard bentgrass. During the next 7 years Meridian Valley greens stayed pretty much the

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Superintendent, Merdian Valley Country Club, Kent, WA.

same pure Old Orchard. Then slowly but surely we succumbed to Old Poa annua (annual bluegrass) and at the present time we are probably 90% Poa annua on all our greens.

When the Elanco people asked me to experiment with their new product, Rubigan, not only as a fungicide but also as a Poa annua irradicant, I jumped at the chance.

Everyone knows how much better pure bent greens play and putt, etc. To get Meridian Valley greens back to pure bentgrass would be fantastic.

So, in the fall of 1982 and the spring of 1983 I experimented with their product, Rubigan.

Tuesday, October 12, 1982, I sprayed Rubigan on a 1000 ft^2 plot on the putting green and a 1000 ft' plot on No. 10 championship tee. The nursery green was also sprayed at 2 oz per 1000 ft^2.

After almost one month, November 10, heavy frost was experienced for seven days. The, on November 17, we experienced 1½ inches of rain. All Rubigan plots turned brown. Discoloration continued for three weeks before returning to the natural green color. No further product was sprayed on these same areas.

After the grass turned to its natural color, the bentgrass seemed to be more prevalent and vigorous, especially on the putting green plot.

On Tuesday, February 1, 1983, I sprayed Rubigan on a 500 ft^2 putting green plot at ½ oz per 1000 ft^2. Rubigan was also applied to a 500 ft^2 plot on No. 11 green at ½ oz per 1000 ft^2. No abnormal discoloration or effects to the grass were noticed. On Wednesday, February 16, Friday, March 4, and Monday, March 21, we repeated the applications of Rubigan to the same plots. On Monday, April 4, we received rain. The Rubigan plots turned brown. Poa annua was drying and the bentgrass looked good. After two weeks time, Poa seemed completely dead. The bentgrass was holding its own. During the third week the bentgrass on the putting green seemed to be revitalized and extremely vigorous.

The plot on No. 11 green was completely dead. The reason for this was use of a hand sprayer. The material was mixed and held in suspension while spraying the putting green, but by the time we got to No. 11 the material had filtered to the bottom of the tank and the solution was much stronger causing total burn out on the plot.

During the next two months, July and August, it was necessary to overseed the plot on No. 11. The plot on the putting green seemed to have enough bentgrass population so as not to have to overseed. The plot on No. 11 was overseeded weekly through the month of July. The seed would not germinate. Finally, we got germination on August 15. The seed used was Highland bentgrass.

The bentgrass population in the plot on putting green when first sprayed was probably around 15%. At present time the bentgrass population is 50%. <u>SURPRISE!</u> <u>SURPRISE!</u>

The enhancement of bentgrass populations in putting greens with Rubigan shows promise. Rubigan is an excellent fungicide. During spraying of all plots absolutely no disease was noted or experienced.

What I have experienced, especially with the putting green plot, encourages me to believe that with very careful management, *Poa annua* could possibly be eradicated in bentgrass putting greens.

ENHANCEMENT OF PUTTING GREEN BENTRASS POPULATIONS WITH RUBIGAN[1]

Dick Schmidt[2]

In the fall of 1982 tests were initiated to evaluate fungicidal properties of Rubigan (fenarimol) for control of Fusarium nivale and to determine any potential post-emergent herbicidal activity on Poa annua.

At the end of October Rubigan was applied at rates of 1.75 and 3.5 oz per 1000 ft^2 in separate plots of bentgrass/annual bluegrass putting green turf. Approximately 0.30 inch of rain fell the evening following product application. Two weeks following application Port Ludlow Golf Course experienced two heavy frosts. Approximately 30 days following application severe discoloration of Poa annua was observed, with little or no adverse effect on Penncross creeping bentgrass. Throughout this time period there was considerable disease pressure (Fusarium nivale) at Port Ludlow, yet no visual evidence of disease was present in the treated areas, either on the discolored Poa annua or the bentgrass. Even with continued disease pressure, no further fungicide treatment was needed until mid-January. At that time all putting surfaces were treated with PCNB except for the test plot treated with 3.5 oz/m of Rubigan. This plot was totally free of disease and remained so throughout the entire disease season. Evidently the rainfall immediately following October application did not appreciably negate the long-term fungicidal activity of this product, as seems to be the case with several other products used for control of Fusarium nivale.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

In early spring of 1983 disease pressure from Fusarium nivale was virtually nonexistent. Tests were initiated to more closely evaluate Rubigan's post-emergent herbicidal activity on Poa annua. Rates and application intervals are outlined in the accompanying table. There was no frost during or following early spring application and the severe Poa annua discoloration which followed the heavy fall frosts did not occur.

At 1/2 oz/m every 2-3 weeks absolutely no discoloration of Poa annua was evident. At 1 oz and higher rates a very slight discoloration of Poa was observed (just a slight yellowing and/or light leaf-tip burn). This very slight discoloration was no more pronounced at the highest single application rate (3 oz/m) than at the 1 oz rate. In general, Poa populations on most of Port Ludlow's putting greens were somewhat off color at this point in time. As such, it was quite difficult to determine if the discoloration of the Poa in the test plots was due to the effects of Rubigan alone or if other factors were involved. It appeared more of the varying strains of Poa annua in the test plots displayed this very slight discoloration. But, in general, no definite visual differences could be noted when comparing entire test plots to large adjacent areas of untreated putting green surfaces.

Only at the highest cumulative rates of Rubigan were any morphological differences in bentgrass noted. In the plot where 3.5 oz/m was applied in the fall, then 2 oz plus 0.5 oz in the spring, a widening of the leaves and deepening of color in bentgrass was observed --but only in certain areas of the test plot. This effect was most prevalent in areas where Poa annua was predominant. In areas where there were but a few tillers of bent among the Poa, this morphological change was most striking. These few tillers also seemed to be spreading and invading the adjacent Poa annua. In areas of the test plot where bentgrass was predominant, the morphological change was not as distinct nor did the bent seem to be spreading or invading adjacent Poa. Compared to untreated areas and areas with lower rates of Rubigan there were perhaps some morphological differences in the bent, but virtually no invasion in the small patches of Poa. In general, the morphological change and spreading of bentgrass became greater in those areas of the test plot where _Poa annua_ greatly predominated the mixture.

The warm, mild winter and then cool, moist spring of 1983 provided optimal conditions for the growth and proliferation of _Poa annua_. _Poa_ was, however, severely discolored after heavy fall frost following Rubigan treatment. No such response was observed in the spring when there were no frosts. Perhaps environmental stress during and/or following treatment is a key factor in discouraging _Poa annua_ with the use of Rubigan. If soil and air temperatures were higher and soils drier, even to the point of stressing _Poa annua_, perhaps Rubigan treatments would be more effective in suppressing _Poa annua_. Reports from central California indicate not a gradual elimination of _Poa_, but rather an almost immediate one has occurred following applications of Rubigan, even at light rates. Unfortunately we do not "enjoy" central California climatic conditions here in the Pacific Northwest. There have been some promising signs in enchancing bentgrass populations with the use of Rubigan, but overall results have been somewhat disappointing. But we do feel that Rubigan may certainly be another tool we can utilize in our ongoing battle against _Poa annua_.

DATE & WEATHER	10-28-82 50 F/overcast/ afternoon showers, evening rain. 0.30 Precip.	3-8-83 50 F/overcast. 0 Precip.	3-22-83 58 F/hazy/ broken clouds. 0 Precip.	4-12-83 45 F/broken clouds. 0 Percip.	4-27-83 60 F/clear. 0 Precip.
NO. 1 GREEN			3 oz./m.	1 oz./m.	
NO. 4 GREEN		0.5 oz./m.	0.5 oz./m.	0.5 oz./m.	0.5 oz./m.
NO. 5 GREEN	1.75 oz./m. 3.5 oz./m. .... Frost 11-11-82. Hard Frost 11-14-82.	....	...2 oz./m.	.0.5 oz./m.	
NO. 6 GREEN			1 oz./m. .... 1.5 oz./m.	.1 oz./m. .no follow-up	

THE CAMBRIDGE SPORTSTURF DRAINAGE SYSTEM OF SPORTSFIELD RENOVATION[1]

Glen G. Krause[2]

This years theme "Integrating Management Programs" encompasses subjects ranging from planning to management, turfgrass cultivars to maintenance practices. The ultimate goal of combining research and practicum along with technology and advancement of maintenance practices is to achieve a turfgrass suitable for a wide variety of applications.

Basic to the success of establishing and perpetuating any turfgrass cover are the interrelationships of soil types, structure, texture and drainage. When applying the mechanical forces of intensely traffiked areas such as sportsfield activities, the forementioned relationships become increasingly critical. The complexity from impacts upon soil air, water and solid soil fractions thus presents conditions which, if not ameliorated through regular maintenance practices, can become increasingly incapable of supporting vigorous turfgrass growth.

Over the past two decades, we have seen a marked rise in the demand for improved natural turf playfield conditions. Put simply, this meant a stand of turf that did not wear out before midseason and the riddance of water logged mudhole battlefields. The answer to the above was a variety of sand profile fields with varying degrees of sophistication. The measure of success of these installations has been as variable as the number installed. Two factors which prevail throughout are substantial construction costs and the requirement for specialized maintenance practices that follow. Those who have been fortunate to have properly constructed and maintained sand fields are among an elite minority. Budget restraints for the majority of school

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Landscape Architect, Beaverton, OR.

and park districts do not provide adequate funding for these types of installations. At the same time, public interest in recreational activity and a demand for better, safer playing surfaces has increased dramatically.

The alternatives between the sand field and natural soils modification are few when considering the efficiency of traditional mechanics for the relief of compaction and drainage problems. The effects of properly conducted core aeration and sand topdressing, while increasing aeration and improved water movement in natural soils, is efficient to only a 3 inch to 4 inch depth. After rainfall or irrigation fills the amended voids, it has nowhere to go but to charge the large capillaries of the adjacent soil. This condition results in the creation of saturated soil interstices, that when impacted by traffic, result in soil particles being "squeezed" out and about in the form of mud. It is not my intent to discuss the mechanics of soil water movement nor the technical parameters relating to performance of soil drainage systems this morning.

I am pleased to present to the Association an alternative approach for relieving surface water from turf surfaces known as the "Cambridge System". The "System", developed by Mr. Geoffrey Davison of Cambridge, England in the late 1960's, was a result of many years of working with soccer field drainage. A process known as sand infection, cutting a vertical slit and backfilling it with compacted sand, was developed to create a small scale French Drain system for remove surface water from the playing surface. By varying the spacing of sand injection slits and installing them in a grid matrix, the amount of water draining capacity could be varied depending upon the severity of conditions and soil type.

In 1974, Mr. John Moreland, then a golf course superintendent at the Carmel Country Club in Charlotte, North Carolina, met Mr. Davison at the GCSAA Convention. Mr. Davison, who had little interest in golfing, shared his concepts and development of specialized equipment with John, who had been working on a similar philosophy to correct drainage of tees and greens suffering from compaction and improper construction. From this meeting evolved a working relationship involving mechanics, materials and processes the two parties had experience with over past years to achieve the same result. Thus was born Cambridge Soil Services of America under the ownership of Mr. Moreland who administers the American based organization promoting the development and application of Cambridge Soil Services Limited principles of England in the United States and Canada.

The "System" includes sand injectors, deep fissuring tools, sand grooving, slicing and compaction breaking equipment corresponding to the variety of conditions which may be applicable to the remedy of differing soil or drainage problems. The rights to acquire "System" components are made available only through the purchase of Territorial Franchise Licenses and internationally patented equipment through the United States organization.

The components of the "French Drain" system include a grid of 9-inch deep sand injection slits closely spaced in an interconnected network to form drainage channels for removal of surface water. The simultaneous installation of drainage tubing at the base of the injection slit provides a positive movement of water from the sand channels to a subsurface drain pipe which carries collected water to a stormwater drainage system or a suitable "daylight" outfall. To protect the integrity of the surface water infiltration into the injection slits, a sand topdressing is recommended where the system is installed in clay and silt soils. The compliment of pre-existing sand constructed greens or playfields is obvious to the adaptability of the sand injection principle.

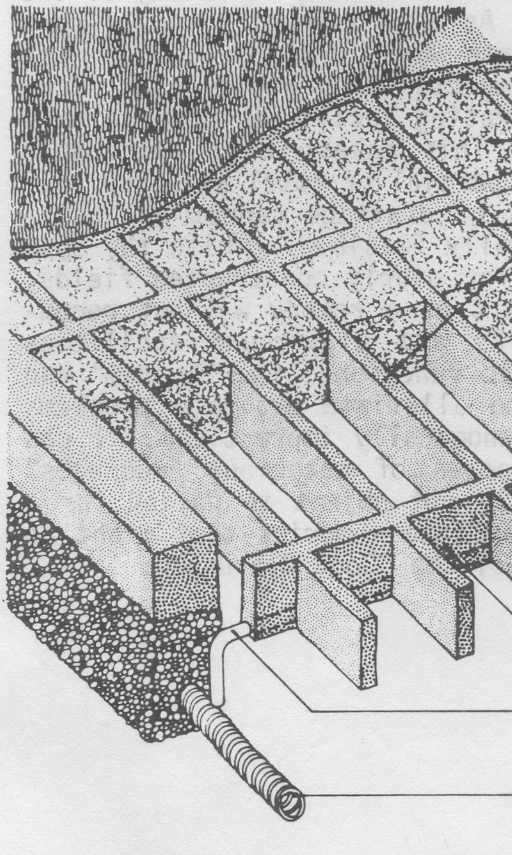
The performance of the "sand injection" and "minidrain" components is promoted to remove a minimum of 10 inches of water in a 24 hour period. Through the precise analysis of clean, washed sand percolation rates can be confirmed from 30 inches to 80 inches an hour. The same evaluative process provides filtration qualities to prevent fine soil particle migration into the sand injection columns and drainage tubing system. Depending upon the physical make-up of existing field soils, the ranges of available sand in a given region and the desired rate of removal, these three factors are evaluated to pre-determine system design and performance. While this may appear sophisticated in principle, it is, by far, freer of potential error or failure that can arise during or after construction of an all-sand field profile. Considering that a significant amount of sand pore space will be displaced by turf-root growth over time, the specification of sand for the injection slits and topdressing accounts for this depreciation of infiltration rate over an extended period of time.

It is known from 10-year-old installations in Europe that performance levels of 10 inches per day can be maintained by proper maintenance of the turfgrass cover. The system's sand grid lifespan is estimated to provide an indefinite period of service, at least 30-40 years according to Mr. Davison. Once the basic system is installed, it is possible to re-activate more rapid surface infiltration by performing sand grooving later on whereby new sand slits are installed at a 3 inch to 4 inch depth to intersect with the original sand grid. This technique was employed at The Orange Bowl earlier this year to mitigate organic capping of the P.A.T. system field.

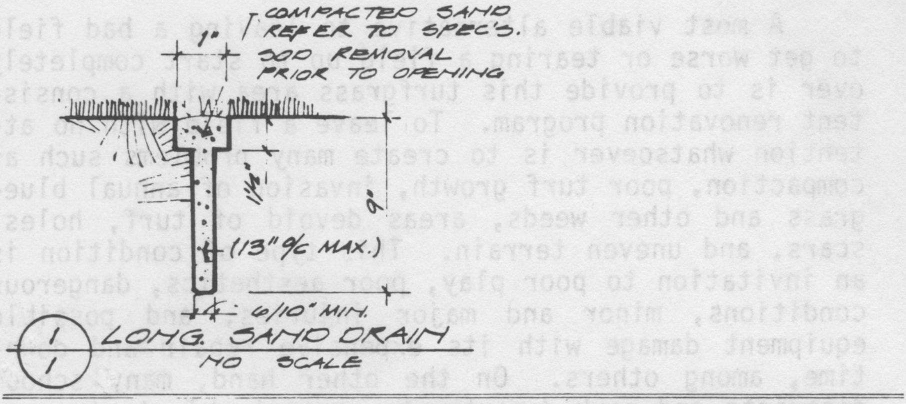
Not unlike other solutions to drainage and compaction problems, the degree of proper maintenance and management after installation of the "System" is important to its success. As I indicated in my opening, the "System" will work best when integrated with other maintenance practices and is proportionately related to that effort. Continued programs of aerification, thatch removal, overseeding and topdressing, properly carried out, will enhance the system's performance through promotion of a vigorous turfgrass surfacing.

The Cambridge System is another alternative to consider when faced with renovation needs for existing facilities. Among the benefits the "System" provides is the immediacy of result, obtainable without interruption of field use. Up to a 10% volume of a field soil can be altered without negatively impacting the remaining area. Total recovery of turfgrass infill will occur in six to eight weeks during the growing season. The remaining 90% of unaffected soils are manageable by conventional practices and do not require dramatic changes in day-to-day maintenance operations. The Pacific Northwest Franchise for the"System" considers education of key maintenance personnel through written maintenance programs during and after installation as a part of any project including hands-on training for those whose responsibility it will be to carry out the tasks.

The costs for installing the "System" is varied depending upon site conditions and the intensity of the grid network installed. As an alternative to all-sand construction it represents about 1/4 to 1/3 of the cost, less any revenue impacts which would result from down-time of income-generating facilities undergoing a reconstruction process. This makes it an affordable approach to dealing with partial or total area application where other methods of drainage cannot be justified or are not economically feasible. While the system is not a substitute for poorly constructed fields, it can be an integral part of a remedy without reconstruction. For the parks and playground facilities which serve general public functions, the "System" can become the opportunity to alleviate drainage problems previously considered economically impractical. I can imagine that there are acres of notorious "mudholes" that even the public would not object to paying for a solution; even considering fond memories that might be attached to Dad's recall of the "Good Ole Days".



SAND INJECTION & DRAINLINE CUTAWAY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1"
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1¼"
9"
(13" O/C MAX.)
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LONG. SAND DRAIN
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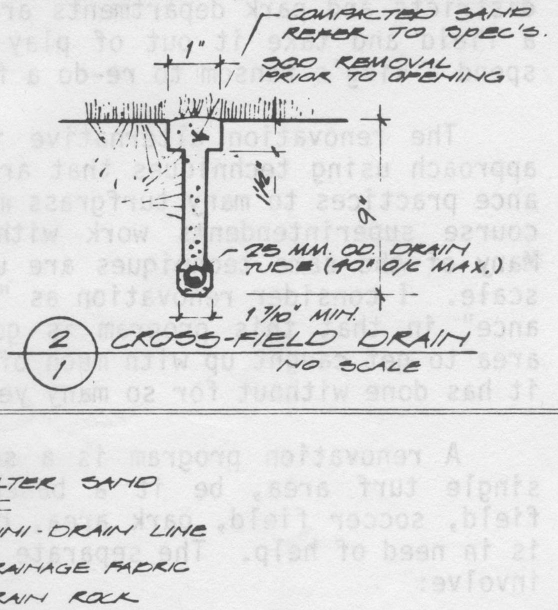
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REFER TO SPEC'S.
1"
SOD REMOVAL
PRIOR TO OPENING
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9"
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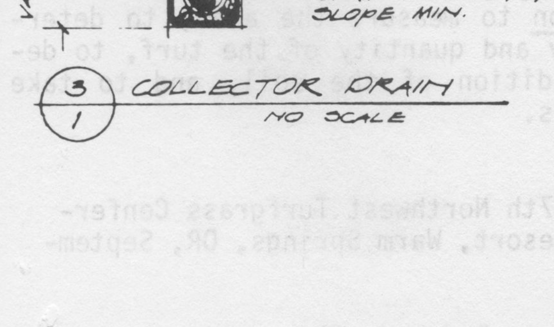
TUBE (40" O/C MAX.)
1 1/10" MIN.
2
1
CROSS-FIELD DRAIN
NO SCALE


9" MIN.
FILTER SAND
MINI-DRAIN LINE
DRAINAGE FABRIC
DRAIN ROCK
DRAIN PIPE @ ½%
SLOPE MIN.
VARIES
24" MIN.
3
1
COLLECTOR DRAIN
NO SCALE

LOW BUDGET SPORTSFIELD RECONDITIONING[1]

Gene Howe[2]

A most viable alternative to leaving a bad field to get worse or tearing a field up to start completely over is to provide this turfgrass area with a consistent renovation program. To leave a field with no attention whatsoever is to create many problems such as compaction, poor turf growth, invasion of annual bluegrass and other weeds, areas devoid of turf, holes, scars, and uneven terrain. This type of condition is an invitation to poor play, poor aesthetics, dangerous conditions, minor and major injuries, and possible equipment damage with its expensive repair and downtime, among others. On the other hand, many school districts and park departments are not able to tear up a field and take it out of play for a year or so to spend a king's ransom to re-do a field completely.

The renovation alternative involves a programmed approach using techniques that are considered maintenance practices to many turfgrass managers, such as golf course superintendents work with their golf greens. Many of the same techniques are used, but on a larger scale. I consider renovation as "concentrated maintenance" in that this program is going to allow a turf area to get caught up with much of the maintenance that it has done without for so many years.

A renovation program is a series of visits to a single turf area, be it a baseball field, football field, soccer field, park area, or any turf area that is in need of help. The separate aspects of renovation involve:

1. Visual inspection to measure the area, to determine the quality and quantity of the turf, to determine the condition of the soil, and to take soil test samples.

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2/ Sportsturf Northwest, Redmond, WA.

2. Have a professional <u>soil test</u> taken to determine what condition the soil is in and to find out what can be added to make it a better growing medium.

3. <u>Aerify</u> the hard soil as many times as is practical to loosen the soil, to allow air, water, and nutrients to get down to the rootzone, and to create holes for the introduction of sand via topdressing.

4. <u>Verticut</u> (thatch) the area several times in different directions to remove as much unwanted dead and organic material. This also helps loosen the soil somewhat and creates a better environment for overseeding.

5. If there is much material left on the surface from verticutting, <u>the area should be swept and vacuumed</u> and the debris removed from the site.

6. Depending on the time of the year, the uses the area is to be subjected to, <u>overseeding</u> is usually the next step. Overseeding should be done with the proper equipment to create seed to soil contact. This should also be done in several different directions using seed determined best for the situation at a fairly high rate in order to get as much new turf established before the field is put under constant use again. The proper irrigation, fertilization, and mowing techniques are critical to the success of overseeding. This process should be done at least once if not twice to many turf areas in high use.

7. <u>Topdressing</u> with sand should prove to be one of the most important techniques of renovation in that it helps improve the soil structure that the turf must survive in, reduces compaction, helps level the field, improves the drainage on some fields, and lessens the quagmires that are constant companions to many fields in our Northwest climate. This sand is usually applied in 1/4 inch intervals spaced about one month apart. There is now limit as to how much sand can be put down, the more the better. The sand is dragged into the holes left by aerifying to get the sand into the soil structure. Topdressing is done with a tractor-

drawn machine made specifically for this purpose. It has been my practice that 50 cubic yards of sand can be put on a football field in 5 hours. These fields, once dragged, can be opened for business if necessary if the area has not been overseeded, etc. This practice is dramatic in its results, especially in the area of reducing muddy playing conditions. The more sand put down, the maintenance of the area must change somewhat, especially the fertilizing practices.

8. A fertilizing program must be set up to provide the existing turf and the newly introduced turfgrass plants with the proper nutrients to survive and flourish in this improved environment. The results of the soil test should be examined and the necessary steps taken as per this test.

9. A spray program should be implemented to reduce the weeds, insects and other pests. Also, spraying can help control annual bluegrass if the turf manager follows the directions for this practice and can withstand the pressures caused by the turf going off-color for three weeks or so. A preemergence chemical can be put down during certain times of the year for added control. Care must be taken when coupling any spraying with a sound renovation program in that the timing of certain aspects (such as seeding) may be affected.

A renovation program should never be considered a one time miracle cure. Even a year of programmed visits should not be construed as the last attention a field should receive. Many of the functions may be able to be reduced or eliminated in the future, but most should become a fixed part of the maintenance of the turfgrass area. This approach to rebuilding definitely takes a dedication of time to achieve the results most expect. One good thing about this type of program is that it does not take the field out of play. Of course, it is always a dream of grounds managers to close a field for an extended period of time, but more times than not, this is not practical or even possible. I feel strongly that the grounds managers should have more control of field usage if they do not abuse this control. Scheduling of play to allow for rest times is very important.

Renovation can take place in many different variations to the program outlined above. The decision as to what to do to a field is sometimes not any easy one to answer. This question must look at many factors such as: field usage, how long it could be kept out of play, the budget available to do the job, the equipment and manpower constraints, but most importantly, what type of turf surface is desired and/or demanded. After these questions are answered and completely understood by all those involved, the specific type of renovation project can be selected. If the turf quality is not good, the area can be sprayed with Roundup herbicide prior to the renovation program. If the turf quality is good but the quantity is not, then the area can be tilled using a special horizontal tiller and reseeded. If the area is very rough where topdressing would not be able to smooth it out for some time, this type of tilling will also do wonders. This is also the case of when an irrigation system is installed after the turf is established to remove those difficult trench scars. To take a plow and disc to the field can also be considered a renovation project, although a rather major one. Removing the sod from an area (or a portion of a field), tilling and relevelling of the soil, and re-installing the old sod, installing new sod, or seeding the area are then possible. I use the criteria above plus the estimated number of topdressings to get the field in the desired condition as a guideline as to what type of approach to use or to suggest.

There are other factors to consider when discussing this more major type of renovation. This is the perfect time to put in needed drainage lines and/or an automatic irrigation system. Though drainage and irrigation systems can be installed at any time, the installation is easier to do when the field is being rebuilt. Special attention, care, and a special number of tricks are necessary to successfully trench into existing turf and then close them up to make the field level. This is where the topdressing will really help.

To return the discussion to the simple renovation program, I would like to discuss some particulars. I try to start out by topdressing a field at least four times the first year and then go from there for the future. This gives the field one inch of sand and usually takes care of many of the bad situations. This is also the point where I start discussing a more major type of work, even though topdressing will still be required upon completion. Football fields can be top-dressed more between the hash marks where a majority of the game is played. Caution should be taken not to just work on this part of the field as it will soon raise up from the remainder of the field and will look rather odd with just the middle devoid of mud. Top-dressing outside of the hash marks will also help in removing a high crown, if that is desired. Baseball fields should be worked on after the season and through the remainder of the year to make them ready for the spring season. Football fields should be worked on in the spring and summer, assuming that irrigation is available. Depending on the weather and field conditions, topdressing can be done in the winter months, also.

Irrigation is so critical during much of the year. This is especially true when the field has been over-seeded. An automatic system is best. New seed must remain moist, not soaked, for at least one month during the germination period. This may involve watering every square inch of the field several times a day, possibly up to five or six. This can only be done with an automatic system.

Follow-up maintenance is also critical. The mowing of the field may change drastically. This type of renovation program is noted for one thing, growing turf. This growth pattern may be much different than in the past and may require much different care if the field is to take on this new life. It is usually the maintenance practices that get the turf into many of its difficult situations. If this area of maintenance is not reviewed prior to renovation, then the turf area may quickly resort back to its original and pitiful condition.

Any type of renovation requires specialized equipment to do the job correctly. This includes tractors with loaders, tractors with wide turf tires, aerifiers, spreaders, overseeding equipment, topdressrs, spray tanks, sweepers and/or vacuums, among others. Also necessary are personnel who understand the function and correct operation of this equipment, who can program the various events, and who will have the time to do this work at the correct time. The justification of the purchase of this specialized equipment and the use of personnel for such an undertaking is difficult, if not impossible, for some. This equipment is used a couple of times during the year which makes it difficult to justify their high expense. Crewmembers are always overloaded with work and do not usually need to take on more, especially if they are not experienced at this type of work.

Just as a renovation program is a viable alternative to rebuilding a sportsfield, the contracting out of this specialized work is also a viable alternative to attempting to do this in-house for most of you. This is the basis for why I set up Sportsturf Northwest. I do not consider myself as a landscaper, but as a turf manager with only one aim: to help others improve their turf areas. Renovation as described here is my main focus of business, even though other aspects of turf management are being developed or explored. These include contract mowing of large turf areas, consulting with grounds maintenance personnel when they may need help, performing single aspects of the renovation program as described, such as field spraying or fertilizing, the design and/or installation of automatic irrigation systems (especially for my renovation customers), the rental of handlines and sprinkler heads plus the addition of valves and controllers to make an automatic irrigation system on top of the ground for those who do not have it, emergency mowing in case of breakdowns of equipment and/or personnel, and planting of the correct types and amount of seed in new construction either for the customer or for the contractor through a sub-contractor arrangement. In this latter instance, the specification can be followed or changes to better the end results may be suggested to the owner or his representative, if desired. It has been my experience that it doesn't take any more effort or cost to do this critical job right the first time.

This contract alternative reduces equipment purchase requirements, employee requirements, mechanic, fuel, and repair costs and puts the proper equipment with trained operators on your project. This, like renovation, is definitely a viable alternative which should be considered by many. The costs of these programs do vary, but will surprise many with its low cost and its results.

ESTABLISHING GRASS ON SPORTSFIELDS[1]

Dr. Roy L. Goss[2]

Rapid and uniform establishment of turfgrasses on sportsfields is probably the most important factor after proper construction. Most turfgrass managers experience difficulty in patching in or reseeding skips or poorly established turfgrass which can result in thin and weak areas or areas that become dominated by Poa annua, a poor wearing type of grass. The following discussion is important in helping you to achieve uniform and rapid establishment.

SOIL TEXTURE

In general, establishment is faster on soils with a higher content of silt and clay such as sandy loams or silt loam soils due to a higher water holding capacity in the surface where the seed are germinating. These soils, of course, are not suitable for good athletic fields. Therefore, we must address the issue of sand. During sunny periods the surface of sand will dry within 1-2 hours to the point where the grass seed will not germinate. It is most important, therefore, to apply very light but frequent waterings to insure the surface is continually moist to enhance rapid germination.

AUTOMATIC IRRIGATION VS. MANUAL

Automatic irrigation is much more effective than manual irrigation for establishing sportsfields. During dry periods the timers can be set to turn the sprinklers on once every hour if necessary for a matter of 1-2 minutes to moisten the surface. It may be necessary to repeat these cycles 8 or 10 times throughout a long day. This process will be required for only 4-7

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

days when you will notice the seedlings emerging. After germination is complete, then reduce the frequence of irrigation and slightly increase the amount of water applied to prevent the root zone from drying out. It may be necessary to water the field with .15 to .25 inches of water per day to maintain adequate moisture. After 2-3 weeks begin extending the interval between irrigations. Use a soil probe to determine the root zone moisture and don't guess at it. After the grass is well established it is still a good idea to apply the total amount of irrigation water in 2 or 3 cycles during a given irrigation period. Sands can become hydrophobic (develop localized dry spots) and 2 or 3 short cycles within a given irrigation period will tend to produce more uniform wetting than a single heavy application.

FERTILIZATION

Assuming that the proper amount of fertilizer was applied prior to seeding which would include nitrogen, phosphorus, potassium, micronutrients and dolomitic lime (for sands), followup fertilization is very important to maintain a vigorously growing turf. Approximately 50% of the nitrogen for establishing new turfgrasses should be in the form of slow release materials. This will insure some nitrogen availability to the developing seedlings for a period of 6-8 weeks.

If you use soluble sources of nitrogen, apply only small amounts such as 1/3 lb of nitrogen per 1000 ft^2 and repeat this treatment every 10-14 days. It is important when using soluble nitrogen sources to guard against over-irrigation. Excess water will simply wash the soluble fertilizer below the root zone and the turf can still be deficient.

SELECTING THE RIGHT GRASS

It has been proven on Pacific Northwest sportsfields that turftype perennial ryegrasses and improved Kentucky bluegrasses are best. We have found that a 50:50 mixture of two or more varieties each of the turftype ryes and Kentucky blues will provide sportsfields with the greatest sod strength and wear factors. It is a good idea to blend two or more varieties of the ryegrasses and two or more varieties of bluegrasses and then mix all of them in a uniform mixture.

Turftype ryegrasses can be selected from the following varieties and perhaps others as well: Diplomat, Omega, Blazer, Fiesta, Loretta, Yorktown II, and Manhattan II. Kentucky bluegrasses can be selected from Bristol, Sydsport, Baron, Victa, America, Columbia, Majestic and Touchdown.

SEEDING METHODS

We have found that brillion drill seeding produces best establishment. Other similar equipment can be used effectively as well. We have often had complaints that it is difficult to operate tractors and brillion seeders on sand fields due to sand flowing ahead of the drill. This can be avoided by thoroughly moistening the soil prior to seeding. Dry sand is unstable and will rut. Moist sand is much more stable and this problem can be avoided.

Do not use drop or broadcast seeders for establishing sportsfields. The seed must be pressed into the soil and come into firm contact with the soil for rapid germination. It is always best to apply one-half of the seed in each of two directions to avoid any skips. Hydroseeding is usually effective in establishing grasses on sands provided the application is very uniform. This method, however, is usually much more expensive.

EARLY MOWING

Mow the new sportsfield when grasses have attained a height of 1-3/4 inches with mowers adjusted to cut at 1-1/2 inches. Do not allow the grass to grow taller since seedlings can be injured from too severe height reduction. It may be necessary for the first one or two mowings to mow with light weight equipment to avoid rutting. On newly established fields it is important to mow shortly after a light application of irrigation water to make the surface as firm as possible.

The old rule of never removing more than 1/3 of the leaf blade should be practiced at all times. This means that you will have to mow the field a minimum of once per week and, in general, two times per week if the grass is vigorously growing.

This all may seem like a great deal of detail, but it is very important for uniform and rapid establishment. Density of the shoots and extensive root systems are the most important factors on sand based sportsfields. If all of the management practices are carefully followed, you should develop a strong and durable sportsfield in one year or slightly less.

MAINTENANCE OF LOW-TRAFFIC TURFGRASS AREAS[1]

Tom Cook[2]

Perhaps this sounds like an odd title for a talk, since we spend most of our time trying to figure out how to keep grass on athletic fields and other heavy use areas. But the fact remains that even on the busiest college campus or city park the vast majority of turf really is low-traffic turf. Some estimates indicate as much as 75% of all turf areas are essentially low traffic areas. In our current times of tight budgets and manpower shortages it may be that we worry too much about football fields and not enough about the rest of our turf. Since funds are not likely to increase, maybe we should figure out how to make maximum use of money we have available to us now rather than lament the fact we don't have more.

What we need is to develop a strategy that administrators can understand. Something they can look at and evaluate and make decisions with. In a sense, this is exactly what we attempted to do at OSU when we were faced with a major budget crisis. What follows is a summary of how OSU dealt with this crisis and what the results have been.

What happened at OSU was triggered by an arbitrary administrative decision to quit watering turf and shrub areas so we could save money by buying less water from the city. In the back of someone's mind, I'm sure, they felt other costs associated with landscape care would decline also. The result was a short term savings in water bills and a host of headaches for maintenance personnel. We quickly found out that our mass plantings of rhododendrons and azaleas could not survive without supplemental irrigation and lawns quickly became invaded by deep-rooted, drought-tolerant weeds.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

Worst of all, alumni and other campus visitors were appalled at the appearance and condition of the grounds. It wasn't long before high-level administrators became alarmed and attempted to correct the problems. Leading this effort was our Vice President for Administration who proposed an interim ad hoc committee to "conduct a campus-wide study of our shrubs, plants, and trees in an effort to determine whether we are being life-cycle, cost-efficient in our installation and maintenance procedures. A second aspect would be to determine if we are using the most appropriate plant materials for the various applications." Among our responsibilities were a comprehensive review of existing conditions and non-acceptable practices, and recommendations for improvements. Further, we were to point out both desirable and minimum levels of development, care, and maintenance for various areas of campus. These levels would be used as guides for budgeting and administration purposes.

The committee created for this purpose was diverse and included our grounds superintendent, an Assistant Dean of Forestry, our landscape architect, a member of the Office of Planning and Institutional Research, and myself. In addition, we were assisted by the Horticulture Department Chairman, a senior horticulture faculty member, and a consulting architect. While we were definitely not of the same minds and at times argued vociferously, we did persevere and produce what I feel was a functional, comprehensive guide that is currently being used by the University. Our report included: 1) recommendations, 2) review of existing conditions (under the no water policy), 3) development of maintenance priorities, and 4) several appendices.

Recommendations

Recommendations were based on questions posed by our Vice President. They are unique to our situation and would probably be different as budgeting constraints change. Six of our recommendations addressed issues related to minimum acceptable levels of maintenance. They are as follows:

1. Provide adequate maintenance to preserve existing investment in plant materials while moving to a long-term plan for more cost effective design.

2. Establish a general minimum standard of maintenance for the entire campus to reflect the various zones of care, use, and effective investment of resources. (A map was attached indicating areas that should receive this minimum standard of care).

3. Areas maintained by the student housing office and other cooperating agencies should conform to the established standard of maintenance to provide a unified appearance to the entire campus. (At OSU, apartments and other types of student housing are under control of the housing department and are maintained by their staff).

4. Improvements in irrigation equipment should be made in those areas where the minimum maintenance standard cannot be achieved. (These areas were also indicated by a map).

5. Establish maintenance standards and appropriation for newly developed additions to the campus grounds to accommodate increased demand on physical plant resources. (Typical of many institutions, no allocation was made for increased maintenance costs due to additions of newly landscaped buildings).

6. Cost effective water metering conversions should be made to separate irrigation metering from building metering. (Many of our landscape areas were operated through building meters and paid a higher charge).

One recommendation dealt with desired level of maintenance as follows:

7. Locate and develop higher level landscape treatment of campus landscapes where desired and appropriate.

Review of Existing Conditions

Before detailing just what various levels of landscape care entailed we chose to review existing practices and point out short- and long-term implications. In this section we discussed grasses used throughout campus, how they performed under drought conditions, and what could be expected over the long run. We noted the rapid increase in broadleaf weeds and the effect they had on mowing and weed control programs. The same approach was taken regarding shrub beds and trees.

Development of Maintenance Priorities

It's easy to talk in glorious terms about high and low maintenance. What exactly is high maintenance? In this section we attempted to develop quantitative maintenance standards to answer this questions. The actual numbers we used are based on our needs and capabilities. They likely differ a great deal from other campuses and are offered here only for example.

1. First Priority Areas. These are spotlight areas that deserve top care year around. At OSU this includes the mall in front of the student union building and the grounds around the administration building.

Turf

Irrigation	12-16 irrigations annually
Fertilization	4-5 lb N/1000 ft^2 per year Lime according to soil test
Mowing	45+ mowings per year
Edging	12 edgings per year
Weed Control	2-3 applications for broadleaf control initially. Spot treatments as needed in subsequent years.
Overseeding	Annually or as needed

Trees and Shrubs

Irrigation	8-12 irrigations annually
Fertilization	1-2 applications per year. Dependent on specific plant requirements.

Mulching	Annual replacement or as needed
Weed Control	3 applications of pre-emergence per year. 1-3 applications of non-selective post-emergence herbicides or as needed. Hand removal weekly where appropriate.
Pruning	Annual pruning of small trees and shrubs. Touch up pruning as needed. Systematic shaping and grooming of large trees including crown thinning, cabling, etc. Touch up pruning annually as required.
Pest Control	1-2 sprays per year or as needed to prevent plant injury.

<u>Flower Beds</u>

Irrigation	12 irrigations per year or as needed
Fertilization	2-3 applications annually with balanced formula high in P
Weed Control	Hand weeding as necessary

<u>Miscellaneous</u>

Leaf Removal	Weekly during fall drop period or as needed
Litter Removal	As needed

2. Second Priority Areas. At OSU this included drive by areas of high visibility, large lawns receiving moderate use, and intramural athletic fields.

<u>Turf</u>

Irrigation	6-12 irrigations annually
Fertilization	3-4 lb N/1000 ft² per year Lime according to soil test

Mowing	40+ mowings per year
Edging	3 edgings per year
Weed Control	1 application annually for broadleaf control. Spot treatments as needed
Overseeding	Annually or as needed

Trees and Shrubs

Irrigation	8-12 irrigations annually
Fertilization	1 application per year. Dependent on specific plant requirements.
Mulching	Annual replacement or as needed
Weed Control	3 applications of pre-emergence herbicide per year. 1-3 applications of non-selective post-emergence herbicides or as needed.
Pruning	Annual pruning of small trees and shrubs. Removal of dead or dangerous limbs only on big trees.
Pest Control	1-2 sprays per year or as needed to prevent plant injury

Contingency Plan for Second Priority Areas. In the event of severe economic difficulties, we also developed a plan that amounted to a reduced level of care for selected second priority areas.

Turf

Irrigation	4-6 times per year, starting in mid to late August.
Fertilization	3 lb N/1000 ft^2 per year
Mowing	30-35 times per year

Weed Control	1 application annually for broadleaf control
Overseeding	Annually or as needed

Trees and Shrubs

Same as second priority

Miscellaneous

Same as second priority

3. Third Priority Areas. This included grass areas not maintained as fine turf. At OSU 29 acres fit in this tractor mowed non-irrigated category.

Turf

Irrigation	None
Fertilization	None
Mowing	6 times per year
Weed Control	None

Once these priority levels were established and assigned to various areas on campus, two things became apparent immediately. One, many of the areas were already maintained at or below the assigned levels and two, significant irrigation system improvements were necessary to upgrade many areas to their assigned priority levels.

Appendices

To support points made throughout the report several appendices were included.

1. A list of costs and savings associated with discontinuation of summer watering. This demonstrated hidden costs such as re-establishment of turf areas, woody plant loss, increased weed control costs, and returning irrigation systems to service.

2. Additional costs to achieve recommended minimum standards. By our calculations over $150,000 would be required just to upgrade existing facilities to achieve minimum standards of maintenance. This seemed to impress administrators with the fact that budget allocations had already been allowed to drop far below actual costs.

3. Estimated cost and pay-off time to change water metering systems to reduce costs associated with sewerage taxes. By making changes detailed in this appendix we were able to save nearly $5,000.00 per year in water charges.

4. Brief history of OSU grounds crew. This document showed the fluctuations that have occurred over time in crew size. While crew size has fluctuated with each passing economic crisis, acreage on campus has increased dramatically in the last 25 years. Also chronicled are changes in grounds maintenance responsibilities. One point that comes out clearly is that regardless of improved technology, manpower has been spread thinner and thinner over time.

5. Summary of grounds crew duties by man hours and percent. For those who question just how efficiently manpower is used, this summary spells out completely the answer. Administration took up nearly 27% of total hours while mowing totalled only 11.7%. Overall maintenance totalled 57.2% of total hours. Shop orders which essentially dilute maintenance efforts on campus took up 14.3% of total hours.

This was very useful in helping administrators focus on just where costs are incurred and which items take the most time.

Summary

Was this report of any real value? The answer is probably yes and no. Many of our recommendations have never been realized and probably never will. No one checks this document daily to see how current maintenance matched up with recommended standards. On the other hand it has made many administrators aware of the complexities of grounds maintenance and perhaps has made them realize that our grounds maintenance program is in competent hands. Since this document was prepared, our maintenance supervisor has rightfully assumed greater responsibility and authority for grounds care at OSU. I think it is quite obvious that the quality of maintenance has also increased without dramatic increases in costs. I feel we have a better foundation for enduring quality landscape care than ever before.

CONTRACT FERTILIZATION AND WEED CONTROL[1]

Joseph L. Miller Jr.[2]

During the past four years I have observed, at least in the Portland area, a change in interest as well as in the attitudes in the industrial/commercial segment, towards turfgrass management. Many here have tried to manage their responsibilities by doing it themselves. Some have taken these risks to farm part or all of that responsibility out to a landscaper or specialized segment, such as a commercial maintenance company or spray service.

In this presentation I would like to deal with the options you have as managers in the area of contract fertilization and weed control. Within this presentation I would like to meet the following objectives: 1) Provide information, both old and new, on the types of materials available (1). 2) Review some of the considerations that are important when selecting equipment. 3) Review factors you might consider in hiring a specialized service. 4) Review the professionalism, safety, expectations and flexibility of such services in order to reduce those risks.

The area of fertilizers, fungicides, insecticides and herbicides has changed a great deal since early agriculture. Although we paralleled agriculture in the beginning, we now represent a large, highly organized and highly specialized segment of the green industry. We are also involved in a very complex system. We not only are combating the identification of the problem and which material should be used, but also the legal ramifications in the use of those products.

Fertilizers have, in many ways, not been given the time and money to be investigated and researched the way we need. So while many of the materials we have are old they provide us with our only means of quality.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Branch Manager, ChemLawn Corp., Lake Oswego, OR.

I would like to briefly review some of the Nitrogen Sources. Our nitrogen sources range in release from very fast to very slow.

Very Fast	Moderately Fast
Ammonium Sulfate	Urea
Ammonium Nitrate	Methylol Ureas (MO)
	Urea Ammonium Nitrate

Slow	Very Slow
IBDU	Urea Formaldehyde
Sulfur Coated Urea	Milorganite
Methylene Ureas (FLUF)	

In the areas of fungicides there are literally hundreds of materials to combat those unsightly diseases which damage turf as well as trees and shrubs. Some of the important factors to consider in their use are: First) what is the disease and is it controllable; Second) is the control a contact or systemic; and Third) and most importantly, the cost of these materials. Some of these materials are:

Manzate 200	-	Contact
Tribasic Copper	-	Contact
Cyprex 65W	-	Systemic
Tersan 1991	-	Systemic
Daconil 2787	-	Contact
Bayleton	-	Systemic
Subdue	-	Systemic

Although there are only a few cases of insect problems in turf in the Portland area, there are problems in Washington. Recently, many lawns there have been destroyed by a newcomer, the cranefly. In the Portland area we still see the occasional sod-web-worm and chinch bug. To list some of the materials that help us control these insects and others found on trees and shrubs, there is:

Kelthane, Plictran, Orthene, Cygon, Dursban, Malathion, Diazinon, Sevin, Oftanol, Ficam.

Herbicides are listed in several different categories, such as, pre-emergent and post-emergent, selective and non-selective. Again, the problem determines which is used. Some of these are:

Pre-emergent	Post-emergent
Dacthal	Trimec (Sun, Shade)
Lescosan	Banvel
Casoron	2,4-D amine
Surflan	Daconate 6
	Round-up

I would now like to take a few minutes to review some of the considerations in selecting equipment (2).

Kind of Job

Many of us make this consideration mentally when viewing the job site, but obviously, the method of application will vary depending on whether the job is a weed control application on a golf course or a tree and shrub treatment. Similarly, in the area of weed control, the method may vary depending on site. An industrial weed control application probably will not be made the same way a ground cover weed control application would.

Size of Job

Larger, wide open sites can take advantage of more efficient application equipment than small sites or those that have many trees and hinder the movement of a larger piece of equipment. A large piece of equipment is only efficient if it is operating. If a great deal of trim work is involved and that piece of equipment has to sit by to spray only part of the job, other options should be considered. Also, if steep slopes are involved, the method of application is usually limited to a few choices.

Materials to Use

As previously mentioned, costs are definitely a consideration. Many of the materials we use are expensive. It is not uncommon for us to use materials that cost between $60.00 and $100.00 per treated acre and some considerably more. Misapplication of these products can lead to plant damage and high cost overruns.

For this reason our applications must be precise and a conscious effort is needed to apply only the amount specified on the label.

Target Area - Coverage

In some instances, such as when using systemic insecticides, thorough coverage may not be as important as when controlling plant growth with a growth regulator. Further, some target areas may be randomly distributed warranting spot treatments as opposed to broadcast applications for general problems. Volume also enters into the picture here as certain herbicides are most effective when a few droplets of high concentration land on a target weed while certain others, as well as some insecticides, fungicides and growth regulators require high volumes of lower concentration for best results.

Safety

Although safety is the last point I have to discuss it is by no means the least important. Important factors such as problems with neighboring vegetation, people, pets and the applicator must be considered before choosing a method of application. Drift to neighboring properties and non-target organisms is a subject of great controversy today and this concern is the basis for a number of neighbor pre-notification ordinances on the East Coast that have recently been enacted. So, if we want to keep out of this kind of controversy, we must do a good job of restricting our applications to the target area. To do this we must 1) measure the area correctly, 2) calibrate the sprayer, 3) adjust the pattern, and 4) spray at the correct pressure.

Now, what about some of the equipment we use today. In turf for selective or non-selective spot treatments the hand can is still quite popular. But it must be used carefully as it is easy to overapply materials.

For up to a few thousand feet of broadcast applications the backpack sprayer is quite popular especially since they are made of plastic materials which are much lighter and less expensive than the galvanized or stainless steel counterparts.

As areas get larger and the need arose to apply fertilizers and insecticides with weed control materials, applicator guns were developed. These guns operate at a volume of 130 to 170 gallons per acre but in most cases provide sufficient weed and insect control.

In larger, wide open turf areas more efficient power sprayers have been developed. These units can be towed behind or entirely self-propelled.

For trees and shrubs there are a number of spray guns and nozzles available to choose from. JD-9, Bean, FMC Tail tree gun. Everyone has their own preference of equipment depending on the nature of the operation.

The JD-9 is quite popular because it is easily adjusted from shrubbery pattern to a medium tree spray pattern with a quick turn of the barrel. The Bean gun needs a change of an orifice to change the pattern. The tall tree gun, used for well established tall trees, requires 500-700 psi to operate.

In the area of ground cover weed control for small areas, single flat fan nozzles on wands were originally employed. As areas got larger and more interest was focused on ground cover weed control multiple nozzle booms were developed, but these booms were somewhat clumsy and hard to control. With improvements in spray technology, swivel units were developed and the application has become much easier. The double swivel units allow us even greater coverage with the same ease of application.

Boom sprayers are the most popular units for total vegetation control and some turf areas. These units usually have some kind of flexible boom mounted on the front or back of a pickup with a small nurse tank and pumping system. The controls are located inside the cab for easy access and operation. Some are elaborate, some are quite specialized.

An area of new technology that is being developed, because of the concerns about exposure to humans and non-target organisms to spray material, a great deal of research work is being done in the area of injection. This work is being done in three specific areas.

Injection directly into the plant has been tried for control of Dutch Elm Disease with varying degrees of success. The success or failure of this method depends largely on the vigor of the tree at the time of the injection, because the tree must distribute the concentrate material. Also, many concerns have been expressed about the effect wounding and the concentrate has on the tree.

The second method of injection involves placing dilute spray mix into the soil and allowing the plant to take the systemic up through the root system.

The final area of injection research is in the injection of materials directly into the spray lines for specific problems. This injection can be done at the nozzle using spray flow to draw metered amounts of material into the nozzle or at the beginning of the hose reel.

Other developments are shown by a Herbe, an ultra low volume applicator and a wick applicator. Both of these have been effective in the use of Round-up.

The last area I want to cover, is that which involves the actual contracting of the service to be performed. There are several things you should consider when hiring a service.

Check List for Hiring a Service Company

1. Determine what work you want to farm out or do yourself.

2. Size of Company: big doesn't mean better, but they may be equipped to handle the job. They may have some recent data on new materials.

3. Costs: Since you shop for shoes, houses, etc., why not check to see what these companies have to offer. $Profit.

4. Length of Service: Who are some referral clients.

5. Expectations: Do you understand what the results will be after the application; 1 month later; 1 year later? Is this Guaranteed?

6. Flexibility: You may be happy with the products you are using but you hope you can make the same profit by subletting this work out. Will that company do a program you designed?

In conclusion, we are all involved and concerned with profit and results. If a service company can do the job as good or better than you for less, why not sublet the work to him and "Put your feet up fellows" and make your profit by doing no more than organizing the contract. We are all professionals, specializing in different parts of a complex industry. With research people, landscape contractors and service companies working together we can do more, with better results for less money.

(1) ChemLawn does not endorse any of the products mentioned nor the companies that manufacture those products. They are mentioned as examples of products being used today in our market.

(2) I would like to thank David Hanson, Regional Agronomist, for his help with materials for this program.

MANAGING SPORTSFIELDS WITH FUNDS WE CAN AFFORD[1]

Dr. Roy L. Goss[2]

While conducting recent seminars, the general comments were, "We have very little budget for maintenance."

This statement is probably true for most schools, parks and other recreational areas. It becomes increasingly important, therefore, to carefully analyze your program and make the right decisions so you can get the most from your dollar spent. We should not lose sight of the fact that reduction in maintenance can result in the loss of good turfgrass areas or significantly affect the playability and length of life of the field. Let us remember also that a moderate maintenance program that does not require exhorbitant amounts of money may prevent the need for spending large sums of money to completely renovate a good sportsfield. The following are just a few thoughts for minimum maintenance on sportsfields.

THATCH REMOVAL

Thatch and other dead, matted material that has been punched into the surface by cleats should be removed annually to prevent a significant buildup in the surface. These accumulations of dead, undecomposed and partially decomposed material increase the water holding capacity, decrease the infiltration rates of water and partially inhibit the development of dense turf. If possible, this dead material should be removed from the field at the end of the playing season in the fall, and otherwise, remove it by March or April of the following year.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

RESEEDING

Reseeding should be practiced one or more times annually to maintain a dense stand of grass. The best surface protection you can achieve is to maintain a dense, well rooted mat of turfgrass. Where turfgrass sands have become thinned due to intensive wear and after the thatch and dead material has been removed, overseeding can be very successful. Roughened surfaces following thatch removal usually provides a good seedbed for reseeding. It is the best practice to use drill seeding with slicer-seeders wherever possible, but not everyone has these. Therefore broadcast overseeding is practiced. The seed will have a much better chance to germinate if a liberal sand topdressing is applied after the seed.

In general, turftype perennial ryegrasses alone are recommended for reseeding since ryegrass seedlings are more competitive with established turf. If stands are extremely thin, then mixtures of turftype ryegrass and Kentucky bluegrass can be used.

TOPDRESSING

If you can afford to sand topdress as many as 6-8 times throughout the season, it will materially increase the quality of a good playing surface and prolong its life. This practice is most often neglected due to inadequate budgets, but we should make every effort to obtain funds for this practice.

If you cannot afford to topdress the entire playing surface, you should at least concentrate on the center 60 x 300 which is only 18,000 ft^2 and represents a small expenditure in sand, equipment and time. Only 27 cubic yards would be required to apply 8 ft^3 per 1000 ft^2 five times annually down the center of the field. If we expect to provide any kind of reasonable surface, this certainly should be within the budgetary means of any sportsfield.

FERTILIZATION PROGRAMS

Too frequently the best salesman wins without respect to the price of his product. Price is not the only factor but should be carefully weighed against the quality and the balance of nutrients supplied. If you cannot afford expensively formulated materials, you might even consider applying "simples". For example, nitrogen can be applied at 8 lb per 1000 ft^2 per year on 48,000 ft^2 of playing surface from urea at $91.00; ammonium sulfate, $180.00; sulfur-coated urea, $434.00. Other materials will probably be somewhat more expensive.

Phosphate can be supplied at 1.5 lb of P_2O_5 per 1000 ft^2 on 48,000 ft^2 from treble super phosphate at a cost of only $22.08.

Potassium can be applied at the rate of 6 lb K_2O per 1000 ft^2 on 48,000 ft^2 with 576 lb of potassium sulfate at a cost of $82.00.

From this program an entire football field can be fertilized for the year with $538.00. The above fertilizers would supply 384 lb nitrogen, 72 lb P_2O_5 and 288 lb of K_2O for a total of 744 lb of plant nutrients. You would have to search hard to find a more economical program if finances are your problem. Otherwise, formulated fertilizers with urea formaldehyde, IBDU or sulfur-coated urea are perfectly acceptable.

The other factors of maintaining a good sportsfield would obviously include mowing and irrigation when needed. But these are practices generally carried out as basic minimum; whereas the other factors listed above are important to quality playing surfaces.

VEGETATIVE IDENTIFICATION OF COMMON TURFGRASSES[1]

Tom Cook[2]
Illustrations by Joan Caughey

The importance of being able to identify the grasses we work with is obvious. Still, for various reasons many people who make their living maintaining turf have never learned how to identify the plants they manage. This guide is offered as a practical tool to help anyone who is interested to learn to identify our common turfgrasses.

Proper identification requires knowledge of basic morphological structures common to all turfgrasses and the ability to systematically examine unknown plants to determine how they compare with known characteristics. One of the hardest things for many students to do is to force themselves to examine the turfgrass in question and to note all important identification characteristics.

The primary characteristics I study when looking at a grass are:

1. Leaf tip configuration.

2. Whether the youngest leaf is rolled or folded in the surrounding sheathes.

3. Surface characteristics of the leaf blade.

4. Presence and configuration of the ligule.

5. Type and extent of auricle development.

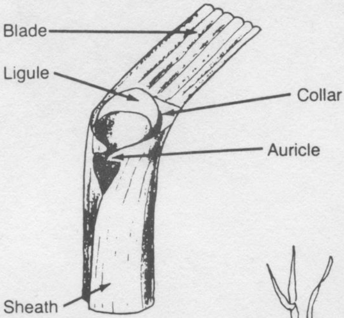
1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

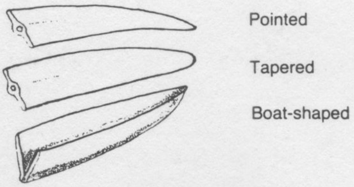
2/ Department of Horticulture, Oregon State University, Corvallis, OR.

These characteristics are illustrated on the following page. Detailed drawings of specific characteristics of individual grasses are also included. By comparing features you observe against those detailed for specific grasses you should be able to identify most of our common turfgrasses.

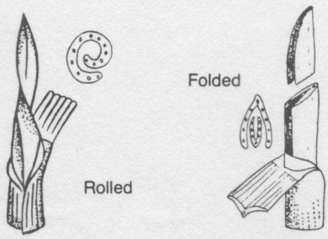
Vegetative Characteristics of Turfgrasses

The leaf consists of several parts. The leaf sheath is a cylindrical portion surrounding the stem and its growing point. The sheath arises at a node and ends in a pale-colored region, the collar. The collar is transitional to the outer, usually flat portion of the leaf—the blade. The collar usually has a membranous outgrowth or ligule. In ryegrass and certain other grasses, the collar produces small, clasping outgrowths, which are the auricles.

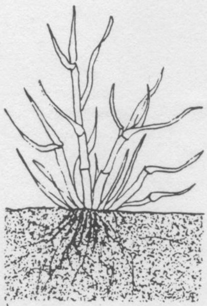




The leaves may have parallel or tapered margins, with either tapered, boat-shaped, or pointed tips.

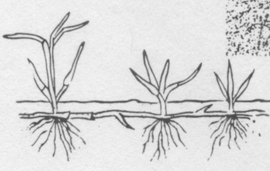


Before the leaf unfolds, the new leaf blade is rolled in some species, folded in others.

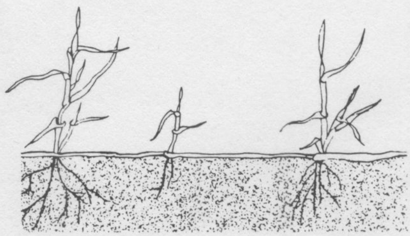


Bunch

Rhizomes



Grass plants may form a bunch or tuft, or they may spread to form a sod. They may spread by aboveground runners or stolons, or by underground rhizomes, or both.



Stolons

This page courtesy of the University of California Extension Service

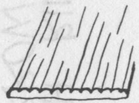
COLONIAL BENTGRASS
(*Agrostis tenuis*)

LEAVES:

- ROLLED IN SHEATH

- POINTED TIPS

- TOPS WITH RIDGES 1-3 MM WIDE BLADES



LIGULE:

- MEDIUM LENGTH TRUNCATE

AURICLES: ABSENT

GROWTH HABIT:
BUNCH (MAY PRODUCE SHORT STOLONS AND RHIZOMES)

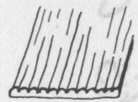
CREEPING BENTGRASS
(*Agrostis palustris*)

LEAVES:

- ROLLED IN SHEATH

- POINTED TIPS

- TOPS WITH RIDGES 2-3 MM WIDE BLADES



LIGULE:

- GENERALLY LONG ACUTE TO OBLONG

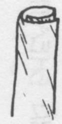
AURICLES: ABSENT

GROWTH HABIT:
STOLONIFEROUS

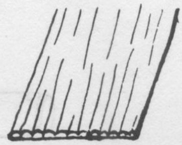
VELVET BENTGRASS
(*Agrostis canina*)

LEAVES:

- ROLLED IN SHEATH



- POINTED TIPS



- TOPS WITH RIDGES
  VERY NARROW BLADES
  (LESS THAN 1MM)

LIGULE:

- LONG, ACUTE TO OBLONG

AURICLES: ABSENT

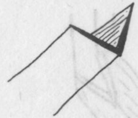
GROWTH HABIT:

STOLONIFEROUS

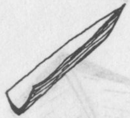
PERENNIAL RYEGRASS
(Lolium perenne)

LEAVES:

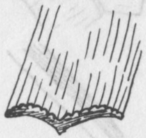
- FOLDED IN SHEATH



- TIPS SLIGHT BOAT SHAPE TO POINTED



- TOPS RIDGED: UNDERSIDE SMOOTH, SHINY AND KEELED



LIGULE

- POINTED, MEMBRANOUS

AURICLES:

- SHORT, STRAIGHT (OR MAY BE ABSENT)

GROWTH HABIT:
BUNCH TYPE

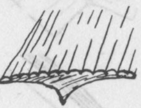
ANNUAL RYEGRASS
(Lolium multiflorum)

LEAVES:

- ROLLED IN SHEATH

- POINTED TIPS

- TOPS RIDGED
  WIDE BLADES (3-7MM)
  UNDERSIDE SHINY
  AND KEELED



LIGULE

- MEDIUM LENGTH MEMBRANOUS, OBTUSE

AURICLES:

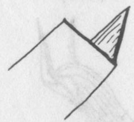
- LARGE, CLASPING

GROWTH HABIT:
BUNCH TYPE

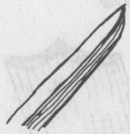
KENTUCKY BLUEGRASS
(*Poa pratensis*)

LEAVES:

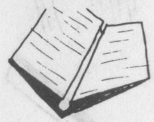
- FOLDED IN SHEATH



- BOAT SHAPED TIP



- TOP SURFACE SMOOTH UNDERSIDE DULL WITH SMALL KEEL



LIGULE:
- SHORT, RIDGE - LIKE

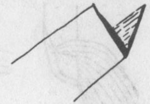
AURICLES: ABSENT

GROWTH HABIT:
RHIZOMATOUS

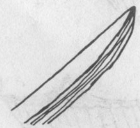
ANNUAL BLUEGRASS
(*Poa annua*)

LEAVES:

- FOLDED IN SHEATH



- BOAT SHAPED TIP



- TOPS SMOOTH UNDERSIDE DULL WITH SMALL KEEL

LIGULE
- LARGE, MEMBRANOUS

AURICLES: ABSENT

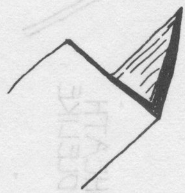
GROWTH HABIT:
BUNCH TO STOLONIFEROUS

ROUGH STALK BLUEGRASS

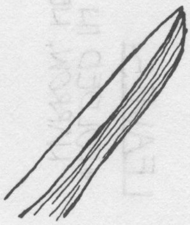
(*Poa trivialis*)

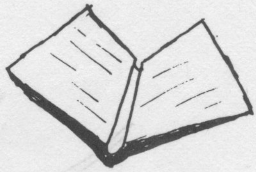
LEAVES:

- FOLDED IN SHEATH



- BOAT SHAPED TIP

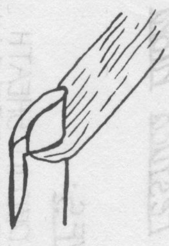




- TOP SMOOTH
  UNDERSIDE SHINY
- LEAF SHEATH OFTEN RED

LIGULE:

- MEDIUM LENGTH, TRANSLUCENT



AURICLES: ABSENT

GROWTH HABIT:
STOLONIFEROUS, PROSTRATE

RED FESCUE
(*Festuca rubra*)

LEAVES:

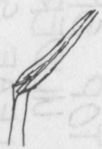
- FOLDED IN SHEATH NARROW, NEEDLE-LIKE
- (SOME HAVE COARSER TEXTURE)

- POINTED TIP

- TOPS DEEPLY RIDGED

LIGULE:

- SHORT, MEMBRANOUS



AURICLES: ABSENT

GROWTH HABIT:
CREEPING, RHIZOMATOUS

CHEWINGS FESCUE
(*Festuca rubra* VAR *commutata*)

LEAVES:

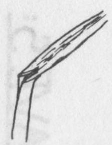
- FOLDED IN SHEATH NARROW, NEEDLELIKE

- POINTED TIP

- TOPS DEEPLY RIDGED

LIGULE:

- SHORT, MEMBRANOUS



AURICLES: ABSENT

GROWTH HABIT:
NON-CREEPING BUNCH-TYPE

HARD FESCUE
(*Festuca longifolia*)

LEAVES:

- FOLDED IN SHEATH NEEDLE LIKE

- POINTED TIP

- TOPS DEEPLY RIDGED

LIGULE:

- SHORT, MEMBRANOUS

AURICLES: ABSENT

GROWTH HABIT:
NON CREEPING BUNCH-TYPE

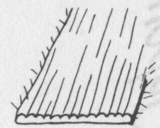
TALL FESCUE
(*Festuca arundinacea*)

LEAVES:

- ROLLED IN SHEATH

- POINTED TIPS

- TOPS RIDGED UNDERSIDE NOT KEELED, VERY WIDE BLADES.



LIGULE

- VERY SHORT

AURICLES:

- VARIABLE - LARGE TO ABSENT

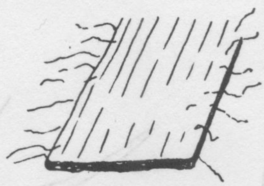
GROWTH HABIT:
BUNCH TYPE, (WEAKLY RHIZOMATOUS)

JAPANESE LAWNGRASS
(*Zoysia japonica*)

LEAVES:

- ROLLED IN SHEATH

- POINTED TIPS



- FLAT BLADE, STIFF HAIRS ON SURFACE 2-4 MM WIDE

LIGULE:

- FRINGE OF HAIRS

AURICLES: ABSENT

GROWTH HABIT:
STOLONIFEROUS, RHIZOMATOUS

FERTIGATION OF LARGE TURFGRASS AREAS[1]

Bruce Jackman[2]

My topic today is fertigation, or the lazy superintendent's method of feeding grass.

There are several ways to fertilize:
1. Cyclone spreader - slide
2. Nature - rain slide
3. Fertigation - sprinkler slide
4. More nature - lucky

There are advantages and disadvantages to fertigation - first the advantages:

1. Storage. An enclosed building is not needed as the fertilizer is kept in tanks (one or more) which are usually furnished by the fertilizer companies free of charge.

2. Application. You need only turn on a valve and a switch - no 50-80 lb bags to lift (or try to open with the string that doesn't work most of the time), nor any bags to dispose of.

3. No gas (at $1.20 per gallon) operated equipment needed, nor the 2-4 days of manpower for application.

4. No streaking of fairways near the club house, where everyone can see everything very well.

<u>Disadvantages</u>

1. You should not fertigate when the wind is blowing (even the granular is hard to apply in wind).

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ Superintendent, Clarkston Golf and Country Club, Clarkston, WA.

2. You cannot fertigate if the ground is too wet to accept any more water.

3. If you should have a small leak that you may not know about, one that just seeps, you will have a very green oasis if you leave the lines charged with fertilizer. (A stuck or broken sprinkler head will not show unless you fertigate two or three nights in succession.)

4. It shows badly in the fall when you are giving the course its last shot of vitamins. As the laterals drain to the lowest heads, and if you do not water enough to dilute it, the next two or three nights it shows a nice green circle in otherwise dormant grass. This problem can be cured with stopomatics.

Our system has six heads per valve - 68 feet apart, with the smallest pipe at 1-1/2 inches in diameter down from 2 to 2-1/2, so there is a large amount of water and fertilizer to drain out to the low heads.

Mixture

You may have any analysis made up to satisfy your soil needs including micronutrients. You can do the entire golf course or parts of it within reason - say 100 feet. For fairways, if needing an extra boost, we will turn on three fairways in the morning and at 142 lb actual nitrogen per hour we will put on approximately 0.30 actual pounds nitrogen per 1000 ft^2 in a 20 minute cycle. If we fertigate the entire golf course, we will get approximately 0.10 lb nitrogen per 1000 ft^2.

609 gallons of 12-0-0-26 will give us 1740 lb sulfur

391 gallons of 32-0-0-0 will give us 2291 lb nitrogen

Cost

The pump costs us $510 in 1975. We use mostly a combination of 609 gallons of 12-0-0-26 and 391 gallons of 32-0-0-0 which gives us 2176 lb nitrogen and 1748 lb sulfur at a cost of $1,131.88. One thousand gallons will last approximately 6-8 weeks. From this we obtain 0.55 lb nitrogen per 1000 ft^2 and 0.36 lb sulfur per 1000 ft^2.

Ammonium phosphate costs us $1,326.80 plus labor and will produce 0.4 lb nitrogen and 0.5 lb phosphate per 1000 ft^2 as well as 1/3 lb sulfur per 1000 ft^2 and lasts 2-3 weeks.

Ammonium sulfate costs $1,171.65 plus labor and yields 0.5 lb nitrogen and .66 lb sulfur per 1000 ft^2.

Five tons of urea (46-0-0-0) costs us $1,556.85 plus labor and yields 1.16 lb nitrogen per 1000 ft^2 and lasts 3-4 weeks.

So far this year we have used 1,656 gallons of 12-0-0-26, 1,982 gallons of 32-0-0-0, and 313 gallons of 10-34-0-0.

The total cost for this year is $5,094.73 for 9,300 lb actual nitrogen, 1,189 lb of P_2O_5 phosphorus, and 4,754 lb of sulfur.

MAINTENANCE MOWING REDUCTION AND TURFGRASS RESPONSE TO GROWTH REGULANTS[1/4]

Stan Brauen[2], Darlene Frye[3], Bruce Osborne[2], and Roy Goss[2]

Many growth controlling chemicals are under development nationwide. These growth regulants may become important as management tools to enhance turfgrass use and reduce total maintenance costs or provide flexibility of labor use in landscape maintenance programs. How this will come about is not predictable, but it is probable that each landscape manager will find selective uses of growth regulants that will benefit his management needs.

There may be many desirable characteristics of a growth regulator on grass. Some of the desirable characteristics would be (a) inexpensive, (b) applied once annually, (c) have no phytotoxicity, (d) enhance color and tillering, (e) greatly reduce mowing requirements, (f) encourage dominance of desirable species at the expense of less desirable types.

GROWTH REGULATORS EVALUATED

For the past three years we have undertaken extensive evaluations of several growth regulant products. The primary objectives have been to identify the duration and degree of vegetative growth and seedhead suppression, along with plant phytotoxicity and turf composition change.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

3/ Technical Representative, Monsanto Company, Yakima, WA.

4/ This research was partially supported by a grant and equipment from Monsanto Chemical Company.

The products being evaluated are mefluidide, EL-500, PP-333, MON 4621 and MON 4623. Mefluidide, sold as Embark, is the only new product which is registered for use. The other products, EL-500, PP-333, MON 4621 and MON 4623 are in different stages of developmental research.

The growth regulator treatments tested in 1983 are listed in Table 1. Eleven studies were conducted and most of the treatments listed were tested at five locations which included turfs characterized by schools, sod farms and golf course fairways and roughs. One study included the effects of nitrogen fertilization on growth regulator use.

The regulators were evaluated under mowed and nonmowed conditions following two application periods. The mowed locations were mowed when needed either for growth need or for trim need. Clippings were collected and weighed for a period of 12 weeks after application. Treated and nontreated areas also were monitored weekly for turf quality, growth height, turf density, seedhead suppression of specific species and annual bluegrass composition.

The growth regulants were applied the week of April 14 at 100% greenup or they were applied the week of May 12, four weeks after 100% greenup.

RESULTS AND DISCUSSION

Figures 1 and 2 show the total clipping reduction as a percent of untreated turf for the growth regulants tested. Embark alone or Embark in combination with EL-500 or PP-333 reduced clipping yield to the greatest extent during the six week period following application. The average reduction during this period was 70-90% of untreated turf. This resulted in the elimination of the need for mowing in rough type turf during the first six weeks following application and lowered the need from five to two mowings during the six week period under low intensive cutting management, and from 17 to 6 mowings under intensive cutting management. Thus, for most turfs, the need for mowing was reduced 70-80% during the first six week period following application. Following this period a flush of growth occurred which increased the mowing need of the Embark-treated turf in comparison to untreated turf. Thus, some of the gain in reduced mowing need was lost during the period from 6 to 10 weeks. Over the entire 10-week period following application, the application of Embark reduced the need for mowing approximately 15-20% in medium to intensively mowed turf and reduced the need for mowing by 30-50% in the lower maintained turf.

The addition of EL-500 or PP-333 to Embark reduced the need for mowing even more primarily by extending growth reduction for a longer period of time.

EL-500 and PP-333 alone were much less effective than Embark or Embark combinations with EL-500 or PP-333 in controlling growth. However, both EL-500 and PP-333 were longer lasting than Embark alone. Both EL-500 and PP-333 reduced the need for mowing by 35-40% in medium to intensively cut turf and by 0-50% in rough cut turf. This was because the lack of seedhead control by these materials may require trim mowings depending upon the turf manager's requirements.

MON 4621 was intermediate in total clipping reduction between Embark and EL-500 or PP-333 and the duration of growth control was similar to Embark. MON 4621 and 4623 reduced the need for mowing approximately 50% during the first six weeks following application while there was a 20% reduction in mowing requirement over the 10-week period following application.

Turf quality was always reduced when growth regulators were applied. This turf quality reduction was most apparent from 2-4 weeks after application. Combinations of EL-500 or PP-333 with Embark reduced turf quality the most followed by Embark alone, then EL-500, PP-333 and MON 4621. After 4 weeks following application, turf quality of growth regulator-treated plots was often better than nontreated turf. The decline in turf quality of growth regulator-treated plots was usually about 2 points on a scale of 1-9 during the period 2-4 weeks after application. When EL-500 or PP-333 was added to Embark, this decline in turf quality could be as much as 2½-3 points as compared to untreated turf. After a period of 5-6 weeks following application, turf quality of growth regulator-treated plots was often 1 or 2 points better than nontreated turf.

Some of the growth regulators were very effective in controlling the emergence of seedheads (Table 4). Embark and MON 4621 controlled emergence of seedheads of most perennial grasses while EL-500 and PP-333 did not. Also, MON 4621 did not control annual bluegrass seedhead development well. The lack of seedhead control in perennial grasses with EL-500 and PP-333 and annual bluegrass seedhead control by MON 4621 could require more trim mowings during the growth suppression period.

Estimates of annual bluegrass composition from one location strongly suggests that some growth regulators may provide some control of this species (Table 5). Embark alone or MON 4621 alone had no influence on turf composition. However, PP-333 nearly eliminated annual bluegrass survival and any treatment combination that included EL-500 greatly reduced annual bluegrass survival. However, this was not true at all locations and the results may be related to the age of grass and to turfgrass stress during the peak period of growth inhibition.

CONCLUSIONS

Under abundant moisture, cool temperatures and adequate nitrogen nutrition, all of the growth regulants were very effective in reducing mowing need, particularly over the first six weeks following application. Much of this growth control was lost during the period from 6 to 10 weeks following application suggesting the need for reapplication if a longer period of growth suppression is desired. If this were done 50-70% mowing savings could be achieved for a period of approximately 12 weeks or more. Lower quality turf can be expected during this period and applications should not be made to stressed, medium or high use areas. In the future, registrations of growth regulants such as EL-500 or PP-333 could enhance the beauty of roughs through partial elimination and dwarfing of plant and seedhead height. Preliminary data suggests that the roots or below ground biomass is increased as a result of growth regulator application and this benefit may result in improved grass recovery in the low use season.

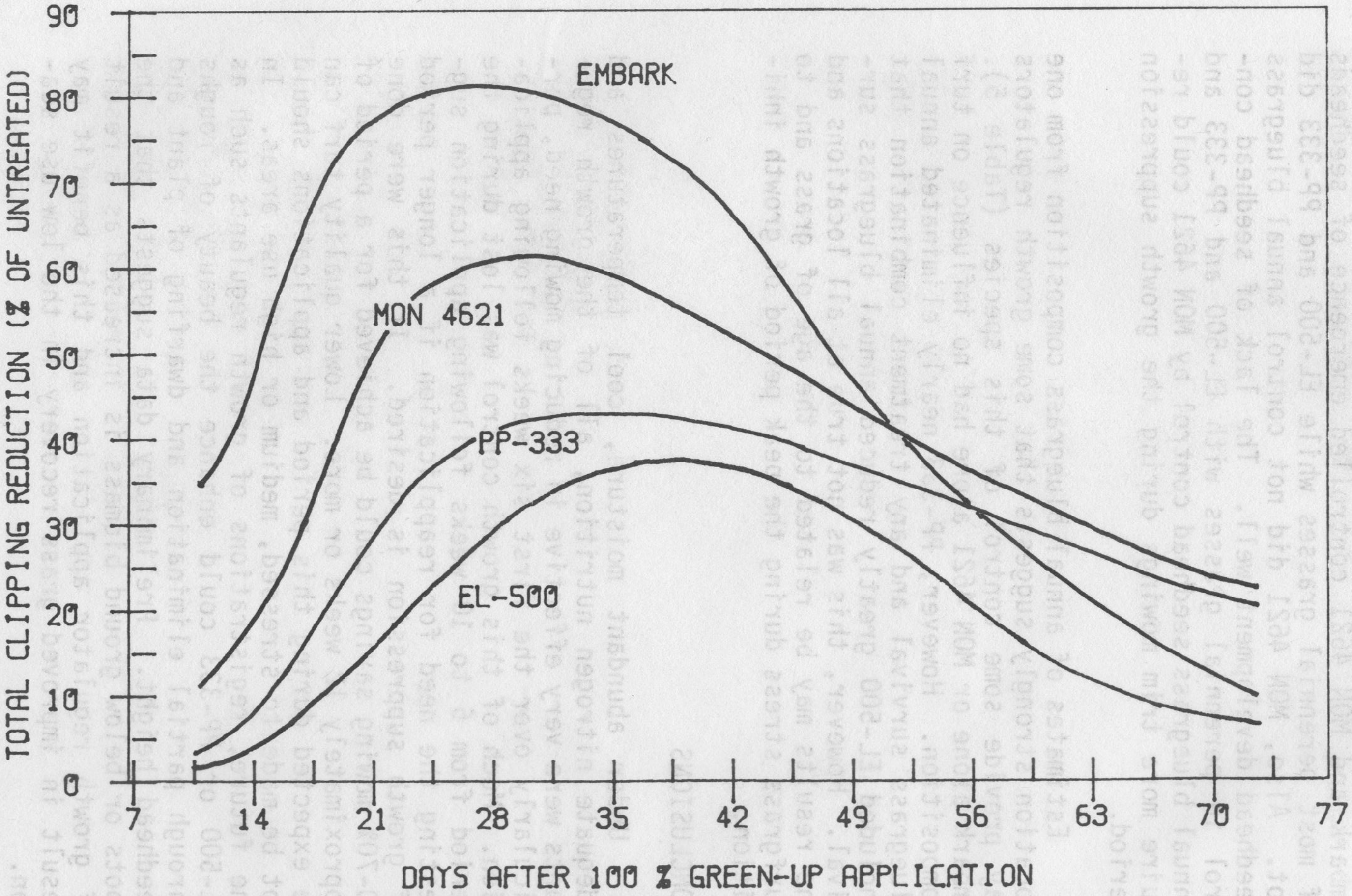


Fig. 1. The effect of growth regulator application on the total weight reduction of grass clippings for 77 days after application.

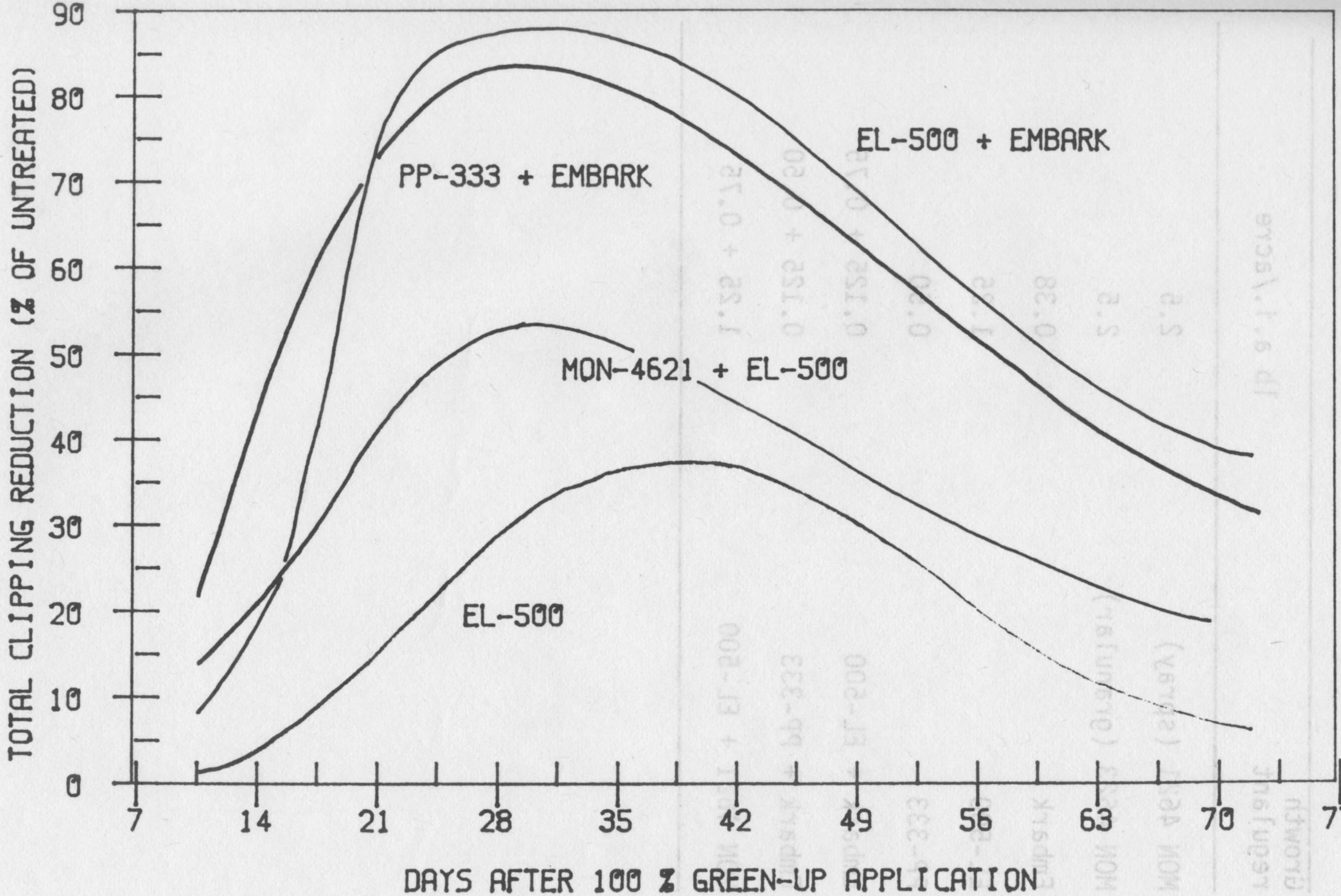


Fig. 2. The effect of growth regulator application on the total weight reduction of grass clippings for 77 days after application.

Table 1. Growth regulator chemicals and rates evaluated on turfgrasses in 1983.

Growth regulant	lb a.i./acre
MON 4621 (spray)	2.5
MON 4623 (granular)	2.5
Embark	0.38
EL-500	1.25
PP-333	0.50
Embark + EL-500	0.125 + 0.75
Embark + PP-333	0.125 + 0.50
MON 4621 + EL-500	1.25 + 0.75

Table 2. Estimated total number of mowings required during 6 weeks after application of growth regulants.

	Cutting management			
	Intensive	Medium	Low	Rough
No treatment	17	8	5	1-2
MON 4621	10	5	3	1
MON 4623	7	3	2	1
EL-500	11	5	3	1
PP-333	12	6	3	1
Embark	6	3	2	0
Embark + EL-500	4	2	1	0
Embark + PP-333	5	2	1	0
MON 4621 + EL-500	10	5	2	1

Table 3. Estimated total number of mowings required during 10 weeks after application of growth regulants.

	Cutting management			
	Intensive	Medium	Low	Rough
No treatment	29	15	8	2-3
MON 4621	24	13	7	2
MON 4623	22	11	6	2
EL-500	27	14	7	2
PP-333	22	11	6	2
Embark	24	12	7	1
Embark + EL-500	17	9	5	1
Embark + PP-333	19	10	6	1
MON 4621 + EL-500	23	12	7	2

Table 4. Effect of growth regulants on percent seedhead suppression.

Growth regulant	Poa annua	P. ryegrass	Bentgrass
MON 4621	0	90	50
Embark	99	100	99
EL-500	95	20	40
PP-333	98	25	25
Embark + EL-500	95	90	99
Embark + PP-333	98	100	99
MON 4621 + EL-500	95	85	70

Table 5. Effect of growth regulators on Poa annua control in ryegrass-bluegrass sod.

Growth regulator	Poa annua
	(%)
MON 4621	57
MON 4623	66
Embark	54
EL-500	19
PP-333	5
Embark + EL-500	20
MON 4621 + EL-500	26
No treatment	55

Table 6. Effect of growth regulants on total root mass.

	Dry wt.*
MON 4621	1.07
MON 4623	.94
Embark	.97
EL-500	1.21
PP-333	1.17
Embark + EL-500	.95
MON 4621 + EL-500	1.04
No treatment	.78

* g/173.7 cm²

TAKE-ALL PATCH-LIKE DISEASE OF BLUEGRASS: CHARACTERIZATION OF FUNGUS AND ITS SENSITIVITY TO FUNGICIDES[1]

Gary A. Chastagner[2]

Take-all patch, formerly known as Ophiobolus patch, has been recognized as a disease of bentgrasses in the Pacific Northwest since the early 1960's. Bluegrasses are considered to be more resistant to take-all patch than are bentgrasses and are not generally affected by this disease. During the past several years, a disease resembling take-all patch has been observed on recently established bluegrass turf in eastern and western Washington. Most of the affected turf has been established as sod. Symptom development is similar to take-all patch on bentgrass turf, but also resembles more familiar diseases of bluegrasses, namely Fusarium blight.

Positive identification of take-all patch relies on symptoms and the presence of characteristic structures of the pathogen, _Gaeumannomyces graminis_ var. _avenae_ (Gga). These structures consist primarily of runner hyphae, fruiting bodies know as perithecia and ascospores. Gga-like runner hyphae are associated with diseased bluegrass plants, but we seldom see fruiting bodies. Perithecia have been produced under laboratory conditions for a number isolates of the Gga-like fungus obtained from diseased bluegrass plants. These perithecia and the ascospores they contain are similar to those reported for Gga, but a few isolates produce longer ascospores than Gga. Pathogenicity tests are planned for next year under field conditions to determine if the Gga-like fungus associated with diseased plants is what is causing this disease.

1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

During the past year we have screened several fungicides for activity against the Gga-like fungus obtained from bluegrass as well as isolates of Gga from bentgrasses. We tested the ability of Chipco 26019 50W, Benlate 50W, Bayleton 25W, Rubigan 50W and Banner 1.1 EC to inhibit the growth of these isolates on culture media. Incorporation of Benlate 50W, Rubigan 50W and Banner 1.1 EC were very effective in inhibiting growth of these isolates. Dr. Roy Goss and I are currently field testing the effectiveness of some of these fungicides in controlling this disease. Initial results from these trials should be available during 1984.

PERSISTENCE OF PERENNIAL RYEGRASS AND KENTUCKY BLUEGRASS CULTIVARS IN THE WILLAMETTE VALLEY OF OREGON[1]

Tom Cook and John Wohler[2]

INTRODUCTION

Since the early 1960's Kentucky bluegrass has been widely planted for turf purposes in the Willamette Valley. More recently turftype perennial ryegrasses have been widely planted for lawn and sports turf. Persistence of these two grasses has never been reported on under replicated test conditions in the Willamette Valley. This paper reports on persistence of improved cultivars of both species after 5 years of maintenance as turf on the Oregon State University Campus.

PROCEDURE

Thirteen Kentucky bluegrass cultivars, one rough bluegrass cultivar, and ten perennial ryegrass cultivars were seeded 5/20/78 at the test site on the OSU campus. The seedbed was prepared by removing existing sod, tilling the entire area, and grading the area smooth. Plots (5' x 5') were arranged in a randomized complete block design replicated three times. Plots were fertilized at seeding with 15-15-15 at 1 lb N/1000 ft^2 and thereafter as needed to maintain acceptable turf. Over the 5-year observation period, fertility levels varied but averaged approximately 4 lb N/1000 ft^2/year including late fall nitrogen applications three of the five years. Mowing heights varied between 1-1/4 inch to 2 inches over the course of the test. Plots were irrigated throughout the test on an as-needed basis except in 1981 when plots were subjected to prolonged drought stress during summer. During the

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

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

test, plots were treated as necessary to control annual bluegrass. Treatments included endothal, ronstar, and drought followed by ethofumesate.

In the spring of 1979 one Kentucky bluegrass and one rough bluegrass plot in each rep were sprayed with glyphosate, dethatched, and reseeded with ryegrass cultivars, Prelude and Barry.

The test site was on a fine silty loam soil receiving full sun in summer and partial to full shade in winter. Plots received uniformly heavy foot traffic during most of the year since the area was part of a student "short cut" between classes.

Because the area was originally intended for demonstration purposes, data was not recorded regularly over the 5-year period. Data reported here include visual ratings of all plots on 10/5/82 that estimate the percent of each plot covered by perennial ryegrass, Kentucky bluegrass, and bentgrass.

RESULTS AND DISCUSSION

Table 1 indicates the purity of perennial ryegrass cultivars after five years. Ryegrasses were remarkably free of contamination from either neighboring Kentucky bluegrasses or weedy bentgrasses. Only Barry and Citation covered less than 95% of the plot area and both were primarily invaded by bentgrass.

Table 2 indicates relative purity of bluegrass cultivars after five years. Only Sydsport covered more than 50% of the plot area in this test. Most plots were infested with wild bentgrasses (both *A. tenuis* and *A. palustris*) and surprisingly with perennial ryegrasses. In some cases a single stray ryegrass seed had developed into a clone more than 12 inches in diameter. Likewise, ryegrass near the edges of bluegrass plots often extended 8-10 inches into bluegrasses just from tillering. Note that for most bluegrass plots the total percentage of ground covered by all grasses was less than 100%. This reflects the amount of bare ground showing in portions of the plot dominated by bluegrass.

The data presented in Tables 1 and 2 show quite clearly that perennial ryegrass was competitive throughout the test period while Kentucky bluegrass was not. The question, of course, is why? Data compiled during the test period really wasn't adequate to answer that question. Our observations did indicate several factors might be involved. In general bluegrasses progressively lost density as winter developed. While this appeared to be primarily due to leaf spot disease (Drechslera poae), other factors such as shade may also have been involved. This reduction in density occurred at a time when bentgrass was relatively vigorous (i.e. cool and moist weather). We also noted that ryegrasses entered an accelerated growth period earlier in the spring than bluegrasses and this may have given them a long-term edge in competition. An additional factor relates to a gradual loss of vigor observed in bluegrass plots. For the first two growing seasons most bluegrasses were quite vigorous and dense but by the end of the test vigor had declined dramatically.

CONCLUSIONS

In a situation where turf plots were subjected to foot traffic, winter shade, periodic summer drought, and variable mowing and fertility management, Kentucky bluegrass cultivars were unable to maintain purity after five years. Perennial ryegrasses showed much greater persistence as a group than did any of the bluegrasses. Primary contaminants in bluegrass plots included volunteer bentgrasses and ryegrass from adjacent plots. Based on data collected during the test, no clear-cut reason can be given for the poor persistence of bluegrass.

Table 1. Purity of perennial ryegrass cultivars five years after planting at Corvallis, Oregon.

Cultivar planted	$\bar{x}$ % of plot after 5 years[xx] Per. rye	Bentgrass	Ky. blue
Omega	100	0	0
Birdie	99.3	0	0
Prelude[x]	98.3	0	0.3
Pennfine	97.3	0	1.0
Belle	96.7	0	0
Yorktown-II	96.7	0	0
Diplomat	96.7	0	0
Manhattan	96.7	3.3	0
Derby	95.7	2.7	0
Linn	94.7	0	1.0
Barry[x]	90.0	9.3	0.6
Citation	80.0	13.3	3.3

x Ratings for these grasses were done after 4 years

xx Plots planted 5/20/78, final readings taken 10/5/82

Table 2. Purity of Kentucky bluegrass cultivars five years after planting at Corvallis, Oregon.

Cultivar planted	$\bar{x}$ % of plot after 5 years[x] Ky. bluegrass	Bentgrass	Per. ryegrass
Sydsport	53.3	16.7	26.7
Merion	38.3	8.3	48.3
Columbia	38.3	25.0	28.3
Kimono	36.7	20.0	35.0
Bonnieblue	35.0	27.5	32.5
Haga	30.0	10.0	51.7
Majestic	28.3	20.0	43.3
Baron	26.7	15.0	38.3
Glade	21.7	15.0	36.7
Adelphi	20.0	45.0	28.3
Newport	18.3	15.0	51.7

x Plots seeded 5/20/78, final readings taken 10/5/82

MANAGING SALINE, ALKALI OR SALINE-ALKALI SOILS FOR TURFGRASSES[1]

DR. M. Ali Harivandi[2]

The quality of a turfgrass stand is the net result of the effects of the climatic conditions, the ravages of pests, and the existing status of the soil within the inherent genetic characteristics of the turfgrass species involved.

Ordinarily, in addition to soil related factors such as too low or too high moisture content, low fertility and poor physical conditions, soil excess salt may also inhibit normal turfgrass growth and development. Actually, in most arid and semi-arid regions where precipitation is insufficient to leach the salt from the root zone, accumulation of excessive amounts of soluble salts in the root zone is major limiting soil related factor in production and/or management of quality turf. Salinity extremes on turfgrass is also a major problem near seacoasts as a result of tidal action or in areas where water tables are shallow and highly saline.

Wherever salinization occurs it is a continuous process resulting from various combinations of insufficient precipitation, inadequate irrigation, poor drainage, irrigation with poor quality water, and/or the upward movement of salts from saline underground water. As a general rule, if the amount of water applied to the soil (irrigation plus natural precipitation) exceeds evapotranspiration, salt movement is downward. Conversely, salt movement is upward if evapotranspiration exceeds the amount of water applied. In the later case salt drawn to the soil surface gradually

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1/ Presented at the 37th Northwest Turfgrass Conference, Kah-Nee-Ta Resort, Warm Springs, OR, September 19-22, 1983.

2/ University of California Cooperative Extension, Hayward, CA.

accumulates to levels toxic to turfgrasses. An additional, though minor, source of salinity problem in turfgrass culture rises from the application of large quantities of salt, primarily sodium chloride, to highways during snow and ice removal. In areas with severe winters where highway deicing is routine, brine flow from the road is pronounced near the paved surface resulting in direct injury to turfgrass grown alongside the road, and to grass in stream beds and catchment basins.

Salt-affected soils may contain excess soluble salts, excess exchangeable sodium or both. Such soils are generally divided into 3 groups:

A. <u>Saline Soils</u> - The saturation extract of these soils has an electrical conductivity (EC) greater than 4 decisiemens per meter ($dS.m^{-1}$) [equivalent to millimhos per centimeter ($m\ mhos.cm^{-1}$)] and exchangeable sodium percentage (ESP) below 15. Soil pH is ordinarily below 8.5. Saline soils are often referred to as "white alkali", and are easily recognized by the white salt crust which forms at the surface as the soil dries. Given adequate water and drainage, these soils can be desalinized by leaching.

B. <u>Saline-Alkali (Sodic) Soils</u> - The saturation extract of these soils has an EC greater than four $dS.m^{-1}$, and ESP greater than 15. Soil pH is seldom above 8.5. If existing soluble salts are leached downward while exchangeable sodium in the soil profile remains constant, soil properties are likely to closely resemble those of alkali (sodic) soils. As long as soluble salts are present, however, these soils are more similar to saline soils in both appearance and physical properties.

C. <u>Alkali (Sodic) Soils</u> - This category applies to soils in which the EC of the saturation extract is less than 4 $dS.m^{-1}$ and the ESP exceeds 15. The soil pH is generally above 8.5. These soils, often referred to as "black alkali", are recognized by the absence of white in the surface crust when the soil dries. High levels of sodium in these soils, combined with relatively low levels of calcium and magnesium, cause dispersion of clay particles. The result is a structureless soil with low water and air permeability.

Salinity/Alkalinity in a given soil can vary greatly over relatively short distances. Spotty stands of grass and bare spots are, in fact, common in soils with salinity and/or alkalinity problems. Where various spots are covered with a white crust upon drying of the soil, salinity is usually responsible. In areas where bare spots occur without evidence, an alkali (sodic) environment is more likely at fault.

Depending on the salinity tolerance of the turfgrass grown, full stands of grass can sometimes be established at low or moderate soil salinity levels. Turfgrass growth in highly saline soils, however, is restricted. Specific symptoms of salinity stress in turfgrasses are likely to vary somewhat since existing salt can result in osmotic stress (physiological drought), nutritional imbalances, toxicity, or a combination of these. In general, however, the following symptoms are associated with turfgrass grown under saline conditions:

Turf is likely to appear blue-green or light bright green in the early stages of salt stress, a coloration which is followed by irregular shoot growth. If specific ion (e.g. boron) toxicity occurs, necrotic spots may develop on leaves. As salinity stress increases, shoots appear increasingly wilted and become progressively darker green. Higher salinity levels cause burning of leaf tip with the burn eventually extending downward toward the entire leaf surface. At this level shoot growth is greatly reduced and turfgrass is stunted. Also, as salinity stress increases, leaves generally become finer textured and root growth is stunted. The stunted shoot growth associated with turfgrass grown under salt stress also commonly results in a shallow root system. If corrective steps are not taken, grass growth will be minimal, shoot density will decrease, and the turf stand will thin as individual plants die.

Although a salinity problem can often be identified by visual symptoms alone, the magnitude of the problem and identifying potential solutions are possible only after chemical analysis of representative soil samples.

The extent of salt uptake and its consequent effects on turf growth is directly related to the salt concentration of the soil solution. Growth of most turfgrasses is not significantly affected by salt levels below 2 $dS.m^{-1}$. In soils with salt levels of 2 to 8 $dS.m^{-1}$ the growth of some turfgrasses is restricted; at 8 to 16 $dS.m^{-1}$ the growth of most turfgrasses is restricted; and above 16 only very salt tolerant turfgrasses can persist. Obviously, this categorization provides only the most general guidelines to the effect of salinity on turfgrass growth. Due to pronounced differences among turfgrass species and cultivars in their tolerance of both individual salts and total salinity, each turfgrass must be individually evaluated in regard to a specific soil salinity characteristic. The information given in Table 1 is a general guide to individual turfgrass salt tolerances.

The only practical way to correct excess soil salinity is leaching and removing the soluble salts from the root zone by periodically applying large amounts of water to the soil. The excess water dissolves the accumulated soluble salts and carry them below the root zone. This is possible only if the soil's internal drainage is adequate. Shallow soils overlaying rock, hard clay, or clay pan restrict water percolation and drainage. Breaking through this improves drainage and downward movement of salts. In the absence of adequate internal drainage, installation of drain tiles to remove the excess water, along with dissolved salts, may be the only solution to the problem.

It should be stressed that there are no amendments or soil conditioners which can remove salts from the root zone or make them less harmful. Selection of salt tolerant turfgrass species, good irrigation practices and adequate drainage are practically the only factors assuring successful management of turfgrasses under saline conditions.

Although there are similarities in the formation of alkali (sodic) and saline soils, and the two terms are often used interchangeable, the effects on turfgrass growth and development and corrective measures are distinctly different.

As mentioned earlier, alkali (sodic) soils, contain an excess sodium ion in comparison to calcium and magnesium ions. Sodium does not usually cause direct injury to turfgrasses; which, in comparison to other plants, are relatively tolerant to sodium. However, if the soil exchangeable sodium percentage (ESP) exceeds 15, a turf stand may be damaged by resulting soil impermeability to water and air. Symptoms of reduced soil impermeability include water logging, slow infiltration rates, crusting, compaction and poor aeration, any of which can restrict the normal turfgrass growth and development. In the case of saline/alkali soils, obviously, leaching of the salts will not be possible without first removing the sodium from the soils and restoring porosity.

To remove sodium from the soil, often amendments such as gypsum, sulfur and other sulfur-containing materials are used. Gypsum (calcium sulfate) is, however, the most commonly used material. Calcium ions, introduced to the soil by application of gypsum, replace sodium ions which then could be leached out of the soil.

Sulfur or sulfur-containing materials may be used on soils naturally high in calcium as they make this calcium more soluble to replace the sodium. The two major factors in a successful alkali soil reclamation are:

1. Incorporation of amendments into the soil's top 1-2 feet.

2. The presence of internal drainage to facilitate the removal of sodium ions from the root zone.

In conclusion, only a soil chemical analysis can determine the extent of saline and/or alkali (sodic) problems. The frequency of leaching and amount of water needed will depend largely on the soil's texture and its salt concentration. Also, the amount of amendments required to improve an alkali condition depends on the soil texture and its sodium ion concentration.

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Table 1. Approximate salinity tolerance levels of common turfgrass.

Turfgrass	Electrical conductivity ($dS.m^{-1}$ = m $mhos.cm^{-1}$) 4	4 - 8	8 - 16	16
Cool season	Kentucky bluegrass	Tall fescue	Creeping bentgrass	Alkaligrass
	Colonial bentgrass	Perennial ryegrass	Western wheatgrass	
	Red Fescue*	Smooth brome	Tall wheatgrass	
	Meadow fescue	Orchard-grass		
Warm season	Centiped-grass	Blue grama	Bermuda-grass	Seashore paspalum
			Zoysia-grass	
			St. Augustine-grass	

* 'Dawson' and 'Golfrood' creeping red fescue are reported to have higher levels of salt tolerance.

RESPONSE OF TURFTYPE PERENNIAL RYEGRASS TO A SHADE ENVIRONMENT[1/4]

S.E. Brauen[2], R.L. Goss[2], Ray McElhoe[3], and S. Orton[2]

Growing quality turf in shaded areas under use is difficult and may be impossible. Also, many morphological and physiological differences occur in shaded turfgrasses as compared to turfgrasses grown in open areas. Tillering, shoot density, plant height and leaf elongation are noticeable differences. But also, respiration, photosynthesis, transpiration and carbohydrate levels are less obvious differences. Then, the addition of management stresses such as cutting height and traffic and environmental stress other than light further alter grass persistence and survival. What all these differences suggest is that varieties which perform well in the sun or in usual evaluation trials may not perform well in the shade.

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

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Shaded environments differ from place to place. Light intensity, light quality, air movement, nutrient and moisture competition or water stress are site specific environmental characteristics. Varieties that may survive and compete in one shaded environment may not persist in another. A factor such as a period of severe moisture stress may be sufficient to eliminate drought susceptible but otherwise shade and disease tolerant varieties or species from a shaded environment. Stresses imposed by disease may be responsible for similar grass failures to shade tolerant varieties in the shaded environment.

Our shade evaluation site of perennial ryegrass varieties is located at the Everett Golf and Country Club on a regularly used, shaded fairway mowed at 5/8 inch. The site is in constant, dense shade except for approximately 2 hours at mid-day on days of open sunlight. Figure 1 illustrates the average 3-week light levels during spring and summer periods. These light levels suggest photosynthesis is greatly reduced and carbohydrate production is just slightly above, equal to or even below carbohydrate utilization for 22 or more hours per day. Many species and varieties will not survive such energy stress under use. Although the evaluation is primarily an evaluation of the newer perennial ryegrass varieties, several combinations of Kentucky bluegrass, ryegrass and fescue are also included.

Elka, Diplomat, Palmer, Yorktown II, plus Derby-Elka and Diplomat-Yorktown II blends achieved the most cover by the end of six weeks after establishment in the fall of 1982. Manhattan, Pennfine, Regal, Dasher, Delray, Acclaim, Citation, Linn, Prelude, and blends of Barry-Prelude and Premier-Pennant were somewhat less aggressive in achieving early cover.

By late fall, or 10 weeks 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 70% cover. Prelude, Citation, Linn, Delray, Acclaim, Dasher, Regal and Premier were less than 68% cover. Although, as suggested above, there were differences among varieties with regard to early cover, all varieties achieved good cover prior to winter and no diseases were noted.

Turf quality ratings were conducted monthly and density and percent living cover ratings were conducted once during each climatic season in 1983. These ratings are summarized in Table 1 for the named varieties plus the average of the top 5 varieties (all unnamed and not available).

The average turf quality from March through September of the "top five" plus Pennant and Elka was significantly better than Diplomat, Yorktown II, Derby, Prelude, Manhattan, Omega, Barry, Acclaim, Fiesta, Dasher, Premier, Regal, Pennfine, Linn and Citation. Manhattan II, Palmer and Blazer were intermediate between these two variety groupings.

Only Elka, Palmer, Pennant and Yorktown II had ryegrass cover greater than 70% at the end of one year; although, Manhattan II, Blazer, Derby, Manhattan, Omega, Barry, Regal and Pennfine were in the range of 60% cover. Dasher, Premier, Acclaim, Fiesta, Citation, and Linn all were near or less than 50% cover by ryegrass (Table 2). Linn, Citation, Dasher, Omega and Barry were most invaded by annual bluegrass (*Poa annua*).

The varieties that are being tested in the shade study were also seeded in a non-shaded area at Puyallup. Turf quality evaluations were conducted at Puyallup similar to those in Everett. Figure 2 shows the turf quality relationship of these perennial ryegrass varieties in a shaded and non-shaded environment during the first growing season. If expected performance of turftype perennial ryegrass was similar in shaded and non-shaded environments, all of the graphed response points should be grouped along the dashed line titled "shade equals non-shade". Instead, most varieties are grouped around the solid regression line which represents the performance in non-shade as equal to .47 times the shade performance plus 4 points. Although a nonlinear curve would fit the data better, the data distribution in Figure 1 suggests the expected turfgrass quality in the first growing season will be 10-25% lower in quality as compared to performance in full sunlight on sites similar to those being tested; but there may be selected varieties in the non-shade low performance group and high performance group that may perform equally well in the shade. In the evaluations thus far those better performing varieties are Elka and Pennant; and in the poor performance grouping these varieties were Linn, Citation and Pennfine.

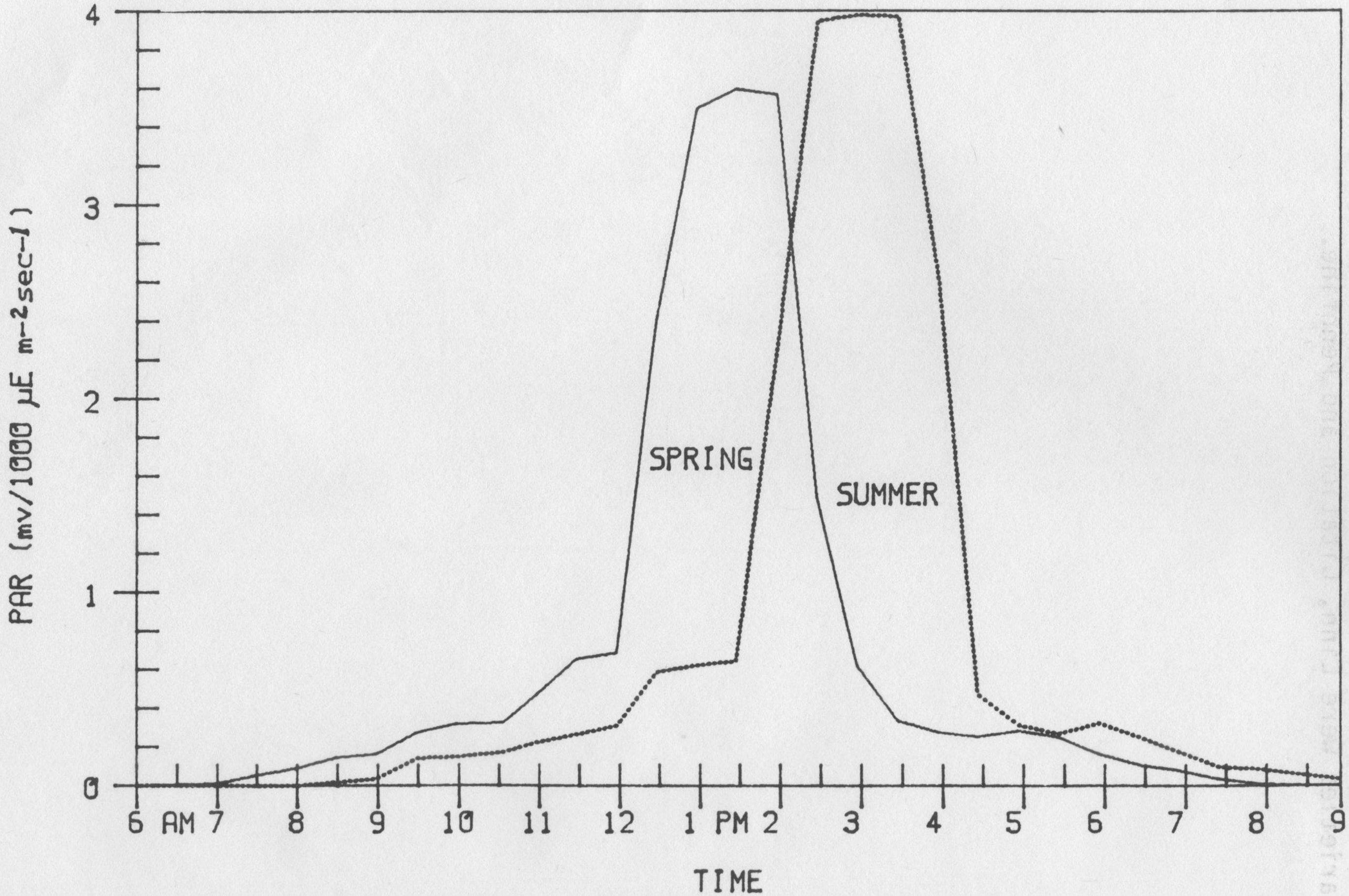

Fig. 1. Average photosynthetically active radiation (PAR) in shaded environment at Everett, Washington.

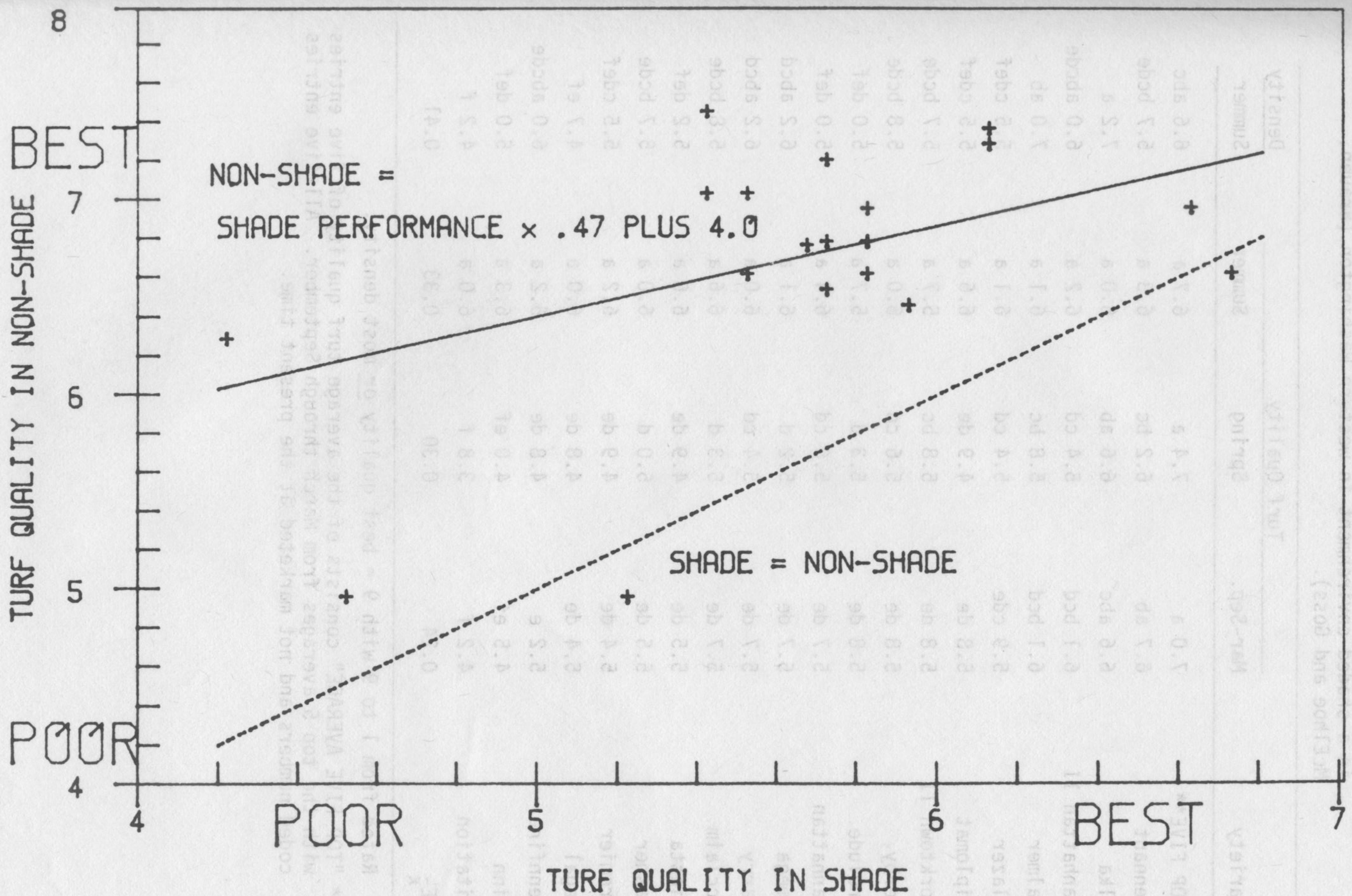

Fig. 2. Relationship of turf perennial ryegrass variety performance in shaded and non-shaded environments in western Washington.

Table 1. Turf quality and density* of perennial ryegrass varieties in a shaded environment in western Washington (Brauen, McElhoe and Goss).

Variety	Turf Quality			Density
	Mar-Sep.	Spring	Summer	Summer
TOP FIVE**	7.0 a	7.4 a	6.7 a	6.6 abc
Pennant	6.7 ab	6.2 bc	6.3 a	5.7 bcde
Elka	6.6 abc	6.6 ab	6.0 a	7.2 a
Manhattan II	6.1 bcd	5.4 cd	6.2 a	6.0 abcde
Palmer	6.1 bcd	5.8 bc	6.1 a	7.0 ab
Blazer	5.9 cde	5.4 cd	6.1 a	5.5 cdef
Diplomat	5.8 de	4.9 de	6.6 a	5.5 cdef
Yorktown II	5.8 de	5.8 bc	5.7 a	5.7 bcde
Derby	5.8 de	5.6 cd	6.0 a	5.8 bcde
Prelude	5.8 de	5.3 d	5.7 a	5.0 def
Manhattan	5.7 de	5.6 cd	6.4 a	5.0 def
Omega	5.7 de	5.2 d	6.1 a	6.2 abcd
Barry	5.7 de	5.4 cd	6.0 a	6.2 abcd
Acclaim	5.7 de	5.3 d	6.6 a	5.8 bcde
Fiesta	5.5 de	4.9 de	6.0 a	5.2 def
Dasher	5.5 de	5.0 d	6.0 a	5.7 bcde
Premier	5.4 de	4.9 de	6.2 a	5.5 cdef
Regal	5.4 de	4.8 de	6.0 a	4.7 ef
Pennfine	5.2 e	4.8 de	6.2 a	6.0 abcde
Linn	4.5 ef	4.0 ef	6.3 a	5.0 def
Citation	4.2 f	3.8 f	6.0 a	4.2 f
$SE_{\bar{x}}$	0.24	0.30	0.33	0.41

* Rated from 1 to 9 with 9 = best quality or most density.

** "TOP FIVE AVERAGE" consists of the average turf quality of five entries with the top 5 averages from March through September. All five entries coded numbers and not marketed at the present time.

Table 2. Percent living cover by annual bluegrass and ryegrass in shaded perennial ryegrass variety study in western Washington, September 1983 (Brauen, McElhoe, Goss).

Variety	Percent living cover: Annual bluegrass	Perennial ryegrass	Total
Pennant	17.7	71.7	89.4
Elka	18.3	81.7	100.0
Manhattan II	15.7	66.7	82.4
Palmer	17.3	80.0	97.3
Blazer	15.7	68.3	84.0
Diplomat	21.7	58.3	80.0
Yorktown II	15.7	70.0	85.7
Derby	30.0	65.0	95.0
Prelude	12.3	56.7	69.0
Manhattan	21.0	66.7	87.7
Omega	35.0	65.0	100.0
Barry	30.0	68.3	98.3
Acclaim	31.7	51.7	83.4
Fiesta	28.3	45.0	73.3
Dasher	33.3	53.3	86.6
Premier	20.7	53.3	74.0
Regal	30.0	60.0	90.0
Pennfine	26.7	66.7	93.4
Linn	63.0	36.7	99.7
Citation	35.0	40.0	75.0
CV (%)	39.8	50.1	
SE	10.4	14.2	

THE EFFECTS OF HIGH RATES OF POTASSIUM FERTILIZATION ON *POA ANNUA* PUTTING GREEN TURF[1/3]

Stanton E. Brauen and Roy L. Goss[2]

In turf where annual bluegrass competition is low sulfur is suggested in nutritional programs to reduce annual bluegrass (Poa annua) competition. These recommendations are based on past studies by Goss, et. al. (2,3,4) and Brauen, et. al. (1) that have shown sulfur is an important nutrient factor in determining Poa annua invasion and survival in bentgrass putting green turf and in the control of Fusarium patch. While these studies have shown that phosphorus induces in annual bluegrass development, K has not been shown to influence Poa annua levels in Northwest turf. Potassium has been shown by Goss and Gould to be influential in the control of Fusarium at least at lower levels of nitrogen application (4).

Since potassium sulfate is much less likely to cause turf injury, we have initiated two studies to follow the influence of a range of applications of potassium sulfate and/or potassium chloride alone or in combination with elemental S to determine the influence of K and S from two sources on turf quality, disease incidence and turf composition on putting greens and fairways composed primarily of annual bluegrass.

During the winter of 1982-83 applications of K_2O from zero to 40 lb per 1000 ft² was applied to a Poa annua putting green turf at the Linden Golf and Country Club and to a Poa annua fairway at the Everett Golf and

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3/ This research is partially supported by a grant from the Great Salt Lake Mineral & Chemical Corp., Ogden, UT.

Country Club. The source of K_2O was potassium sulfate (K_2SO_4) for one series of treatments and potassium chloride (KCl) for two series of treatments. One series of the KCl-treated plots received elemental S at rates of .85 to 15.6 lb S per 1000 ft² which was similar to the S supplied by K_2SO_4. All K_2SO_4 applications were applied in a single application in December 1982 while the treatments containing KCl and KCl plus S were applied in five equal increments on three week intervals from December to March. At Everett the application time was from January to April, 1983.

No phytotoxicity to grass occurred for 90 days following application of the K_2SO_4 (Table 1). Although no phytotoxicity occurred with the application of KCl or KCl plus S during the period of application from December through March, some limited phytotoxicity became apparent at the 10 and 20 lb K_2O per 1000 ft² rates and significant phytotoxicity occurred with KCl and KCl plus S treatments at the 40 lb K_2O per 1000 ft² rates soon after April 1. The turf quality was reduced by a minimum of 3 points on a scale of 1-10 with the highest KCl application and was reduced 5-6 points when elemental sulfur was added to the KCl as compared to nontreated plots or plots treated with K_2SO_4, KCl or KCl plus S at 2.5, 5.0 and 10.0 lb K_2O per 1000 ft². Thus, K_2SO_4, even applied at high single rates of application, showed a wide safety margin with regard to immediate and longterm turf injury.

Potassium chloride and KCl plus sulfur applied at 20 and 40 lb K_2O per 1000 ft² caused severe phytotoxicity after the third month of the beginning applications. In the Poa annua putting green turf this phytotoxicity of grass due to KCl plus S application resulted in loss of annual bluegrass cover. The recovery from this injury was almost totally bentgrass. Recovery data are presented in Table 2. We will be monitoring the effects of overseeding these areas through the next season.

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Table 1. Effect of potassium and sulfur sources on phytotoxicity and quality of *Poa*-bentgrass putting turf.

K_2O	Quality*			Phytotoxicity*		
	K_2SO_4	KCl	KCl+S	K_2SO_4	KCl	KCl+S
(lb/1000)						
0	---	7.5	---	---	7.3	---
1.25	7.5	-	-	7.3	-	-
2.5	7.5	7.0	7.8	7.3	7.5	7.5
5.0	7.3	7.5	8.0	7.8	7.5	7.5
10.0	7.0	7.5	7.3	8.0	6.8	7.0
20.0	7.3	8.0	4.5	7.8	6.8	7.5
40.0	7.5	5.5	1.8	8.0	6.0	5.0

* 9 = best or darkest color

Table 2. Effect of potassium and sulfur sources on bentgrass and *Poa annua* cover in putting turf.

K_2O	Bentgrass			Poa annua		
	K_2SO_4	KCl	KCl+S	K_2SO_4	KCl	KCl+S
(lb/1000)						
0	---	---	---	---	---	---
1.25	28	-	-	72	-	-
2.5	21	21	24	79	79	76
5.0	21	24	24	79	76	76
10.0	19	23	40	81	77	60
20.0	13	20	95	87	80	5
40.0	19	28	64**	81	72	23**

** 88% cover in KCl+S due to injury.

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Northwest Mowers
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International Seeds
Jacklin Seed
Pickseed West, Inc.
Mallinckrodt Chemical
Montco Products Corp.
Mobay Chemical Corp.
Elanco
Forminco, Inc.
Turfgo Northwest
Omni-Pacific
W. A. Cleary Chemical
Hobbs & Hopkins, Ltd.
Turf-Seed, Inc.
Normarc, Inc.
Lundeen Landscapes
Fran-Cher Chemicals
Femrite Nursery
Manito Golf & Country Club
Agate Beach Golf Course
Auto-Rain, Inc.
Black Butte Ranch
Bonner Company
Coos Country Club
Everett Golf & C.C.
Ron Fream Design Group, Ltd
Carl Kuhn
Lake Tapps Development Co.
Lakeside School
Linden Golf Club
Meridian Valley Country Club

Inland Empire Supt. Assoc
Monsanto Chemical Co.
Glacier Sand & Gravel Co.
Highland Bentgrass Com.
Emerald Turfgrass Farm
Inland Toro
O. M. Scott & Son
Agricultural Service Corp
Puget Sound Seed
PBI-Gordon, Inc.
Pennwalt
Ortho
Lilly Miller
3-M
Melamine Chemicals Inc.
Estech, Inc.
Industrial Mineral Prod.
BFC Chemicals
Great Western Seed Co.
E. F. Burlingham & Sons
Rhone-Poulenc
Webfoot Fertilizer Co.
Best Fertilizers
Walla Walla Country Club
Alderbrook Golf Club
BPOE #318 Golf & C.C.
Blue Lakes Country Club
Capilano Golf & C.C.
Eugene Country Club
Fircrest Golf Club
Hayden Lake Golf Club
LaGrande Country Club
Lake Wilderness Golf Club
Leavenworth Golf Club
Longview Country Club
Missoula Country Club

Moses Lake Country Club	Al Mundle
Nile Country Club	North Thurston School
North Shore Golf Club	NW Golf Course Supt Assoc
Oakbrook Golf Club	Oregon Turf Farms
Oswego Lake Country Club	Overlake Golf & C.C.
PGA Pro-Am, Seattle	Pleasant Valley Golf Club
Port Ludlow Golf Club	Portland Golf Club
Rainier Golf Club	Riverside Golf & C.C.
Riviera Country Club	Royal Oaks Country Club
Sahalee Golf Club	Salishan Golf Links
Sand Point Golf & C.C.	Seattle Golf Club
Shelton-Bayshore Golf Club	Similk Beach Golf Course
Skagit Golf & Country Club	Spokane Parks & Rec Dept
Sunland Golf Club	Sun River Properties
Tacoma Country & Golf Club	Twin Cities Sod Farm
Twin Lakes Golf & C.C.	Madrona Links Golf Course
Vancouver Island Golf Club	Washington Tree Service
Waverley Country Club	Wenatchee Golf & C.C.
Wing Point Golf & C.C.	Charles W. Woosley
Yakima Country Club	Diamond Shamrock Corp.
Ciba-Geigy Corp.	ChemLawn Corp.

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Broadmoor Golf & C.C.	Seattle Golf & C.C.
Everett Golf & C.C.	WSU Golf Course
Spokane Parks Dept.	Puyallup School Dist.
Oakbrook Golf & C.C.	Linden Golf & C.C.
Emerald Sod Farm	Veterans Memorial G.C.
Walla Walla Parks Dept.	Hi-Cedars Golf Club
Hangman Valley Golf Club	Port Ludlow Golf Club
Meridian Valley Country Club	Meadow Springs Golf&C.C.
Holy Family Hospital,Spokane	Stan Sequin
Cavanuagh's Landing,Richland	Everett Mulhall
Carl Hoth	Carol Carey
Dale Morris	Nora Calvert
Jane Poole	James E. Wall
Robert Jordan	Patty Kernkamp
Russ Thornsen	

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