Proceedings

Of the

45th Northwest Turfgrass Conference

September 16-19, 1991

Coeur d'Alene Resort
Coeur d'Alene, Idaho

PREFACE

One of the primary objectives of the **Northwest Turfgrass Association** (NTA) is to disseminate the most current turf development and maintenance information available from research, study and experimentation to interested persons. The annual NTA **Northwest Turfgrass Conference** and publication of the proceedings from each conference is one of the ways the association has chosen to accomplish this objective.

First Printing

Publication Date: February, 1992

Published by
Northwest Turfgrass Association

P.O. Box 1367
Olympia, Washington 98507
(206) 754-0825

Blair Patrick, Managing Editor

PRESIDENT'S MESSAGE

William B. Griffith

I would like to thank each of you who took the time to attend this year's conference at the beautiful Coeur d'Alene Lake Resort. Your participation made this one of the best attended conferences ever. The combination of topics and speakers, spectacular golf course, excellent weather, beautiful surroundings, and the courteous and helpful staff made this year's conference a rewarding experience and an enjoyable and relaxing time.

It is the intention of your NTA officers and board to continue to make the annual conference one of, if not the best, educational opportunities available to turf managers in the Pacific Northwest. We are the representation of "YOU" the membership and are trying to incorporate your ideas and suggestions as we plan for the future. We are thankful for the successes we have had, but realize the need to be constantly aware of the changing needs of our membership and the changing demands of our profession. Your board consists of a cross-section of turf professionals from a diversity of locations all working hard to make the annual conference of real value to "YOU".

Next year's conference is going to be at Sunriver resort in Bend, Oregon and the educational program looks to be one of the best ever. Sunriver is a terrific facility with many options for accommodations, lots of leisure time activities, and many golf courses with some of the best scenery that you will find anywhere. Be sure to encourage a friend to consider attending next year's conference and I look forward to seeing you there.

Bill Griffith
1990/1991 President

Board of Directors
1990/1991

President
William B. Griffith
Golf Course Superintendent
Walla Walla Parks Department
Veterans Memorial Golf Course
P.O. Box 478
Walla Walla, Washington 99362

Vice President
Thomas M. Wolff
Golf Course Superintendent
Sahalee Country Club
21200 N.E. 28th Street
Redmond, Washington 98053

Treasurer
Bo C. Hepler
Turfgrass Agronomist
Senske Lawn and Tree Care
P.O. Box 9248
Yakima, Washington 98909

Past President
William J. Johnston
Turfgrass Agronomist
Department of Agronomy & Soils
Washington State University
Pullman, Washington 99164-6420

Director
Jon C. Hopper
Grounds Manager
Physical Plant FG-10
University of Washington
Seattle, Washington 98195

Director
Patrick J. Nibler
Vice President Operations
PROGRASS Landscape Services, Inc.
8600 S.W. Salish Lane
Wilsonville, Oregon 97070

Director
Alan L. Nielsen
Golf Course Superintendent
Royal Oaks Country Club
3605 NE 49th St. #5 **
Vancouver, Washington 98661

Director
David P. Jacobsen
President
Farwest Turf & Indust. Equipment
3265 N.W. Yeon Avenue
Portland, Oregon 97210

Director
Rebecca R. Michels
President
Messmer's Landscaping Service
13417-81st Avenue S. **
Seattle, Washington 98178

Director
Larry L. Farwell
Golf Course Superintendent
Wenatchee Golf & Country Club
610 S. Lyle
E. Wenatchee, Washington 98802

Director Emeritus
Roy L. Goss
Extension Agronomist (Retired)
13716 Camus Road
Anderson Is., Washington 98303

Executive Director
Blair Patrick, CAE
Northwest Turfgrass Association
P.O. Box 1367
Olympia, Washington 98507

TABLE OF CONTENTS

RESEARCH AND RECOMMENDATIONS FOR TRAFFIC TOLERANCE[1]

David D. Minner[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] State Turfgrass Specialist, Department of Horticulture, University of Missouri, Columbia, Missouri.

Traffic is defined by Webster's Dictionary as "the movement along a route by vehicles or pedestrians". In sports turf this definition should be expanded to include animals since horseracing on grass tracks results in obvious traffic problems. The affect that traffic has on a turfgrass system can be separated into two distinct areas — wear and compaction. In sports turf, wear occurs when the weight and motion of an object results in crushing, tearing, scuffing, bruising, or abrasion of leaves, stems, or crowns. Wear is the collective direct injurious effect of traffic on turf and is distinct from the indirect effect of traffic on soil compaction. Soil compaction is the pressing together of soil particles into a more dense soil mass. When the vegetative mat is worn from the surface, the potential for soil compaction is greatly increased. Therefore, maintaining an aggressive turf cover is an important first line of defense to make playing fields more traffic tolerant. Conventional wisdom has taught us that thatch is detrimental and ,should be minimized in turf. However, in heavy traffic areas, i.e., center of practice football fields, a certain amount of thatch and mat will add cushion to a field and reduce soil compaction.

The following discussion will address two different areas of traffic tolerance that are currently being researched at the University of Missouri. The first involves identifying traffic tolerant grass species and cultivars and the second involves synthetic additives that are used to stabilize the playing surface.

TRAFFIC TOLERANCE

The following cool season grasses are ranked according to their traffic tolerance:

Good	-	Perennial Ryegrass
Medium	-	Kentucky Bluegrass
		Tall Fescue
Poor	-	Fine Fescue

Bentgrass
Annual Bluegrass
Rough Stalk Bluegrass

Perennial ryegrass, Kentucky bluegrass and tall fescue are the species predominantly used for sports in the northwest United States. Our research in Missouri uses a Brinkman Traffic Simulator pulled over field plots to simulate traffic.

A Brinkman Traffic Simulator (BTS) is pulled over field plots to simulate traffic. The BTS is a cleated, two roller device that causes a slip motion that results in tearing and compaction similar for football activity. Traffic treatments are applied for a 6 to 10-week period in the spring and fall. Generally, treatments are applied every Monday, Wednesday and Friday at 10 passes/day. Traffic treatments are skipped on days that are too wet to operate the BTS equipment. Following a period of traffic treatment, turf is allowed to recuperate and is then rated for percent grass cover and turf quality. Immediately following a period of treatments with BTS, the plot area can be described as: 20 to 80% bare soil, hard compacted soil, excessive cleat marks visible, and vertical leaf growth is minimal. Recover is rated as the percent of each plot covered with grass (% cover). Turf quality is also evaluated on a scale of 1 - 10 with 10 being best and 7 being the lowest acceptable turf quality for sports turf. In this subjective rating, consideration is given for active growth, density, % grass cover and surface smoothness. Turf color has no influence on the measure of turf quality in our study.

Use the most traffic tolerant cultivars in high traffic areas, especially when trying to reestablish thin turf areas. Some cultivars such as A-34 are very aggressive and tend to produce thatch. In high traffic areas, this will be beneficial since extra thatch and mat will reduce impact and minimize soil compaction. Where traffic is, minimal, aggressive cultivars such as A-34 will require a cultivation program to prevent detrimental levels of thatch from being produced. **It is also important to contact your local University Extension Agent for recommendations of traffic tolerant grasses that are adapted to your regional climatic and pest conditions.**

Perennial ryegrass has found extensive use in sports turf especially because of its ability to provide a rapid turf cover when reseeding worn turf areas. Once established, perennial ryegrass also has a high level of traffic tolerance. Compared to Kentucky bluegrass there are fewer separations among perennial ryegrass cultivars. Some of the perennial ryegrass cultivars that had good traffic tolerance in both Missouri and California trials were: Caliente, Prelude, Ranger, Citation II,

Manhattan II, Diplomat and Fiesta. Perennial ryegrasses with inferior traffic tolerance were: Barry, Regal, Regency, and Linn in Missouri and Birdie II, Ovation, Cigil, Pippin, and Linn in California.

The role of tall fescue in sports turf is still not clearly defined. Once established, tall fescue is a drought and traffic tolerant turf that has few disease problems. Unfortunately, seeded tall fescue fields require at least one and often two years to reach a maturity level where drought and traffic tolerance are typical of the species. This waiting period is very important but is often not acceptable for the scheduled use of the facility. Another misconception with tall fescue is because of its highly touted drought tolerance. Many think it can be used in place of an irrigation system. It is true that tall fescue is the most drought tolerant cool season species we have and it is often recommended where irrigation is limited or non-existent. It should, however, by no means be considered as a substitution for adequate irrigation; especially on high traffic athletic fields that require forced growth. Irrigated tall fescue playing fields have performed quite well as long as traffic is managed to prevent severe thinning. Once thinned by traffic, tall fescue is a bunchgrass that does not adequately fill in to produce an acceptable playing surface. Tall fescue is likely to fail if one of the following fits your situation:

1. Field open for play before tall fescue is mature. Tall fescue should have at least one year of growth before sport activities begin — two complete fall growing seasons is best.

2. No irrigation and moderate traffic.

3. Irrigation, but too much traffic.

With more intense culture, i.e., water, fertilization, overseeding, cultivation, and some traffic control, tall fescue has provided acceptable athletic fields. Establishment and overseeding programs with tall fescue should always include 5 to 10% by weight of a non-aggressive Kentucky bluegrass. Research by Dr. John Dunn at the University of Missouri has shown that Kentucky bluegrass and tall fescue are compatible and will result in a uniform stand of both species in non-trafficked areas. In the same study, perennial ryegrass and tall fescue segregated and perennial ryegrass dominated the grass stand over a five-year period. More research needs to be done to determine if perennial ryegrass should be used with tall fescue in initial establishment or overseeding programs.

Our trials indicate that there are virtually no differences among tall fescue

cultivars in terms of traffic tolerance.

SYNTHETIC STABILIZERS

Synthetic stabilizers are a relatively new innovation to the sports turf industry in the United States. They are still under study but have been more widely used in Europe. They were first used to stabilize soils for roads and to reinforce concrete. Equestrian and grass race tracks have also been stabilized with synthetics. This eventually has led to installations in high traffic athletic fields. Some of the potential uses for synthetic stabilizers include: athletic fields, horse equestrian and race tracks, golf cart paths, temporary parking areas and golf tees.

In the 1970's, synthetic materials such as styrofoam and perlite were added to soil systems in an attempt to increase drainage, reduce compaction and, in general, provide a better soil environment for turf growth. Synthetic stabilizers of today are unlike those of the 70's. Today, state of the art fields are constructed with a high sand content to facilitate rapid drainage. One major problem is that sand fields can have poor footing. Topsoil fields that have been repeatedly topdressed with sand have the same problem with poor footing.

Netlon and Fibergrid are the only two examples of current synthetic stabilizers used for sports turf. Although uniquely different, both products have the potential to increase stability (traction), increase traffic tolerance and, possibly, affect water movement in the root zone.

To achieve maximum benefit, synthetics must be uniformly mixed with sand. Specific mixing equipment has been developed for both Netlon and Fibergrid, but the availability of the equipment is limited at this time. Most of the Netlon projects installed so far in the United States have been mixed off-site with front loaders. Fibergrid can be mixed off-site with front loaders and cement mixers or on-site with rototilling equipment. It is likely that golf course sand mixing companies will modify equipment to accommodate synthetic stabilizers once they are readily accepted in the sports turf industry.

Netlon is a randomly oriented interlocking mesh matrices. Individual pieces of netted, flexible plastic are cut into 2-inch x 4-inch rectangles. Thousands of the individual mesh elements are randomly mixed with sand to form a more stable growing surface. The mesh elements are mixed in the upper six inches of modified sand at a rate of 4.2 lbs. mesh element per cubic yard of sand. The plastic netting used in the Netlon process is thicker and stiffer than any netting material currently

used in production of sod or horticulture crops. Cutting up other netted materials and incorporating them with sand will not produce the same effect as Netlon mesh element. The randomly oriented interlocking mesh matrices rely on a stress transfer mechanism between the soil particles and the mesh. The mesh elements actually absorb some of the force of impact. Reports from Texas A & M University indicate a 35% reduction in divot size. Apparently, roots intertwine with the mesh and anchor the surface more securely. Research projects at Texas A & M, initiated in 1985, and the University of Missouri, initiated in 1990, are currently comparing the Netlon process with conventional grass surfaces. Netlon has also been successfully used at the Santa Anita race track in California and has been recently installed at a practice football field for the Cleveland Browns. One question that is often asked is, "Does the increased stability make the field harder?" One year after establishment, our Clegg impact results indicate that Netlon or Fibergrid do not increase the hardness of a surface in terms of G-max. The Clegg Impact Test uses a dropped weight and accelerometer to determine surface hardness in terms of maximum gravitational units.

The Netlon process was developed by Netlon Limited of Blackburn, England and their method described for the isotropic reinforcement of sands and soils is patent-protected throughout the world. In the United States, the protection is afforded by Patent No. 4,662,946. Stabilizer, Inc. Phoenix, Arizona is currently handling installation of Fiberturf. The synthetic material used in Fiberturf is one-inch long polypropylene monofilament fibers that have the consistency and appearance of human hair. The round fibers are usually mixed with sand at the rate of 0.25 to 0.50 percent fibers on a weight to weight basis. For most sands (assuming sand weighs 1.5 tons/cu. yd.) this would be 7.5 to 15.0 pounds of fiber per cubic yard of sand. The "fibrillated" fiber unit is a one-inch long by 1/16-inch wide piece of flat but flexible polypropylene. Each "fibrillated" unit has several longitudinal cuts so that when mixed with sand or soil, the fiber unit opens up into a grid with approximately twelve smaller fibers each approximately 0.25 mm in width.

Reinforcement of natural grass surfaces with synthetic fiber or mesh element is a relatively new concept in the United States. The research and demonstration currently being conducted in the United States will help define where these types of products can fit into improving sports turf. This innovation will immediately and directly affect the strength of a playing surface. It has a real potential for directly reducing the harmful effects of traffic on sports turf.

Table 1. Traffic tolerance among Kentucky bluegrass cultivars determined in separate Missouri and Oregon trials. Missouri used a Brinkman Traffic Simulator and results are summarized from 1989 and 1990. Oregon results are from 1989 National Turfgrass Evaluation Program.

\+ Good Tolerance
\- Poor Tolerance

Cultivar	Missouri	Oregon
A-34	+	+
BA 69-82	+	+
BA 73-540	+	+
Julia	+	+
Estate	+	+
Suffolk	+	+
Bristol	+	+
America	+	+
Chateau	+	+
Coventry	+	-
Trenton	+	-
Chateau	+	-
Rugby	+	-
Glade	+	-
Wabash	+	-
Eclipse	-	+
Conni	-	+
Princeton	-	+
Ikone	-	+
Annika	-	-
WWAG 468	-	-
Welcome	-	-
Harmony	-	-
Amazon	-	-
Mystic	-	-
WWAG 496	-	-

MANAGEMENT FOR IMPROVED STRESS TOLERANCE OF ATHLETIC FIELDS[1]

David D. Minner[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] State Turfgrass Specialist, Department of Horticulture, University of Missouri, Columbia, Missouri

The greatest stress on athletic fields is traffic. Traffic should be thought of as having two component parts — wear and compaction. Simply put, wear affects vegetation and compaction affects soil. Grass shoots, crowns, roots, thatch and mat are all vegetative components of the playing surface that protect the soil from becoming compacted. Once the vegetative components are worn away, soil is easily compacted with repeated traffic.

A vigorously growing turf with a high recuperative potential is the best means of diminishing the negative effects of traffic. To obtain a vigorous turf, growth must often be forced. Frugal use of water and nitrogen, which is acceptable for many turf situations, may not be suitable for high traffic athletic fields. Even within an athletic field, high traffic areas should be treated differently than low traffic areas (Fig. 1). Traffic patterns are very obvious on a field. In most cases less than a third of the actual playing field will receive the type of intense traffic that will result in exposed soil and severe turf thinning. The remaining two-thirds of the field will usually have acceptable grass conditions. Even with this drastically different stress pattern, it is not uncommon for turf managers to apply the same level of management to the entire field (i.e. fertility, watering, mowing, cultivation). I suggest that sports turf managers develop management specific guide lines according to use patterns within a field rather than treating the entire field the same. If you are continuously lacking the budget you feel is necessary, then it would be especially prudent to increase the use of your resources in high traffic areas of the field and reduce expenditures in areas that have less traffic. High traffic areas of the field should have specialized programs for nitrogen and potassium, irrigation, cultivation, overseeding, divot repair and temperature control with covers.

The following general guidelines are recommended only for excessive traffic areas within the field and may result in undesirable excessive turf growth if applied to areas of the field that receive little traffic.

FERTILITY

Nitrogen and potassium can have a direct effect on the performance of high traffic areas. It is important to force growth to maintain a vegetative cover of grass, thatch, and mat. Nitrogen is the most effective element for forcing growth. Apply nitrogen at 0.5 to 1.0 lbs N/1000 sq. ft. per growing month. For the first three quarters of the growing season, apply potassium ($K_2 0$) at the same rate and timing as nitrogen. Use the higher rate for sandfields where nutrients are easily leached. Potassium will reduce the damage caused by wear and will also reduce the tendency for wilt, making it easier to manage turf during summer conditions. Phosphorus and pH should be tested each year on all fields and micro nutrients should also be checked yearly on sand fields.

WATER

Grass plants are about 90% water. Without sufficient water, turf wilts, slows growth, becomes dormant and may eventually die. Fields that have high traffic cannot afford slow growth or dormancy. It is important to keep forcing growth to maintain a vegetative layer over the soil and to encourage recuperation of turf if it has already been worn thin. All fields should have an irrigation program capable of applying at least one inch of water to each field every three days. The irrigation setup should also be capable of applying at least two tenths of an inch, three times a day, every day, over the high traffic areas. These light and frequent irrigations are needed to germinate seed in high traffic areas. Light frequent irrigation will also be needed in heavy and compacted soils that have very low water infiltration rates.

The best way to control the amount of water put into a field is with a well-designed automatic in-ground irrigation system. Valve and head systems would give the maximum control when trying to water only high traffic areas of the field. Valves present a problem since they must be completely buried to prevent contact with players. Block irrigation systems should be blocked so that high traffic areas can be irrigated separately from low traffic areas. Heads with an adjustable radius and interchangeable nozzles are very useful on athletic fields. Traveling gun systems are usually lower cost, portable, and provide sufficient irrigation to maintain turf. Scheduling activities with traveling guns can sometimes be difficult. Plan on at least eight hours to irrigate one field with one traveling gun. Since traveling guns are portable, the tendency is to purchase one gun with expectations of watering several fields. One gun is sufficient to maintain about three fields; however, traveling guns usually do not meet the required frequency of irrigation needed when establishing grass from seed. Compared to no irrigation system at all,

traveling guns can make a substantial increase in your ability to keep an actively growing grass surface. Hose and sprinkler systems, even small traveling sprinklers, are not sufficient for irrigating athletic fields.

Removing water from athletic fields is as important as adding water by irrigation. Fields holding too much water will result in oxygen deficient root zones as well as soft field conditions. Soil moisture has been determined as the major factor in determining field hardness. A Clegg impact soil tester uses a dropped mass and accelerometer to determine field hardness expressed in maximum gravitational units (G-max). High moisture content causes softer field conditions. Games played on wet fields cause excessive tearing and smearing of the soil that eventually results in greater soil compaction. State of the art sand base fields have been developed to prevent wet field conditions. When properly constructed, they have rapid water infiltration as well as good internal drainage. Rapid removal of water in the upper three inches of the surface greatly reduces field tearing when games are played shortly after rainfall. Sand fields with the proper particle size range are virtually non-compactible compared to most top soil fields. The United States Golf Association has determined sand particle sizes for golf greens. Sands for athletic fields should conform to USGA specifications. One of the major complaints concerning sand athletic fields is the poor footing that can result, especially if the turf mat has been worn thin. Elsewhere in this publication there is an article by the same author discussing synthetic stabilizers that have recently been introduced to provide better footing in sand base fields.

Cultivation is the most used method for dealing with stresses associated with hard and compact fields. Cultivation benefits include: reduced compaction, increased root zone oxygen, improved water infiltration, release of toxic gases, stimulated root growth, disruption of soil layering, controls/reduces thatch, improves fertility response, and prepares a seed bed. Develop a coring program based on your type of field. Here are three examples:

Sand base fields

- Hollow core at least twice per year.
- Drag in cores.
- Add topdressing same as sand base.

Poor topsoil fields

- Hollow core at least twice per year.

- Remove topsoil cores from field.
- Backfill with sand top dressing.
- Gradually build sand layer by continual core removal and topdressing.

Good topsoil fields - no drainage problems

- Hollow core at least twice per year.

- Drag cores once dry for easier mowing.
- Top dress with similar top soil.

High traffic areas may need additional coring. Solid tine coring, slicing and spiking are additional methods of relieving the stress of compaction. Deep tine aerification will also cause an immediate and often dramatic response to reduce waterlogging of fields. This response is usually temporary but very beneficial. Compaction will always be a problem on high traffic areas and cultivation should be a routine practice on nearly all sports fields.

Good management practices and a few tricks of the trade will help reduce the stress on turf. If you really want to reduce the stress on yourself and on the sports field, then develop a good working relationship with the coach and athletic director. Only then can you begin to control the amount of traffic that goes into a sports complex.

GOLFERS' VIEW OF GOLF COURSE MAINTENANCE[1]

Tim Berg[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Director of Golf, Sunriver Lodge & Resort, Sunriver, Oregon.

I want to thank Bill Griffith and the Northwest Turfgrass Association for giving me the opportunity to speak to you today. It's always a pleasure to share my knowledge so as to give more to the game of golf and to make playing more enjoyable for those who participate in it.

First of all, even though maintenance is important to the golfer, I don't believe any golfer walks to the first tee with the attitude that "I'm going to look for all the things wrong with this course today." He's excited about getting out and playing golf. His thoughts are on his swing, who his partner will be, how many strokes he will get and what the stakes are going to be.

A golfer's feelings about the course and its maintenance develop while he is playing and are summed up in comments made during and after the round. The way a player plays and the condition of the golf course affect the attitude the golfer has that evening when he leaves the course. How a player plays can also affect his attitude toward maintenance on the golf course. Those who play well usually have less to say about conditions.

You all know that you can't satisfy all the golfers who play your golf course. They all have certain preferences in greens (speed, firmness), mowing heights of fairways and roughs, length of the holes, among others. Different types of facilities have different types of players, thus requiring differing maintenance practices. For instance, if you're at a public course, you may have a little slower greens and less rough than a private course. How different will be pointed out later in my remarks.

Generally speaking, you should maintain your golf course as near as possible to what your membership or players want while keeping in mind the health of the turf plant.

For the sake of organization, I have separated the rest of my remarks into four

areas which affect the view of a golfer toward maintenance. These are:

1. Consistency

2. Definition

3. Challenge

4. Attention to detail

No matter how you maintain a golf course, the program should be consistent. All of the mowing schedules should remain the same throughout the season. For example, if greens are mowed 5 or 6 times a week, the days the greens are not mowed should remain the same. That way, a golfer knows what to expect when he comes out to play.

An effort should be made to make all of a golf course's greens consistent. The greens should putt at approximately the same speed and receive a well struck ball with the same action. Golfers become very frustrated when one green is slow and another fast or when a ball bites on one green but bounces off another. Also, this isn't fair to the players. The stimpmeter, which has been promoted by the USGA and used mostly for testing speed of greens, should be used to help improve the consistency of speed of your greens.

Longer rough on one hole compared to another hole is unfair to the player who hits a bad shot on one hole and is confronted with a more difficult shot than a player hitting a similar shot on a different hole. Comparative bad shots should result in the same difficulty when the circumstances are the same.

Bunkers should have the same depth of sand to eliminate plugged or bare lies. All bunkers should have adequate rakes!

Try to do major maintenance activities (aerifying, topdressing) the same time of year (weather permitting). Post your activity schedule far enough in advance so the golfer can be prepared for the inconvenience.

Grooming a golf course beyond normal conditions for a tournament can be upsetting to your players. You might hear "Why can't the course be like this for us?" If a consistent maintenance program is developed that includes good grooming practices, the golf course will always be well received by the players and appear

to be in tournament condition.

The second area that affects the golfer's view of maintenance, which I called "definition", answers the questions: Where does the player go? How does my ball lie? Am I or am I not OB or in a hazard or a bunker?

When a player stands on the tee, can he tell what direction he is going? Do the tee markers point the golfer at the fairway or are they aimed toward the rough or bunkers or water? Is the mowing pattern in the correct direction? Does the hole have rough, bunkers, water or trees to show where the hole plays? Even a light rough gives a hole definition. A few trees planted in strategic places can give a plain hole direction.

All hazards, including water, sand bunkers and OBs should be well defined. Poorly edged bunkers and poorly marked hazards and OBs cause frustration if the golfer cannot tell where he is. Poor definition can also lead to cheating. Many players will play the ball without taking a penalty, with or without the approval of their fellow competitors. (A reason for having good definition during normal play as well as for tournament play.) Stakes should be visible from one to the other and close enough so the player can tell how his ball lies. Use paint to define hazards and OBs where possible.

Cart paths that are paved or graveled should be well defined so the player knows he is either on or off the path. Any drop areas should be well marked. Go through your course with white paint and mark it as though you were going to have a tournament. Once you see the bad spots, work to eliminate each area.

Good grooming and mowing practices can give good definition and are aesthetically pleasing (e.g. fairway-rough, tee-rough, greens-collars-rough). Definition is an important part of every hole and enhances the beauty and playability of any course.

The third area I wish to speak on today is challenge. I believe challenge puts the greatest demand on the Golf Course Superintendent. How should the course play? Hard? Easy? What is hard, easy, fair?

Should the course be firm and fast, soft and lush (dark green) or somewhere in between? Some golfers feel dark green is good. I know the neighbors who live around the Sunriver courses feel dark green is best. I am not here to argue the pros or cons of dark green, but I feel what is best for the turf is also best for playability

and challenge.

Golf played at every level should demand something of the player's skills. These demands can be made through the design of the course. Today, I will comment on how I believe maintenance can provide this challenge.

Originally, golf was played in an area with no maintenance. You teed up within a few feet of the hole on dirt that was taken from that hole. Imagine what that putting surface looked like and the condition of the edge of that hole.

Visualize yourself playing under these conditions. No mowed grass. What hazards there are remain unkempt. The hole is cut in the ground (and remains unchanged) and you tee off within a few feet of that hole.

Now bring in modern maintenance techniques and equipment (mowers, aerifiers, topdressers, chemical, fertilizers). Mow the fairways, greens, tees, and roughs. Smooth out the putting surfaces.

Now visualize yourself playing this modern course.

Has a golf course condition been created that penalizes the bad shot? No! I believe we now have a golf course that rewards the good shots a player hits. A premium has been put on accuracy. You've said to the player, "Improve your skills and you can play from better lies, putt on a smooth surface. You will be rewarded for playing better. Your score will reflect the time and effort you put into your game."

What about the bad shot? Conditions have also improved for the shot that is poorly hit. Consistent height of rough, raked bunkers and smooth surfaces throughout the course have given better playing conditions throughout the golf course.

In modern day maintenance, the Golf Course Superintendent can provide the challenge with his grooming methods.

At all levels of play, the golfer should be challenged to hit good shots. Rough should border the fairways. Height of rough would depend on the facility and type of player. Only the U.S. Open would have 5"-6" rough, but even a public course should have a light rough to reward the good shot. A private club would have a little higher rough because, overall, they might have better and more dedicated players.

Greens should be firm enough to demand some spin be put on a ball hit from the fairway. A thinly hit 3-iron that screams along 5 feet off the ground should not land on the green and stop within a-few feet. An example of an over-demand of the player's skill would be if the fairway grass were long and the greens hard. A player couldn't get the clubface on the ball to apply spin for proper stopping action on the green.

Slow, soft greens don't offer a challenge. And despite what some "players feel about soft greens for holding shots, there are negative aspects to this condition. The putting surface cannot remain true with the continual foot traffic. Soft greens vary in speed and cause short shots to react inconsistently.

Greens should be firm and fast enough to require some touch in putting. The sledge hammer approach requires little skill or finesse and is very uninteresting. Too fast slows up play.

Thought should go into tee and pin placements so the golfer receives as much variety as possible within the capabilities of your course. Even the championship tees should be varied and not left out at the tips. On each hole, develop a relationship between the forward, regular, and championship tees and move them together as you vary the distance of the holes.

Remember that the USGA handicap system helps equalize players. A handicap will allow the players to put as much into their game as they wish and still remain competitive.

The golfer who doesn't wish to improve his game shouldn't dictate how the course is maintained. If a golfer wishes to have no hazards or rough, wants sponge greens and doesn't want to think about the game, he should go to the city park or the beach for his walk, because a walk is all that he would be getting from his experience. When a golfer walks on a course, he should expect to be challenged by that course. To be rewarded for his good shots.

The fourth area, which I labeled "Attention to Detail", is relatively new to the industry. It is the result of televised golf plus the Jack Nicklaus and Pete Dye type golf facilities that have been constructed over the last 10-15 years.

When every week our players see the detail mow striping of the fairways, approaches, and greens of the tournament courses like the International in Colorado, or they go to a Landmark course in Palm Springs and see the detail of

flower gardens and plantings around clubhouses and parking lots, visions of what their course should or could look like start popping into their minds. They don't consider how labor intensive that detail maintenance is and how much equipment is required.

How much of that you wish to do is up to your budget and the demands of your players. I can assure you that you can provide a wonderfully playable golf course without all of that.

We do need to pay attention to details that promote cleanliness, neatness, and orderliness. Pay special attention to restrooms, tee areas with signs and benches, clubhouse and parking lot plantings. Repair the broken and replace the worn! Stay on top of things. Don't wait for the player to bring your attention to the little things!

I remember a Golf Course Superintendent saying in jest "If it weren't for the golfer, I would have a real nice golf course". With a golf course that is consistently maintained, has good definition, and provides a challenge for the golfer, you would be very happy to have the golfer around. He is going to be your best friend.

Your maintenance program can challenge the golfer to make good shots. It can put a lot of excitement and interest into the players game and force the player to put some thought into his play. In short, you can develop a dedicated, enthusiastic golfer who can hardly wait to work on his game and get back on the golf course.

EVALUATION OF BUFFALOGRASS FOR USE AS A LOW MAINTENANCE GRASS IN THE PACIFIC NORTHWEST[1]

Gwen K. Stahnke[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Extension Turfgrass Specialist, Washington State University Research and Extension Center, Puyallup, Washington

Buffalograss, *Buchloe dactyloides,* is a perennial warm season, low growing, dioecious, drought-tolerant grass which is native to the central and southern Great Plains. Its area of adaptation extends from southern Canada to central Mexico, covering 190,000 square miles. Buffalograss played an important role for the early settlers on the semi-arid short grass prairies where annual rainfall averaged only 15 to 25 inches. Native buffalograss collections have been evaluated with superior types being chosen for testing and improvement. These grasses have come from Nebraska, Texas, Oklahoma, Arizona, California, New Jersey and Colorado. Being dioecious with separate male and female plants, desirable turf-type characteristics are more commonly found in female plants. Therefore, it is the female plants that are chosen for most vegetative improvement into future cultivars. Some of the key features of buffalograss are:

Advantages
Reduced Irrigation
Reduced Mowing
Drought resistant
Grows on dry, clay soils
Tolerates compaction
Does well in full sun
Very deep root system
Few insects or disease problems

Disadvantages
Doesn't grow in moderate shade
Doesn't have dark green color
Greens up later in spring
Turns brown at first freeze
Seed is expensive

Possible Uses
Home lawns, golf course roughs and fairways, parks, air fields, play grounds, roadsides, cemeteries and other low maintenance areas.

In an effort to conserve water in low maintenance areas, we began evaluation of four buffalograss cultivars in demonstration plots in the Yakima Area Arboretum, Yakima, WA, and the WSU Research Center at Prosser, WA, in June of 1990. The cultivars initially established were NE-378, NE-609, Texoka and Prairie. The NE-378 and NE-609 are two improved female varieties from University of Nebraska. The NE-609 is being vegetatively produced in Texas under the name Oasis. Texoka is a currently available standard buffalograss. Prairie is an improved selection out of Texas A & M University. All four cultivars made it through the entire season, with Texoka and NE-609 covering the plots most rapidly. Due to construction of a new learning center at the arboretum, the test plots had to be moved in early spring. Unfortunately, they did not knit down very well and most of these plots were lost due to desiccation. The buffalograss went dormant about the last week in November and it was still dormant at the time the sod was lifted in April. It is still far too early to recommend buffalograss for use in central Washington, but is a possibility for the future after further evaluation over a period of several years.

There are still management practices which are being evaluated as buffalograss is being produced for sod. One item which Crenshaw and Douget of Austin, TX, discovered, was that buffalograss doesn't like to be rolled before the sod is cut, or it causes a bruised look. Therefore cutting of the sod takes place without first rolling the area. Work is still continuing on production of improved buffalograss seed for establishment in the near future.

On June 27, 1991, the National Turfgrass Evaluation Program (NTEP) Buffalograss Trials were planted at the Yakima Area Arboretum with the help of Yakima Master Gardeners and Rita Pilgrim, curator of the arboretum. Rita and her crew cleared and prepared a 4,000 ft^2 area for the study and handled the irrigation and cultural practices during establishment. The study consists of 22 selections of buffalograsses replicated three times in 5' x 5' plots. They received 2 lbs. of N/M/yr. and will be mowed at a 3inch height of cut. After the buffalograss was established (approximately 6 -8 weeks), it only received 1 inch of water per month to maintain its green color. The 22 cultivars planted are listed below.

CULTIVARS OF BUFFALOGRASS

1. NE 84-609
2. NE 84-315
12. Rutgers
13. Sharps

3. NE 85-378
4. NE 84-45-3
5. NE 84-436
6. Bufflawn
7. AZ-143
8. Highlight 4
9. Highlight 15
10. Highlight 250
11. Prairie
14. NTDG 1
15. NTDG 2
16. NTDG 3
17. NTDG 4
18. NTDG 5
19. Bison
20. BAM 101
21. BAM 202
22. Texoka

Some of the buffalograss plants did not survive the shipping process well and upon arrival required nurturing or just total replanting. At one month after planting, there were seven cultivars which seemed to perform a little better than the other 15 at the Yakima site. These cultivars were NE-315, Bufflawn, Highlight 4, Prairie, Rutgers, Sharps and Bison. Again, it is too early to make any conclusions. The plots have not totally filled in as of September 9, 1991 and we may have weed encroachment or loss this winter due to cold damage or desiccation. This coming year will be crucial to the evaluation of buffalograss in Central Washington.

PRELIMINARY RESULTS OF NITROGEN FUNGICIDE MOVEMENT THROUGH A POA BENTGRASS TURF[1]

Gwen K. Stahnke[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Extension Turfgrass Specialist, Washington State University, Research and Extension Center, Puyallup, Washington.

In the past few years, turfgrass areas have been highlighted as a source of concern for possibly contributing nitrogen and pesticides to our water sources. A water quality study conducted on three golf courses on Cape Cod has shown that even under extremely sandy soils very little ammonium or nitrates (under 10 µg/ml) ended up in ground water. This greenhouse study at WSU Puyallup was initiated to compare the quantities of ammonium or nitrate which move through a sandy root zone under a controlled system in conjunction with normal application rates of two fungicides, Alliette or Subdue, to monitor any possible nitrification inhibition. Previous work at Ohio State with azaleas and rhododendrons (Inbar, Hoitink et al.) showed no effect on nitrification, whereas studies at Cornell University showed slight inhibition of nitrification when Subdue was applied to nursery containers. Experiments using tobacco with soil applied treatments of Subdue showed inhibition of NH_4^+ oxidizing bacteria. Data suggested that metalaxyl (Subdue) allows initial oxidation of NH_4 to NH_20H but inhibits oxidation to NO_3(Rideout et al.). Since these three studies gave variable results with three different crops, this experiment was designed to test nitrogen and fungicide applications to turfgrass.

Thirty mini-root observation boxes were built with fiberglass treated plywood and UV sensitive plexiglas to observe rooting. Boxes were packed with a sand/bark root zone mixture with a CEC of 4.4, pH of 6.7 and 2% organic matter (bark). A Penncross creeping bentgrass/annual bluegrass sod was cut from the field, soil was washed from the roots and the turf was planted on November 29th, 1990, in the boxes. An irrigation system was installed to apply one-half inch water every 3 days. Temperatures in the greenhouse were monitored with a CR-21 data logger. After 2 weeks, the sod had produced roots to the bottom of the boxes (24 inches). During establishment, quick release nitrogen (Peters 20-20-20) was applied at 0.5 lb. N/1,000 ft^2/month to establish the turfgrass.

During the study itself, IBDU (12-4-18 with 2% ammoniated N from ammonium sulfate) was used at 2 Ib. N/1,000 ft^2 according to recommended rates for fairways and tees. Ammonium sulfate was applied at a 1 Ib. N/1,000 ft2 since this is the maximum amount of a quick-release fertilizer to be applied at one application. Phosphorus and potassium were supplemented using phosphoric acid (H_3PO_4) and potassium sulfate (K_2S0_4) to give a 3-1-2 ratio equivalent. Subdue was applied at a label rate of 2 fl. oz./1,000 ft^2 (1.4 Ib. a.i./A) and Alliette was applied at 4 oz./ 1,000 ft^2 (8.3 Ib. a.i./A).

Each run of the experiment was set up in a randomized complete block pattern with all fertilizer and fungicide combinations and controls. The plots were fertilized and sprayed with the appropriate fungicide. Fungicides were allowed to dry on the leaf surface and then were watered in with one-half inch of water. Leachate was sampled from amber glass collection bottles each morning following irrigation the previous afternoon. Each experiment was conducted for a 2-week period. Ten ml of leachate were mixed with 10 ml of 2 M KCI in scintillation vials to store the samples at room temperature until they could be analyzed. Analyses were run on an Alpkem Rapid Flow Analyzer in Pullman, WA. Both ammonium and nitrate contents were evaluated.

PRELIMINARY RESULTS

To date, statistical analyses have not been performed on the data, therefore I can only talk about trends in the data.

LEACHATE

The total leachate collected from each box differed with each sampling, however it did not appear that any specific boxes were consistently high or low. Analyses of leachate showed that ammonium sulfate plus Subdue had the highest nitrate concentrations for the 2 weeks of experiment #1 and 10 days of experiment #2. The highest nitrate concentrations were 1.2 µg/ml which is much less than the 10 µg/ml Federal Standard for nitrates in water. The IBDU plus Subdue showed the highest nitrate concentration from 12-14 days after treatment in experiment #2 (1.2 µg/ml) which again is well below the maximum amount allowed in leachates.

Ammonium concentration in leachate was much higher than the nitrate concentration. Again, ammonium sulfate plus Subdue had the greatest concentration for 10 days in experiment #1 and for 4 days in experiment #2. Experiment #1 reached an average of 8.9 µg/ml and experiment #2 reached an average of 3.4 µg/ml. The

ammonium sulfate alone had the greatest ammonium content in leachate at 5 days after treatment for both experiments and was equal to ammonium sulfate plus Subdue for 714 days after treatment in experiment #2.

GRASS HEIGHTS AND CLIPPING YIELDS

There did not appear to be any significant differences in clipping yields between treatments. The plant height measurements after fertilizer and fungicide treatments showed a trend for IBDU and IBDU plus Alliette to have a slightly greater growth for 5 days after treatment. At this point without statistics I can not say it is of any significance.

ROOTS

Rooting depths and samples have been collected but are still under analysis at this time.

FUNGICIDES

Analyses for the parent compound of Subdue in leachates are currently being conducted. Extraction procedures for Alliette have proven too difficult for our laboratory to utilize and will not be performed.

CONCLUSIONS

This study is currently in the process of being re-established in the greenhouse to begin another series of tests this winter. This is necessary to confirm previous results. With the help of Dr. Dave Bezdicek from WSU-Pullman, nitrogen tracers may be added to the plots in order to better follow the path of nitrogen through the turfgrass system. It also appears that the two-week period of study for each experiment should be lengthened to 3 weeks for adequate evaluation. No conclusions on any effect of fungicides on nitrification can be made at this time. Results presented are strictly preliminary and need to be reconfirmed and statistically analyzed. Conditions created in the greenhouse would represent high nitrogen and irrigation application rates to give maximum possibility for leaching.

REFERENCES

1. Cohen, S. Z. et al. 1990. A ground water monitoring study for pesticides and nitrates associated with golf courses on Cape Cod. GWMR. pp. 160-173.

2. Inbar, Y. et al. 1989. Interactions between Subdue and slow-release fertilizers at high temperatures. Ohio State Research Journal Proc., Wooster, Ohio. pp. 5052.

3. Rideout, J. W. and J. L. Jones. 1987. Inhibition of nitrification in soil by metalaxyl. Tobacco Science. 31:46-47.

ENHANCED TURFGRASS SEED AND SEEDLING PERFORMANCE BY SOLID MATRIX PRIMING[1]

C.D. Burrows/W.J. Johnston/J.D. Maguire[2]
Gwen K. Stahnke[3]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.
[2] Graduate Student/Assistant Professor, respectively, Department of Crop and Soil Sciences, Washington State University, Pullman, Washington.
[3] Extension Turf Specialist, Washington State University Research and Extension Center, Puyallup, Washington.

INTRODUCTION

Solid Matrix Priming (SMP) is a relatively new seed conditioning technique (Kubik et al., 1988: Khan et al., 1991) which utilizes a solid carrier to control the water potential of the seed during the conditioning process. The objective of SMP has been to speed the rate of germination, synchronize emergence, and improve seedling vigor. Kentucky bluegrass (KBG), due to its natural lengthy germination period, lends itself to and benefits from SMP.

During the conditioning process sufficient moisture is allowed into the seed for the necessary enzymatic and metabolic activities associated with seed germination to occur; however, at the same time, radicle emergence is prevented by limiting moisture availability (Heydecker and Coolbear, 1974). Bradford, (1986) refers to this concept as priming to the threshold level. It is desirable to avoid radicle growth during the conditioning process because seed viability can be reduced upon subsequent dehydration if growth has occurred (Bradford, 1986).

MATERIALS AND METHODS

The solid carrier in the SMP operation is Micro-Cel E (MCE), manufactured by Manville (Lompoc, CA). MCE is a synthetic hydrous calcium silicate which is made from a hydrothermal reaction of diatomaceous silica and lime. Its unique physical properties, which include, a large surface area (120 m^2/g), low bulk density (88 kg/m^3), and the ability to absorb large amounts of liquid (525% by weight) relative to its own weight, make it an ideal carrier in the priming process.

Preliminary research at Washington State University indicated that a 16:8:18

ratio of Seed:MCE:Water by weight and conditioning for 7 d in a germinator with light at 15 C worked best to prime seed. KBG seed were conditioned in loosely capped jars, in the afore mentioned manner, and the MCE was washed off the seed at the end of conditioning with deionized water. A fine meshed strainer was used to hold the seed during the 30 s rinsing process, after which, the seed were dried back on absorbent paper at ambient room temperature.

RBG seed were also conditioned for 2 d at 15 C in a germinator at a 16:0:18 ratio of Seed:MCE:Water and subsequently rinsed and dried in the same manner as the MCE treated seed. Preliminary work had indicated this was an ideal duration and ratio when priming with water only.

A separate viability test was performed on the KBG seed prior to conditioning to ensure good seed quality, and the viability was over 94%, with 90% of the seed germinating within the first 7 d.

Three experiments were carried out to compare the performance of matriconditioned (primed) seed against both water conditioned and untreated seed. The first experiment was a germination study in which seed were placed on filter paper in petri dishes. The petri dishes were then placed in a germinator with an alternating 12-hour cycle of 25/15 C with light and dark accompanying the higher and lower temperatures, respectively. The filter paper was periodically moistened with distilled water and germination counts were made everyday for 21 d. Four replications of 100 seed were used and germination was counted when the coleorhiza (root) was longer than 1/2 the length of the caryopsis.

In the second experiment, a thermogradient plate was utilized to check germination at six different constant temperature levels ranging from 10 to 35 C. Materials and methods were conducted in much the same manner as in the germination study: however, the experiment lasted for 28 d instead of 21 d.

The third experiment was an emergence study in which seed were planted 1/4 inch deep in a 1:2:1 peat, pumice, and sand mixture. The temperature remained fairly constant averaging 23 C and lights were set on an alternating 12-hour cycle of light/dark. Soil was kept uniformly moist and emergence counts were made for 21 d. Seedlings were considered emerged upon the first sign of coleoptile visibility. At the end of 21 d, seedlings were measured for height and dry weight. Dry weights were obtained after drying the fresh seedlings for 48 h at 77 C.

RESULTS AND DISCUSSION

In the germination study, the matriconditioned seed germinated at a faster rate than either the water conditioned or untreated seeds however, all three treatments had near the same total emergence after 21 d (Fig. 1). The water conditioned seed performed poorly in this experiment. Perhaps membranes were initially damaged from the uncontrolled rush of water entering the seed during the conditioning process (Simon and Raja Harun, 1972).

In the thermogradient-germination experiment, both the total germination and speed of germination (T50) were increased at all temperatures (with the exception of 35 C) for the matriconditioned seed relative to the untreated seed (Table 1). No germination occurred at 35 C. This indicates that RBG seed may undergo thermoimbibition at high temperatures.

The performance of the matriconditioned seed exceeded that of the water conditioned or untreated seed in the emergence study (Fig. 2). Total emergence, rate of emergence (T10 and T50), average seedling height, and average seedling weight were all greater for the matriconditioned seed indicating that matriconditioning of KBG seed increases both seed viability and vigor (Table 2). Why total germination was low for both the untreated and water conditioned seed is unknown. Perhaps vigor was negatively affected during the water conditioning process. It is also possible that the seed may have been planted deeper than 1/4 inch, thereby resulting in a decreased total emergence for all treatments: nevertheless, the matriconditioned seed, which had 81% total emergence, was planted at the same depth as the other treatments.

SUMMARY

In conclusion, SMP with MCB as the carrier appears to benefit RBG seed by increasing the rate of germination, synchronizing emergence, and improving seedling vigor. These characteristics would markedly improve the establishment and early utilization of Kentucky bluegrass. Also, rapidly establishing bluegrass would reduce dependence upon chemical weed control.

REFERENCES

1. Bradford, R.J. 1986. Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. HortSci. 21(5):1105-1112.

2. Heydecker, W., and P. Coolbear. 1977. Seed treatment for improved performance-survey and attempted prognosis. Seed Sci. and Tech. 5:353-425.

3. Rhan, A.A., H. Miura, J. Prusinski, and S. Ilyas. 1990. Matriconditioning of seeds to improve performance. Proc. National Symp. Stand Estab. Hort. Crops, Minneapolis, MN. p. 19-40.

4. Kubik, R.R., J.A. Eastin, J.D. Eastin, and K.M. Eskridge. 1988. Solid matrix priming of tomato and pepper. Proc. Int. Conf. Stand Estab. Hortic. Crops., Lancaster, PA. p. 86-96.

5. Simon, E.W., and R.M. Raja Harun. 1972. J. Exp. Bot. 23:1076-1085

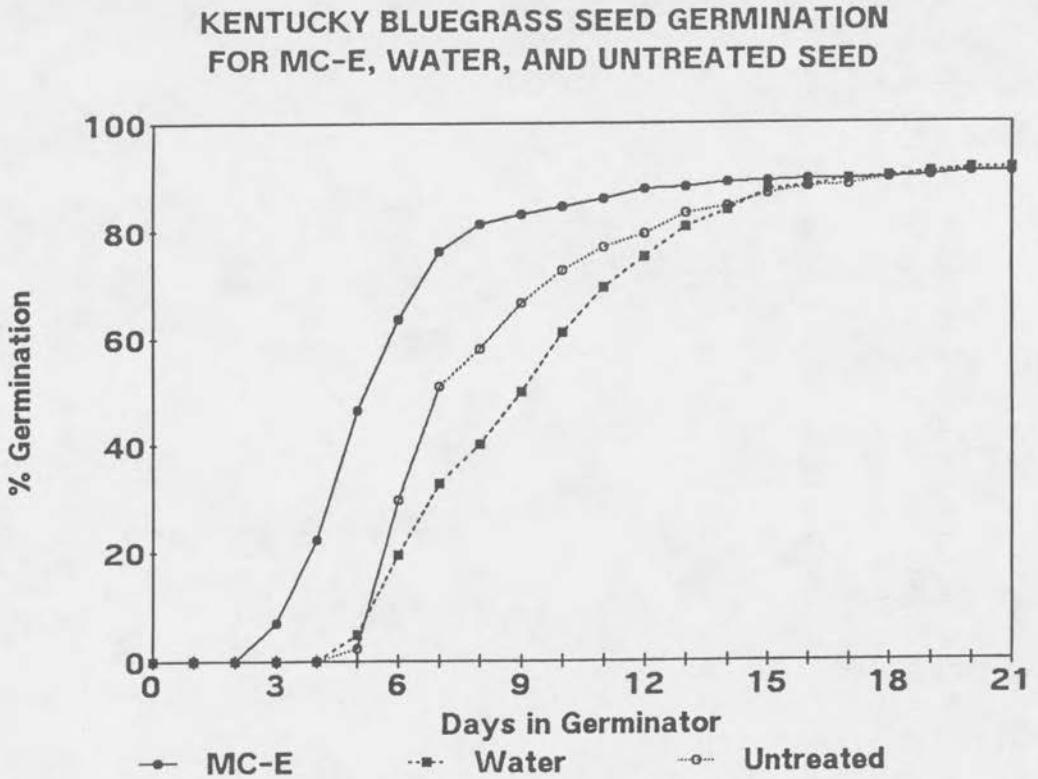

Figure 1. Germination as affected by a 12-hour cycle of 25/15 C (light/dark). Conditioning for MCE and water treated seed was 16:8:18 (7d), and 16:0:18 (2d), respectively.

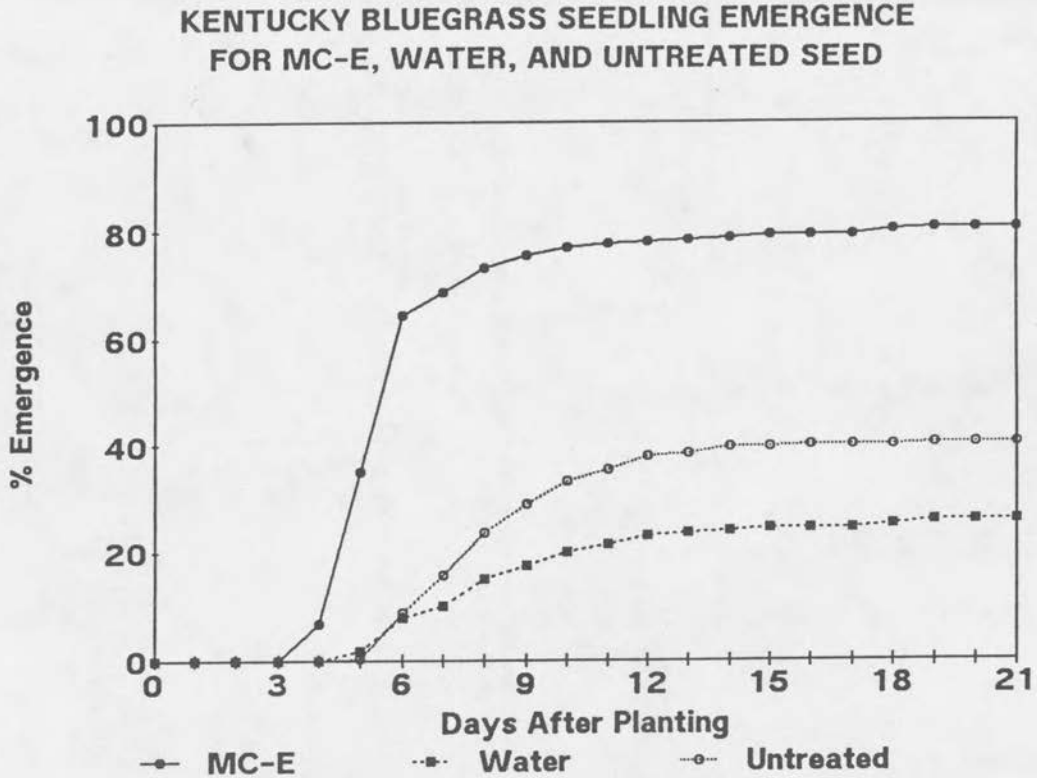

Figure 2. Emergence of conditioned seed in a 4:2:1 peat, pumice and sand mixture. Temperature 23 ± 3 C and humidity 40 ± 4%. Conditioning for MCE and water treated seed was 16:8:18 (7d), and 16:0:18 (2d), respectively.

Table 1. Effect of matriconditioning on the germination of Kentucky bluegrass seed at 10, 15, 20, 25, 30, and 35 C.

Temperature	MC-E[1] (7d)+ dried		Untreated seed	
	Germination %	T50[2] d	Germination %	T50[2] d
10 C (50 F)	44	15.3	14	19.4
15 C (59 F)	67	7.8	63	9.9
20 C (68 F)	72	4.8	49	6.9
25 C (77 F)	81	3.5	56	5.3
30 C (86 F)	55	4.3	56	6.0
35 C (95 F)	0	0	0	0

[1]Seed:MC-E:H_2O = 16:8:18
[2]Time to 50% germination

Table 2. Effect of matriconditioning on the performance of Kentucky bluegrass seed at 23 C.

Treatment	Total emergence %	T10[3] d	T50[4] d	Seedling length cm	Dry weight mg
MC-E[1] (7d)+ dried	81	4.5	5.3	5.5	0.42
Water[2] (2d)+ dried	26	5.3	7.4	4.7	0.35
Untreated seed	41	5.6	7.6	5.0	0.36

[1]Seed:MC-E:H2O = 16:8:18
[2]Seed:MC-E:H2O = 16:0:18
[3]Time to 10% emergence
[4]Time to 50% emergence

SOLVING WINTER TURFGRASS PROBLEMS[1]

William J. Johnston[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Assistant Professor, Department of Crop and Soil Sciences, Washington State University, Pullman, Washington.

The past two winters (1990 and 1991) have been extremely devastating on turf in the PNW (Pacific Northwest). Turfgrass injury has occurred both east and west of the Cascade Mountains and is related to several and not just one cause. Although we tend to look for a single cause to any problem, we must keep in mind that winter injury is a very complex phenomena and it often results from the interaction of several environmental and cultural factors. Having said that, we still can look individually at the principal causes of winter injury in order to better understand the effect each has on turf.

WINTER INJURY- UNDERSTANDING PRINCIPLES

According to most turfgrass research, the major types of winter injury are desiccation, low temperature kill, winter turfgrass diseases, and the effect of traffic on frozen and/or slush-covered turf.

Winter Desiccation.

Winter desiccation of turfgrass is common throughout the Northwest and occurs on semi-dormant slow growing turf and on dormant turf. Winter desiccation is most severe on windswept exposed sites with little vegetation to deflect or block the wind. In addition, elevated sites or even high areas on a green or fairway are often dry due to surface water runoff.

Winter desiccation can also occur on those rare warm, sunny winter days. With elevated air temperatures the grass leaves lose water via transpiration. There is also loss of surface moisture by evaporation. If the plant roots can not take up sufficient moisture to meet this increased demand, desiccation will occur. The roots may not be able to meet the plant's requirements because the soil water is frozen, the root system has been severely reduced during the winter, or the roots are in a very cold soil and can not function efficiently.

The most favorable conditions for desiccation to occur are windy weather, frozen soil, exposed sites, lack of slow cover, and low humidity.

Low Temperature Kill.

Low temperature kill, often referred to as direct low temperature kill, is a basic ecological principle. Low temperature kill is what limits the northern movement of the warm-season turfgrass species. Warm-season species such as bahiagrass and St. Augustine grass are simply not winter hardy enough to survive in the cold climate of the PNW.

Low temperature injury is associated with the formation of ice crystals within the cell. As a plant hardens for winter, water is drawn out of the cell and into the intercellular region between cells. When intercellular water freezes low temperature kill may or may not occur. When ice crystals form within the "living" protoplasm of the cell death of the turfgrass plant almost always occurs. In general, the higher the water content of the tissue, e.g. hydration of the crown area from standing water, the more likely a severe kill will occur.

Winter Turfgrass Diseases.

Snow, while it protects plants from the ravages of desiccation, provides a favorable microenvironment for many low temperature pathogenic fungi. An especially important group of such fungi in the PNW is the snow molds. The snow mold fungi are especially active at temperatures slightly above freezing. At the same time, cold temperatures prevent the grass from growing and, thus, withstanding fungal invasion.

In the PNW, the major snow mold diseases are pink snow mold (Microdochium patch or Fusarium patch) caused by *Microdochium nivale* [also known as *Gerlachia nivalis* or *Fusarium nivale]* and gray snow mold (Typhula blight) caused by *Typhula incarnata, Typhula ishikariensis,* and/or other *Typhula* species.

Other turfgrass winter diseases are yellow patch (cool temperature brown patch) caused by *Rhizoctonia cerealis,* red thread caused by *Laetisaria fuciformis,* and leaf spot caused by *Drechslera* sp. [also known as *Helminthosporium sp.].*

We also need to be mindful of winter diseases reported in other regions of the U.S. and Canada. Coprinus snow mold (LTB or SLTB) caused by *Coprinus psychromordibus* and cool temperature pythium may one day be more prevalent

in the PNW.

Traffic.

Traffic during the winter or early spring is a problem on frozen leaves and on slush-covered turf. On frozen turf subjected to traffic, there is a disruption of the protoplasm (which is often in a very brittle state) by ice crystals surrounding and extending into the plant cells. These ice crystals also disrupt cell walls and cell membranes and when the plant thaws the "plant juices" flow out of the plant. On slush-covered turf, traffic often forces wet snow, ice, and water into the plant canopy and into contact with the living crown meristematic area. This can lead to a hydration of the crown. If this is followed by a rapid decrease in temperature, injury can occur. While the exact mechanism of winter kill on slush-covered turf is not completely understood, it is probably closely related to the processes involved in low temperature kill.

PRACTICES TO PREVENT OR MINIMIZE INJURY

Keeping the basic principles of winter injury in mind, what are some practices that can be initiated to prevent or mitigate winter injury this year and in future years?

Desiccation .

Desiccation affects all turfgrass species grown in the PNW, therefore, changing species is not a cure. There is little that can be done about the weather but certain steps can be taken to provide the turfgrass with the best chance of survival. What is often required is a change in cultural practices and possibly the use of a protectant.

There are several cultural practices that will lessen the likely occurrence of and/or promote rapid spring recovery from desiccation. The turfgrass manager should try to maintain a good fall fertility program with moderate N and adequate K. You should eliminate any thatch problem to prevent shallow rooting of turfgrass plants within the thatch layer. If you aerify in the fall, fill in the aerifier holes.

Turfgrass management texts suggest that critical sites suffering desiccation can often be saved by irrigation or hauling water to the site for application. These options are not particularly practical, especially east of the Cascade Mountains. Once the irrigation system is drained or blown dry it is best to leave it dry. Hauling

water, while possible, is often not practical. One practice that could be helpful is to irrigate desiccation prone sites in late fall just prior to draining the irrigation system. Be careful to irrigate to field capacity and not to saturate or flood the soil.

Protectants such as turf covers have been used with mixed success in the PNW, but should be a component of any scheme to protect against winter injury. Turf covers have been evaluated for several years at Washington State University and the reader is referred to research results reported in several past NTA Proceedings. Turf covers, mulches, heavy top dressing, and strategic placement of wind breaks are very effective in protecting turf from desiccation. Antitranspirants have had limited use in the Northwest, but they have been successfully used in other northern regions of the country.

Low Temperature Kill.

Species commonly affected by low temperature kill in the Northwest are annual bluegrass, fescue, and ryegrass. If efforts are not made to reduce the *Poa annua* population, winter killed annual bluegrass will be slowly replaced in the spring by annual bluegrass germinating from seed and these will again be eliminated the next winter or will be stressed out in the summer. This cycle of disaster will continue from year to year.

Cultural practices to follow to reduce winter kill should include maintaining moderate N and high K fertility in the fall. Also in the fall, raising the cutting height to provide some insulation and promote carbohydrate storage for winter is beneficial for turfgrass survival. Thatch and compaction problems should be eliminated. Avoid any excessive irrigation and promote good surface and internal drainage. It is critical that the occurrence of standing water be eliminated. Subjected to free water, turf crowns will rehydrate during the day and freeze during the night. A cycle of hydration followed by rapid cooling and freezing will inevitably lead to winter killed turf.

Protectants to use are protective turf covers, snow fences to provide an insulating blanket of snow, and various mulches. Soil warming, while often effective, has had limited use in the PNW.

Low Temperature Diseases.

The major low temperature diseases in the Northwest east of the Cascade Mountains are pink snow mold and gray snow mold.

Pink snow mold affects all the major cool-season turfgrass species. In the Northwest, it affects annual bluegrass, bentgrass, fescue, Kentucky bluegrass, and ryegrass.

Cultural practices to lessen the severity of pink snow mold would be a fall fertility program to maintain a slightly acidic soil pH with moderate N, high K, and moderate to high Fe. A moderate to low mowing height should be practiced and any thatch problem should be eliminated. A protective and possibly a curative fungicide program will generally be required.

Gray snow mold is most common on annual bluegrass and bentgrass. Annual bluegrass should be avoided, if possible, in areas of severe snow mold problems.

Cultural practices to reduce the severity of gray snow mold are to provide moderate fall N fertility and a moderate to low cutting height. The site should have good drainage and any problems of compaction or thatch should be eliminated. In areas prone to severe snow mold, a protective and possibly a curative fungicide program will be necessary.

Traffic.

The ravages of traffic on frozen turf with brittle leaf blades affects all cool-season turfgrass species. In such incidences, all traffic should be withheld from the turf, or as a minimum effort, diverted away from critical areas such as golf course greens and tees. If the irrigation system is fully active, a light application of water in early morning can aid in thawing the turf. Care must be taken to insure that excess water is not applied and that there is adequate surface drainage or low temperature kill of turfgrass might occur when crown hydration is followed by freezing night temperature. Low temperature kill problems are also associated with traffic on slush-covered turf.

OTHER WINTER PROBLEMS

This paper has focused on turfgrass problems related to turfgrass winter injury. However, there are numerous other problems and concerns facing the turfgrass manager in the winter. As you prepare to meet the challenges of the coming winter consider other factors such as snow removal (equipment and scheduling), deicing (material, cost, and potential problems to turf, soil, and landscape plants), winterizing the irrigation system, employee winter safety (equipment, clothing, etc.), drainage, cross-country skiing (benefits and problems), winter landscape plants,

and the general overall maintenance of the facility in winter.

In cool-season turfgrass management, the winter period is usually the slack period. Winter is the time to plan, purchase, and recharge the mental and physical batteries for the oncoming rush of spring. For the well prepared turfgrass manager it is a time of rest, for the ill prepared it is a time of anxiety before the onslaught of winter damaged turf appears in the spring. By understanding the basic principles of winter injury and how to avoid or minimize winter turfgrass damage with cultural practices and protectants, you, as a turf manager, will be part of the former group and not the latter.

GRASSES FOR SPORTS TURF[1]

Leah A. Brilman[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Research Director, Seed Research of Oregon, Inc., Corvallis, Oregon.

The selection of the most appropriate grass species or variety for use on a sports turf site has a very large number of variables associated with it These include; 1) the species of grasses most adapted to the area; 2) the height of cut, fertilization, irrigation and other management to be practiced; and 3) the intensity of wear and time of year the primary wear will occur. The budget and equipment available not only for initial establishment but also for long term maintenance has to be a primary consideration. So often groups and communities spend a considerable amount of time and money renovating or establishing sports turf sites, only to have them rapidly deteriorate due to insufficient maintenance. Although many areas of parks and playgrounds do not have to be maintained to the quality of the National Football League, I believe young people deserve high quality playing surfaces, especially for organized sports, to protect them from injuries.

The easy answer for which species to use for sports turf in the Northwest is perennial ryegrass west of the Cascades and Kentucky bluegrass or a blue-rye mixture east of the Cascades. Although for certain sports and situations there will be exceptions to these general rules, in most cases these species will perform very well. However, there are varieties in each species that will perform better in the Pacific Northwest than other varieties. An advantage this area has is that although the market for turfgrass seed may not be as great in this area as in other areas of the U.S., many turfgrass breeders working in the Northwest select for disease resistance here as well as growth characteristics.

In deciding the best varieties to use for a site it is important to have test data available. In England the Sports Turf Research Institute attempts to answer this question, and also performs management research. The cultivars in their trails are often European varieties not available in this country but they measure both wear tolerance of cultivars and other characteristics important to specific sports turf uses. In this country the National Turfgrass Evaluation Program is a useful tool in deciding the cultivars to use in a sports turf area. In addition to providing information on performance of varieties at a wide range of sites in the U.S. there is also data on disease and insect resistance, color, texture and often even wear

tolerance. Visiting these sites in your local area, especially if there is one with wear treatments, and maintaining contacts with the turf researcher is a valuable method of selecting top performing cultivars. Unfortunately most of these sites do not evaluate cultivars with the major purpose of evaluating their suitability for sports turf.

To help you decide which cultivars of perennial ryegrass to use in western Oregon, Washington and British Columbia, Washington State University has compiled a list of the cultivars evaluated in the last 10 years which shows the best adapted. These lists change frequently and it is advisable to obtain the latest list before a major seed purchase. It is recommended that you purchase a blend of 2 or more of the best adapted cultivars. Since each supplier may have only a certain number of cultivars available try to select a blend with at least one top performer.

Some of the newest cultivars available, representing the latest advances in turfgrass breeding, may not appear on this list since they have not been tested as many years. Examine data on these and/or look at them in local turf plots or use sites, such as another sports facility, before using them on your site. In many cases these cultivars may actually provide superior performance but still try to include another top ranked cultivar. At some sites where yearly, or more frequent, overseeding is done to maintain a good stand, the color, texture, density and speed of establishment the first year may actually be more critical than long term performance. Many of the newest cultivars also have reduced vertical growth rates which can reduce the frequency of mowing required, especially during fall to spring, and reduce the clippings. Remember to always purchase **"Certified"** seed by cultivar name to insure you will obtain performance comparable to the test data.

You will find even west of the Cascades Kentucky bluegrass may be included if you purchase sod. It forms a more stable sod but most cultivars will not persist in this area, due to many factors including diseases. If you purchase sod for athletic turf west of the cascades that includes Kentucky bluegrass, you should insure it contains only top ranked cultivars blended with top ranked perennial ryegrasses. The few varieties of bluegrass that do perform well in this area are often those with a lower seed yield potential so availability may be lower and price higher, but they are well worth the investment.

East of the Cascades Kentucky bluegrass is the species of choice. It probably grows as well or better here than in any area of the U.S. The top performing cultivars in many instances are the same as those in the western regions with some exceptions. In the National Test, sites in Post Falls, Idaho, Pullman and Ritzville,

WA are representative of this area. In this area the density and aggressiveness of the bluegrass should be one of the primary considerations in choosing cultivars for athletic sites. A blend of 3 to 4 improved cultivars, with compatible leaf textures and colors would be recommended. In areas where rapid repairs may be necessary or quicker establishment is needed, without the cost of sod, a blue-rye blend would be recommended. Examining the results at Post Falls, ID suggests most of the top ranked cultivars of perennial ryegrass would perform well for this use east of the Cascades. In mixtures with bluegrasses perennial ryegrasses appear to have better winter-hardiness than in monostands. In most situations it may be possible, in many years, to utilize a blend of superior ryegrasses alone east of the Cascades, due to the improved cold tolerance of the newest varieties. However, situations may develop where all or part of the stand would be lost and overseeding would be necessary.

The newest turf-type tall fescues currently have a place in some sites and more research may determine advisability for other sites. West of the cascades if no irrigation is available and green turf is desired in the summer, tall fescues are the answer. On roadways of compacted clay at our research farm the tall fescue will stay green and growing all summer without irrigation. It does not utilize less water it just employs a deeper root system to extract it from a lower soil profile. In many areas of the country these have shown good wear tolerance, good shade tolerance, rapid germination and tolerance of heat and drought. The new types can be mown much shorter than the older cultivars and are being used for many turf sites.

Long term breeding work may open up other possibilities. The best species may also change due to the changing demands of the sport. An illustration of this is the decreased height of cut for golf course fairways and greens has not only changed other management, in many situations the grass species has changed. The ultimate aim is a better, safer playing surface for all sports.

ENDOPHYTE — ENHANCED TURF GRASSES, WHAT SHOULD YOU KNOW?[1]

Leah A. Brilman[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Research Director, Seed Research of Oregon, Inc., Corvallis, Oregon.

With the recent explosion of all the newly released turfgrass varieties, it is sometimes very difficult to distinguish one from the other. What is the criteria used, to pick a variety out of the maze of possibilities? There is certainly the aspect of turf quality, but in this day of environmental awareness, is turf quality the only criteria that should be considered? Today, turfgrass managers and golf course architects must be very sensitive to environmental concerns. This means all phases of a golf course project including design, construction, and future maintenance practices must be based on sound environmental decisions. The selection of the proper turfgrass varieties, in many instances, can be one of those fundamentals that will help make a golf course more environmentally sound. When possible, turfgrasses should be selected for their resistance to disease, environmental stress, and insect pressure. Turfgrass breeders have traditionally sought to improve all of these characteristics. If one chooses carefully it is now possible to have grasses with the highest turf quality, improved growth characteristics, and a reduced need for pesticides. Nature and the success of plant breeders has made all of these benefits possible.

The incorporation of endophytes into turfgrass cultivars is one of the latest advances in turfgrass breeding. Endophytes are a type of fungus that have a mutual, beneficial relationship with certain species of grasses and specific varieties within species. The endophytes get their food and protection by living inside the grass plant, but result in no negative side effects to the plant. As a byproduct, these endophytes produce and release chemicals, called alkaloids, into the leaves of the plant. The alkaloids from the endophyte make the plants resistant to many turfgrass insect pests such as billbugs, chinch bugs, armyworms, and sod webworms To date only certain varieties of tall fescue, perennial ryegrass, and fine-leaf fescues contain endophytes. It takes extra effort and time to achieve and maintain high endophyte levels in varieties so many companies have not utilized them.

The endophyte first became known in the late 1800's However, it became of interest to scientists only when it was discovered to cause illness in livestock that

grazed on pasture grasses which contained high levels of endophyte. In 1982, their potential importance in turfgrass culture was first reported at a pest control conference in New Zealand.

The main endophytic fungi which confer insect resistance to turfgrasses are from the genera *Acremonium*. There are different species of the endophyte for different grass species. For example, *Acremonium loliae* infect perennial ryegrasses and *Acremomium coenophialum* infect tall fescues. The endophytes produce a wide range of chemicals, including various kinds of alkaloids. Some endophytes produce no alkaloids and others may have a whole range of alkaloids. Some of the alkaloids isolated from endophyte-enhanced turfgrasses are ergot, loline, and peramine alkaloids (Siegel et. al 1984). Well known examples of alkaloids include caffeine, nicotine, cocaine, morphine and strychnine. The physiological effects on humans of these alkaloids are well known so it's no wonder alkaloids provide a natural insecticide in the plant. For example, a study carried out by Johnson-Cicalese and White (1990) investigated the mortality rate of adult billbugs on endophyte-enhanced and endophyte-free grasses. They found that the mortality rate of billbugs was 80% on infected tall fescue plants and only 42% on endophyte-free tall fescue. When comparing chinch bug populations on endophyte enhanced and endophyte-free fine fescues, it was found that varieties high in viable endophyte, SR 3000 hard fescue (97% endophyte infection) and Longfellow Chewings fescue (84% endophyte infection) had only 42.4 and 55.7 chinch bugs respectively per m^2. Varieties of fine fescue that are low in endophytes had 185.7 and 132.6 chinch bugs per m^2 (Saha et. al 1987). There are many similar studies dealing with sod webworm, armyworm, Argentine stem weevil and other turfgrass insects. The majority of these studies confirm beyond a doubt that endophyte infected turfgrasses are much more resistant to the major surface feeding turfgrass insects than non-endophyte turfgrasses.

Distribution of the endophyte within the plant varies. The highest concentration occurs in the leaf sheath and seed followed by the stem and crown region of the plant. The roots have the lowest concentration (Siegel et. al. 1984). Initially it was unsure if the roots had endophyte present or just some alkaloids but now endophytes have been isolated from roots in culture systems For this reason, endophyte enhanced grasses are more resistant to surface feeding insects than to subsurface feeders. There are reports of improved resistance to some types of nematodes due to the endophyte. There also appears to be seasonal variation in endophyte concentration or alkaloid production with the highest concentration occurring during the summer and fall.

Once turfgrass scientists and managers started to key in on the characteristics that were attributed to endophyte enhanced grasses other benefits began to become apparent. There is strong evidence that there are some beneficial growth characteristics in endophyte infected plants, particularly in regards to environmental stress tolerances. In a fine-leaf fescue trial (Saha et. al. 1987), there were no significant differences in turf quality when the plots were maintained at high maintenance levels. However, when irrigation and fertility were reduced, SR 3000 hard fescue and Longfellow Chewings fescue had significantly better quality than did non-infected varieties. Over time, these differences became more evident. The turfgrasses without the endophyte had poor recovery from drought stress. Experiments in New Jersey have observed better summer survival, better fall recovery, and reduced weed invasion in endophyte enhanced perennial ryegrass plots (Funk et. al. 1985). This is due in part, to a denser, more vigorous turf. Experiments on tall fescue, under greenhouse conditions, have also indicated that a denser, healthier turf is the result of endophyte enhancement. Endophyte enhanced plants had approximately 12% more tillers and 25% greater root growth than did the non-infected plants In competition studies without insects present (Battista et. al. 1990). Under drought conditions endophyte enhanced plants kept their stomates open longer and maintained photosynthesis giving them an advantage under water deficit conditions. The endophyte enables a tall fescue plant to double the osmotic adjustment in response to stress.

It is interesting to note that the percentage of plants containing endophytes increases while the endophyte-free plants die off. After seven years, the endophyte level of SR 3000 had increased from 94% to 97% while Longfellow had increased from 48% to 84% (Saha et. al. 1987). This phenomenon ensures that once you plant endophyte infected turf It will remain infected, and the benefits will be long lasting. In essence, there is a very long period of residual activity that is totally natural, safe, and comes with a low cost compared to repeated chemical applications. It has also been shown that at all levels of water stress endophyte infected seeds have higher final germination percentages than non-infected. This may also shift a population to higher endophyte status.

There is only one way to get the endophyte into your turf. You must start with seed that is already infected. Endophytes cannot be "applied" to turf in any way. The only way the endophyte is disseminated is through the seed. The endophyte in an infected plant grows up the stalk and into the developing seeds. It cannot be spread from plant to plant in an existing turf. It is important to remember that only certain varieties of tall fescue, perennial ryegrass and fineleaf fescues contain high levels of viable endophyte.

What does viable mean? As mentioned earlier, in an established stand the percentage of the endophyte will increase over time. However, the amount of live endophyte in the seed will decline over time This is especially true if the seed is not stored in cool, dry conditions. Your only guarantee that the endophyte in your seed is still present is to buy fresh seed. Seed that is over two years old will more than likely have experienced a decline in the viability of the endophyte. Unfortunately, there is no way to test seeds to determine if the endophyte is still viable. To date, the tests available for determining the presence of the endophyte in seed cannot distinguish between viable and non-viable infection, so it is very important to purchase the freshest seed available. To determine viability the seed must be grown into young plants and these tested for endophyte when they are 6 weeks old.

Companies that have high endophyte varieties have to control seed production more closely to insure they are selling fresh seed. They must keep their seedstock in cold storage or plant it soon after harvest. An additional problem is that the endophyte can cause problems for grazing animals so as burning of fields is reduced the options for straw disposal may be limited.

The endophyte is not the total answer to all the environmental issues that face turfgrass managers today. However, by using endophyte enhanced turfgrasses, it is possible in many instances to significantly reduce the amount of pesticides that are released into the environment, and at the same time, have a healthier turf of higher quality. This is a step in the right direction that all turfgrass managers can take. It should also be the job of all people in the turf industry to educate the general public about the benefits of turfgrass and how we, as an industry, are constantly looking for ways to improve the quality of our environment.

HERBICIDE RESISTANT WEEDS, A PROBLEM FOR THE FUTURE?[1]

Chris M. Boerboom[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Extension Weed Specialist, Department of Crop and Soil Sciences, Washington State University, Pullman, Washington.

Although weeds are a continual problem for most landowners, we should recognize and almost give credit to weeds for accomplishing their apparent purpose in life: survival. They survive and reproduce despite some of our most intensive efforts in trying to kill them because they have an incredible amount of flexibility. This flexibility allows them to adapt to a changing environment. For example, if mowing is used as a weed management strategy, weeds may either shift to species that are prostrate or they will flower and set seed as a 2 inch tall weed rather than as a 2 foot tall weed. Unfortunately, weeds also have flexibility in responding to the herbicides that we spray on them. The most worrisome adaptation that weeds have to herbicides is the development of herbicide resistant biotypes, weeds that were susceptible in the past that are no longer controlled with the same herbicide.

HISTORY OF PESTICIDE RESISTANCE

The development of pesticide resistance in pests is not a new phenomena. The first resistant insect was identified in 1908 and currently over 400 arthropods are resistant to pesticides that used to control these pests. Plant diseases have also followed this trend by becoming resistant to fungicides since the first report in 1940. Chemical control of weeds has lagged behind the chemical control of these other pests with the herbicide era only beginning in earnest in the 1940's, but why should weeds respond different from insects or fungi? Why would weeds not become resistant to herbicides? As early as 1956, J. Harper predicted the future by suggesting that herbicide resistant weeds would develop. By 1968, his prediction came true when a triazine resistant common groundsel biotype was identified in western Washington. This was soon followed by several other reports of resistant weeds. The current total of resistant weeds stands at 107 weeds worldwide as of last year.

HERBICIDE RESISTANCE VS. TOLERANCE

The key to discussing herbicide resistance in weeds is in understanding a few terms, starting with susceptible and tolerant. For a common herbicide like 2,4-D, many broadleaf weeds are susceptible or are killed following treatment with 2,4-D. Likewise, most grasses are naturally tolerant to 2,4-D or these plants survive the normal rates of 2,4-D that are applied. So the susceptibility or tolerance of a given plant to a given herbicide is just the natural response of that plant species.

Herbicide resistance differs from herbicide tolerance. Resistance actually begins with a susceptible weed, but within the population of that weed, natural variation exists. Some of these variations may allow some weeds to survive the herbicide. For example, common lambsquarters is generally quite susceptible to 2,4-D. If a population of common lambsquarters, perhaps 10 million plants, were sprayed with 2,4-D, all should die, but maybe 10 survive. They might be able to survive because of a naturally occurring variation allows them to detoxify the 2,4-D.

These common lambsquarters would be the start of a herbicide resistant weed biotype. They are still lambsquarters, but they are a type (biotype) that are different from most because they are resistant to 2,4-D.

It is important to understand that many herbicides act in the same way to kill a plant. This is often referred to as the mode of action of a herbicide. Herbicides are generally grouped together into families based on similar modes of actions. For example, 2,4-D, MCPA, dicamba, and several other herbicides all have the same mode of action. They kill plants by disrupting growth regulation. Unfortunately, if the above common lambsquarters became resistant to 2,4-D, it would probably be resistant to most other herbicides in that family.

Herbicide resistant weeds should not be confused with weeds that are naturally tolerant or difficult to control such as several perennial weeds. Also, resistance should not be mistaken for the failure of a herbicide treatment which may be due to application skips, miscalculation of the amount of herbicide needed, improper stage of application, weather stressed weeds, or weed flushes after the herbicide application.

If resistance is still suspected after considering the previous reasons for herbicide failure, some of the following situations may indicate resistance.

1. Other weeds listed on the herbicide label are controlled.

2. Healthy weeds are intermixed with dead weeds of the same species without reason to suspect poor spray coverage.

3. Herbicide failure is patchy and without reason.

4. Poor control of a typically susceptible weed occurred in the same area the previous year with the same herbicide.

WILL HERBICIDE RESISTANCE OCCUR IN TURFGRASS?

Herbicide resistant weed biotypes develop because we select for them much in the same why a plant breeder selects for a particular trait. The resistant weeds survive and increase in number until they become a problem. The rate that they develop depends upon how often we select for resistance. So factors that will speed the probability of developing resistance include: 1. Applying herbicides at a high frequency. 2. Applying herbicides at high rates. 3. Using herbicides that have long soil residuals. 4. Repeatedly using herbicides from the same herbicide family. Although the results of these factors cannot be predicted precisely, the development of resistant weeds in agricultural settings have confirmed these general principles.

STRATEGIES TO PREVENT OR MANAGE HERBICIDE RESISTANT WEEDS

Most of the suggestions to prevent or manage herbicide resistance weeds in agricultural situations could also be applied to turfgrass or landscape settings. In fact, weed management techniques in turfgrass have an advantage over crops which has probably delayed resistance from developing in turfgrass. The primary advantage in turfgrass is the excellent weed control provided by a highly competitive, perennial grass. This cultural weed control limits the amount of herbicide used and thus the amount of selection for resistance. Strategies to prevent or delay herbicide resistant weeds are listed below.

1. Use cultural weed management techniques such as a vigorous, competitive grass.

2. Use mechanical weed control techniques such as mowing or tillage in landscapes.

GOLF AND THE ENVIRONMENT[1]

Nancy P. Sadlon[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Ecologist, United States Golf Association, USGA Coordinator of Environmental Educational Programs.

It is certainly no news that the environment is a hot topic in golf today. It is unfortunate that the growing public concern for protection of the environment has manifested in a growing negative perception about golf's relationship with the environment.

News articles most often emphasize the negative, stressing potential risks related to golf course maintenance activities which continue to feed public fears. These misperceptions are often the result of a lack of familiarity about the golf environment or golf course maintenance activities. Articles which emphasize positive images of the golf course as a sanctuary and elaborate on the beneficial functions the golf course are far less frequently published. This all adds up to the growing negative public perception of the golf course which represents a real problem for golf. It inhibits the public's ability to find an acceptable balance for golf and the environment.

The USGA is approaching this public perception problem through educational programs and academic research.

USGA Environmental Program efforts include the following:

- USGA/GCSAA Turfgrass Research
- 1991-1993 Environmental Research Program
- Audubon Cooperative Sanctuary Program
- New staff with environmental backgrounds including:
- Research Director, Ecologist, Writer
- Publications addressing environmental issues

- Dialogue with environmental groups

This paper elaborates on the USGA sponsored program effort entitled the Audubon Cooperative Sanctuary Program (ACSP) for Golf Courses. This program emphasizes that golf courses can and do represent great open space refugees, "sanctuaries," for a great variety of wildlife and bird species. There are countless golf course sanctuary examples nationwide. Presented below are three examples, there are many, many more nationwide.

1. Pine Valley Golf Club, New Jersey - Famous for its bunkers, less known for its extensive native planting program which provides sanctuary habitat for numerous species, including red fox, who dens in bunkers.

2. Shinnecock Hills Golf Course, Long Island, New York Host noted for its naturalized roughs, which provide habitat and ground nesting cover for pheasant, quail and grouse species, rabbits, mice and many more.

3. The Honors Course, Ooltewah, Tennessee - Recently recognized by USGA for conservation efforts, keeps a computerized wildlife inventory of identified species on the course and has educated crew members to be able to identify species, help monitor nest boxes, and be aware of environmentally sensitive maintenance schedules.

The ACSP program encourages golf courses to take an active part in conservation. The ACSP is a program initiated by the Audubon Society of New York State, Inc. and is sponsored by the USGA through grant funds and USGA staff support. The goals of this program include five objectives outlined below:

ACSP OBJECTIVE #1:

Protect and enhance wildlife habitat on existing and proposed golf courses.

ACSP OBJECTIVE #2:

Enhance the image of golf courses as sanctuaries for wildlife.

ACSP OBJECTIVE #3:

Encourage superintendents, course officials and golfers to become more knowledgeable about environmental issues and take an active role in golf course

conservation practices.

ACSP OBJECTIVE #4:

Change golfers' expectations or standards for the maintenance of their golf course.

ACSP OBJECTIVE #5:

Instill a philosophy among golfers whereby they will accept a reduction in pesticide use, in conjunction with a willingness to accept a few weeds and brown areas on their course. Elaboration and discussion of examples of these objectives is as follows:

There are numerous examples of golf courses protection and enhancing wildlife habitat (Objective #1). Those which are most often noted are golf courses developed in the past years which were required to satisfy various environmental regulations. These examples include.

1. Spanish Bay, Monteray Peninsula, California - This course protects an area of its course for the benefit of the areas wildlife with a sign that reads: "Critical Wildlife Habitat - Nesting Underway - Do Not Disturb."

2. Ocean's Edge Golf Club, Cape Cod, Massachusetts - This course protects state listed rare and endangered plant species with a sign and a fence.

3. Harbor Ridge, Florida - Represents an example of habitat protection on a much larger scale. This course has an expansive boardwalk bridge to span the wetlands of the site, to minimize impact. The protected Southern Bald Eagle calls a large portion of Eagle Ridge its home. Protection of this species has included the designation of 26 acres as eagle preserve.

With respect to Objective #2, to Enhance the image of golf courses as sanctuaries for wildlife, there is significant recognition of a few wildlife species which routinely utilize the golf course with little recognition of the great diversity of wildlife which utilize the golf course environment. The most recognized species is the Canada Goose. The white tailed deer, gopher, and the red fox represent the next most familiar and often sited wildlife species on the golf course. These species, considered nuisance species to some golf courses, represent a very small fraction of the wildlife that utilize the golf course. A great number of bird species

are documented to utilize the golf course environment either during migration, for nesting, or as the permanent residents. Many endangered and threatened species of wildlife and plant life find sanctuary on the golf course environment (i.e., Southern sandhill crane, Southern bald eagle, and Maryland meadow beauty). Northwestern golf courses are more apt to spot a local moose, mule deer, rabbit, grouse or bittern in its grassland roughs and have potential for attracting other species such as trumpeter swan and a great variety of ducks which prefer the relatively calm waters of lakes, pond, and marshes found on many golf courses.

The next ACSP objective (Objective #3), aims at encouraging improved environmental awareness and the golf industry to take an active role in conservation. The Links of Spanish Bay in California is an excellent example of this objective. The site of Spanish Bay was once quarried for its white silicon sand, destroying the original native dunes, wetlands and abundant wildlife, leaving the site abandoned and unprotected from erosion and other disturbances. The development of the golf course provided the opportunity to reestablish the native dunes and wetlands, which are once again valuable habitat for wildlife. As we noted earlier, these areas of the site that were once eroding away are now designated critical nesting areas and protected by the golf course with signs. Another example of environmental awareness and active conservation is seen at Old Harsh, Florida. An unavoidable wetland crossing with a cart path was compensated for by the creation of additional wetland areas on site. This included the hand planting of many acres of marshgrass. Numerous other golf courses span wetlands with boardwalks which represents a protection/conservation action. Environmental awareness of the significance of these projects were greatly influenced by local naturalists that provided regional expertise for the proper implementation, and the reestablishment of valuable habitats. Active participation in conservation can begin on a much smaller level with the construction of nest boxes to help balance the loss of natural habitat suitable for nesting. Eliminating certain maintenance activities can also represent an active conservation efforts. This includes leaving edge habitats unmaintained and wetlands undisturbed, as is the case at Whitefish Lake Resort, Montana.

Our next objective (Objective #4) is to encourage a change in certain maintenance expectations in today's golfers. This refers to the tendency to maintain a manicured look from edge to edge of the golf course. Many courses want to mimic the images they see on television with respect to tournament play on a regular basis. This is unfortunate for this eliminates a significant amount of valuable habitat. Small changes to maintenance practices can mean big benefits to wildlife. I am specifically referring to the following:

A. Maintaining some portion of a pond/water feature with natural vegetation to provide important food and cover.

B. Maintain natural vegetation as a buffer to help eliminate excess nutrients or pesticides which can run into streams and ponds, influencing algae growth.

C. Bio-filters in swales instead of direct discharge of piped stormwater.

D. Native or naturalized shrubs in out of play areas, such as the back and side of tees or greens.

E. Preservation of natural understory of a forest interior.

Our 5th objective, the reduction of pesticides and willingness to accept a few brown spots or so-called weeds, once again asks the golf industry to look at the golf course from a different perspective than that presented by the media and TV championships. It is important to realize that the course we see on TV have been groomed and prepared for this one special event, in some cases many years preceding the event. What is not realized by many golfers is that even these courses and their grasses have dormant seasons, looking characteristically off color at one time. What is also not understood is that pushing the turf surface of the golf course to be constantly in peak condition opens opportunities for disease and pests and often results in the need for greater amounts of chemical assistance. One aspect of achieving this objective, lies in recognizing that the playing surface of the course must pass through normal cycles and cannot always be in peak condition. Use of wildflowers and native grasses addresses another aspect of achieving this objective to reduce pesticide usage. Native species are more adapted to local climates and problems, and have built in resistance to certain regional pest and diseases, therefore requiring fewer fertilizer, pesticide, and water applications.

The Audubon Cooperative Sanctuary Program provides a service of information and guidance to help in the achievement of the above outlined objectives. This Audubon program advises on various conservation projects referred to as "sanctuary achievement options" which are outlined below:

Audubon Program Sanctuary Achievement Options:

- Wildlife enhancement projects

  Cover

Food

Water

- Integrated Pest Management (IPM)
- Water Resource Conservation

A cover enhancement project can be as small as the construction of an artificial nest box project or as large as the reestablishment of acres of native grasses in out of play areas. It can involve a labor intensive project such as hand planting beach grass or a significant labor savings project by discontinuing mowing of out of play areas and discontinuing removal of understory from forested out of play areas. Establishment of native grass roughs encouraged to produce a seed head can represent a food source. A planting project of tree and shrub species which produce seeds, berries and buds, eaten by various wildlife species, represents a food enhancement project. Food enhancement can also be accomplished with supplemental bird seed feedings. Having bird feeding stations near activity areas is also beneficial to increasing a golfers' knowledge of the birds which share the golf course.

Water enhancement project can range from a small bird bath and source of drinking water to an extensive pond/water feature which can provide habitat to waterfowl. Ponds also provide habitat for a great number of other species (aquatic insects, amphibians, etc.) which are important to the food chain of many other upland birds and mammals.

Some wildlife enhancement projects, provide several elements important to wildlife survival at the same time. For example, the construction of a water feature provides water essential to all life as well as supports a food source. Both edge plants and aquatic plants once established can function as cover, food, and nesting areas. The four essential elements to wildlife, water, food, cover and space, can be provided in one water enhancement project.

Integrated pest management (IPM), is an agronomic term which has many different applications. The ACSP encourages IPM alternatives and strategies to minimize the risk of adverse environmental impacts associated with the use of pesticides and fertilizers.

Of particular interest to the Audubon program is the common sense approach

of seeking all alternatives to pest and disease control associated with IPM. Within this strategy, a course can encourage the nesting of insect eating birds (such as the purple martins, robins, bluebirds, bats and others) to help reduce pests on the golf course. Selecting plant material, adapted to the regional environment, results in plants that are more able to withstand environmental stresses and requires fewer chemical inputs to maintain survival in the landscape.

The last of the outlined ACSP Achievement Options or projects refers to water resource conservation. This refers to working towards reducing water usage on the golf course and looking at alternatives to the use of limited supplies of potable water. Recycled water or use of effluent water represents water resource conservation efforts. Irrigation of greens and tees only with non-irrigated native grasses on the balance of the golf course, is another example of water conservation. Implementing this type of project is directly associated with identifying a golfers' willingness to accept a few brown spots or entire fairways which have gone off-color during the normal dormant period of growth.

Participation in the ACSP is simple and involves two levels, they include:

1. Registration

   A. Complete application and send $100 fee.

   B. Fill out and return to NYAS Resource Inventory Form.

   C. Receive and review ACSP report.

2. Certification

   A. Develop "Plan of Action" appropriate for the golf course based on suggestions in ACSP report.

   B. Establish a "Resource Committee Representative" which has expertise to help in implementation of above plan of action.

   C. Submit slides or photos of completed achievement project and receive ACSP Certification status.

Details of the above registration and certification steps are outlined in the ACSP brochure. Brochures are available from the following contacts:

Ron Dodson
Audubon Society of New York State, Inc.
Hollyhock Hollow Sanctuary
Route 2, Box 131
Selkirk, NY 12158
(518) 767-9051

Nancy P. Sadlon
USGA
Golf House
P.O. Box 708
Par Hills, NJ 07081
(908) 234-2300

The Audubon Cooperative Sanctuary Program encourages the golf course industry to look at the golf course from a new perspective and find a way to improve it above and beyond traditional playability improvements. The ACSP encourages golf course managers to direct efforts towards improving the course's potential as a wildlife sanctuary.

MANAGEMENT OF NECROTIC RING SPOT IN THE PACIFIC NORTHWEST[1]

Gary A. Chastagner/Ralph S. Byther/Stanton E. Brauen/Gwen K. Stahnke[2]
William J. Johnston[3]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Plant Pathologist, Agriculture/Research Technologist II, Turfgrass Science Research Coordinator/Extension Program Coordinator, Extension Turfgrass Specialist, respectively, Washington State University Research and Extension Center, Puyallup, Washington.

[3] Assistant Professor, Department of Crop and Soil Sciences, Washington State University, Pullman, Washington.

Necrotic ring spot (NRS) was first reported in North America in 1982 and from the Pacific Northwest in 1984. Necrotic ring spot is found primarily on Kentucky bluegrass turf. Because of the similarity of symptoms between a number of different patch diseases, it is easy to confuse this disease with other diseases such as summer patch, fairy ring and Rhizoctonia yellow patch. In the Pacific Northwest during the late 1970's and early 1980's, NRS was commonly confused with take-all patch which occurs on bentgrass turf. The disease is found throughout Washington but is more prevalent east of the Cascade Mountains where bluegrass turfs are more common. The disease also occurs in Idaho, Oregon and British Columbia.

SYMPTOMS

Necrotic ring spot is most commonly seen in the Pacific Northwest on two- to five-year-old Kentucky bluegrass lawns established from sod, but has also been observed on seeded bluegrass turf. New outbreaks of NRS usually appear in late summer-early fall as small, circular, chlorotic areas with a thinning and/or dying of grass. The infected turf is easily lifted from the soil and both the roots and shoots of the plants eventually die, creating a dead patch. Microscopic observation of the roots and the bases of shoots reveal they are covered with dark strands of fungal mycelium, oriented mostly parallel to the root axis. Initially, patches are several inches in diameter, but can expand to form rings, arcs, or large patches up to several feet in diameter. Actively expanding patches generally have a border of reddish-brown turf. Weeds and unaffected grasses often invade the center of patches creating a donut-like appearance. Individual patches can coalesce to form large,

irregular shaped areas of affected turf.

CAUSAL AGENT

The fungus, *Leptosphaeria korrae*, causes necrotic ring spot on bluegrass turf as well as spring dead spot on bermudagrass turf. The fungus forms microscopic dark brown-to-black runner hyphae on the roots and lower crowns of infected plants. Black, flask-shaped fruiting bodies called pseudothecia are occasionally found on infected root tissues.

DISEASE CYCLE

Little is known concerning the life cycle of this organism. This pathogen probably survives as mycelium on roots during periods unfavorable for disease development. During conditions favorable for growth of the pathogen, it probably spreads from plant to plant by growing along the roots. Fruiting bodies have been observed in Washington during the fall. However, fruiting bodies are not commonly found and the role of ascospores in the spread of this disease is unknown.

DISEASE DEVELOPMENT

Growth of the pathogen and the development of necrotic ring spot symptoms are favored by mild temperatures. Although the fungus can grow at temperatures as low as 40 to 45°, the optimum, temperature for growth and disease development is 68 to 78°. Limited growth and disease development occurs at temperatures above 85°. East of the Cascades, the pathogen appears to be inactive during mid-summer and the symptoms can disappear on properly maintained turf only to reappear in the fall. Patch symptoms can persist through winter and early spring, and in some instances the pathogen is active during late spring and early summer. West of the Cascades, because of its generally mild temperatures, the disease can be active from spring through fall. If the turf has poor recuperative capacity, patches can be evident all year.

The growth of the fungus and production of fruiting bodies are also favored by moist conditions. Once the turf is infected, it can take 12 to 18 months for initial symptoms to appear. Depending on how the turf is being managed, the turf may completely recover and appear to be disease-free during periods when environmental conditions are not favorable to disease activity. However, if the turf is poorly maintained so that it has limited recuperative potential, symptoms that develop during periods of disease activity can persist on the turf for extended lengths of time.

CONTROL

Cultural and Nutritional

Management of NRS should consist of an integrated approach based on cultural practices which create conditions unfavorable to the disease, while at the same time favor the growth of the turf. Factors, such as site selection and preparation, variety selection, establishment method, fertilization, mowing frequency and height, water management, soil compaction, soil pH and thatch accumulation, need to be considered.

While the effect of specific cultural practices on NRS are largely unknown, practices which encourage deep rooting of the turfgrass during the spring and fall periods of root growth and preserve these well-developed root systems during the summer and winter are likely to minimize the damage caused by NRS. The following information outlines cultural practices that maximize good growing conditions for the turf.

Fertilization

A balanced fertilizer program includes three elements nitrogen, phosphorus, and potassium. East of the Cascades, use 4 pounds of available nitrogen per 1,000 square feet each season. Divide this into four equal applications (1 pound each) in April, June, August, and November. Improved Kentucky bluegrasses require more nitrogen. They can receive up to 6 pounds of available nitrogen per 1,000 square feet each season. Divide this amount into four or five equal applications. Have your soil tested to determine phosphorus and potassium needs.

West of the Cascades, use 1 to 1-1/2 pounds available nitrogen (with approximately 1/3 to 1/2 of the N in a slow-release form),

1/3 pound available phosphorus, and 1 pound available potash per 1,000 square feet at each application. The immediately available nitrogen should never exceed 1 pound in a single application.

The amounts can be supplied by 9-12 pounds of a 12-4-8 fertilizer or 11-16 pounds of a 9-3-5 mixture. Apply four times a year - November-December, April, June, and September. If you fertilize at the lower end of this rate, one or two additional applications of nitrogen alone at 1 pound per 1,000 square feet may be made between these dates for maximum turf density and color. If nitrogen is

applied in warmer summer months, either a slow-release fertilizer should be used, or a lower rate of soluble nitrogen (1/4 to 1/2 lb N) to avoid burning the turfgrass or producing an excessive flush of growth.

An application of 2-3 pounds of sulfur per 1,000 square feet per year will improve turf quality and help suppress diseases such as Fusarium patch. Elemental sulfur or the use of ammonium sulfate as the nitrogen source will supply this amount of sulfur. Applications of sulfur during hot weather (over 85°F) can result in severe burns to the turf.

Watering

Turf that tends to be watered every day whether it needs it or not is usually overwatered most of the time. Observations indicate that NRS can occur on turf that is overwatered as well as turf that is under moisture stress. A healthier turf results when adequate soil moisture levels are maintained through the growing season.

Thatch

Heavy thatch in the lawn can prevent water and fertilizer from reaching the roots of the grass and create a stress situation for a lawn. There does not appear to be any direct relationship between thatch development and the severity of necrotic ring spot, but every effort should be made to remove thatch when it becomes more than 1/2 inch thick. Selection of cultivars and proper management practices should help control thatch and improve the chance that the turf will recover when conditions for disease become unfavorable.

Clean Equipment

Since NRS i~ caused by a soil-borne fungus, it is unlikely that equipment such as mowers would be able to spread this disease. There is a potential that equipment that can move soil or infected roots, such as dethatchers and aerifiers, could spread this disease. Thus, to minimize the chance of spreading, this type of equipment should be cleaned before it is used.

Sod vs. Seed

Although NRS is most commonly observed on turf established from sod, it also can occur on seeded turf. Observations in the Pacific Northwest, north central and

northeastern portions of the United States indicate that symptoms of NRS are rarely seen on turf at sod farms under a normal rotation. However, NRS has been observed on some sod farms when turf is not cut and remains on the farm for a number of years. The key to minimizing the potential for NRS to develop on sodded or seeded turf is to buy high quality sod or seed of resistant varieties from reputable growers and suppliers.

Resistant Varieties

The use of mixtures of two or more grass species or two or more resistant varieties within a species should help minimize the potential for NRS to develop whether the turf is established using sod or seed. Perennial ryegrass and tall fescues appear to be resistant to NRS.

Greenhouse studies, primarily in New York, have shown that there is considerable variation in the susceptibility of bluegrass and fine-leaved fescue cultivars to this disease. Research at the University of Wisconsin has been directed toward evaluating the susceptibility of bluegrass cultivars to NRS under field conditions. Under field conditions in Wisconsin, limited disease developed on Adelphi, Majestic, Merion, Midnight, Mystic, Park, Vantage and Wabash bluegrass. Intermediate levels of disease developed on Baron, Eclipse, H-7, I-13, Merit, Newport, and N-535. High levels of disease have developed on Birka, Columbia, Georgetown, Glade, Haga, Nassau, Ram I, Sydsport and Trampas. Until additional information is available on the susceptibility of bluegrass cultivars to NRS, it is suggested that cultivars such as Midnight, Wabash, Park, Eclipse, Adelphi, and Majestic be used in an effort to minimize the development of NRS. Sod or packages of seed predominantly composed of susceptible cultivars should be avoided. Studies are currently in progress to determine the susceptibility of bluegrass cultivars to NRS under Washington conditions.

Melting out or Helminthosporium leaf spot can limit the use of Kentucky bluegrass in areas west of the Cascades. Of the varieties listed with some resistance to NRS, only Midnight, Eclipse and Majestic would have sufficient resistance to melting out to allow their use (without fungicide treatment) in these areas.

Fungicides

Extensive research has been conducted in the Pacific Northwest to determine the effectiveness of various fungicides in controlling NRS. Rubigan has been shown to provide effective control of NRS if it is applied during April or May. A

single application of Rubigan AS at 4 to 8 fluid ounces per 1000 square feet has been shown to be effective in controlling necrotic ring spot in a number of areas in the Pacific Northwest. Two applications at 4 ounces per 1000 square feet is no more effective than a single application at 8 ounces per 1000 square feet. Although very effective in reducing disease damage, the use of Rubigan, particularly at the 4 ounce rate, does not generally provide 100% control of NRS. Applications should be applied to the entire lawn, not just the spots. Applications of Rubigan also tend to result in a darker green turf and may reduce the growth rate of the turf.

Although not as effective as spring applications of Rubigan, research in other states has shown that Fungo 50W applied at 4 to 8 ounces per 1000 square feet and immediately watered in gives some relief of disease symptoms when applied during late summer during periods of disease activity.

It is important to remember that fungicides are only one part of a total disease management program. If fungicides are to be used, they need to be used according to label directions and in conjunction with proper cultural practices to maximize their benefits.

CAN WE MAINTAIN TURF WITHOUT SYNTHETIC CHEMICALS?[1]

Thomas W. Cook[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Associate Professor, Department of Horticulture, Oregon State University, Corvallis, Oregon.

What would happen if synthetic fertilizers, herbicides, insecticides, and fungicides were not available? Could we maintain acceptable quality turf without them or would our turf deteriorate into a hopeless weed patch infested with insects and riddled with diseases?

To be honest, I'm not sure I know the answer although my observations tell me that at least in certain situations we can do very well without synthetic chemical help. The logical areas for natural turf care include parks, schools, and residential sites. Commercial turf sites such as corporate centers and business parks seem like good choices but the quality needed for the professional image might be difficult to achieve. The least likely areas for completely natural turf care are probably sports turf areas such as golf courses, football and soccer fields, and professional quality baseball fields. My purpose with this paper is to explore some of the natural options available for fertilizers, weed control, disease control, and insect control in the Pacific Northwest states.

NATURAL FERTILIZERS

Based on work at OSU over the past six years there is no question we can produce excellent quality turf with natural base fertilizers. The key with natural fertilizers is the same as it is with synthetic fertilizers: put the right amount on the turf at the right time and turf will respond.

Whether we use feathermeal, dried poultry waste, dried blood, composted garden refuse, composted sewage sludge, or various mixtures of these components it takes about 2 lb N/1000 sq ft/application to give satisfactory green up. In the Willamette Valley of Oregon that translates to 6 - 8+ lbs of total nitrogen per 1000 sq ft per year on perennial ryegrass or Kentucky bluegrass to achieve dense green turf for most of the year.

Natural products tend to be weak early in spring (Feb-April) but provide excellent color and growth responses from summer through fall. Winter color is similar to that achieved by conventional fertilizer programs but response from winter applications is poor.

In our long term studies we have observed that the greatest differences are apparent in the first year with synthetic products generally rating higher. Differences in subsequent years are small and turf quality is essentially equal regardless of nitrogen source. The apparent exception is bloodmeal which typically out performs synthetic and the natural fertilizers when used alone.

We have been unable to demonstrate additional properties of natural fertilizers such as thatch and disease control. In one trial with Kentucky bluegrass "Enmundi" we applied nitrogen from synthetic and natural sources at 12 lbs N/1000 sq ft/year for almost three years. At the end of the test period we measured thatch and microbial activity. The results as indicated in Table 1 show all fertilized plots produced more thatch than the untreated check plot. Thatch depths among plots receiving fertilizer were similar for all nitrogen sources. Statistically the Chemlawn program (synthetic) produced less thatch than Ringers Restore (natural). Although there appeared to be a numerical trend towards higher microbial activity in plots treated with natural fertilizer there were no statistical differences.

Perhaps the weakest aspect of natural fertilizers is their low nutrient content. Natural products we have tested range from 3-12% nitrogen. Phosphorus and potassium levels generally range from 1-4%. Low analysis materials mean applicators have to handle a lot of bulk to get the job done. Most manufactured products run around 8-10% nitrogen which is about as low as they can go and still have a usable product.

Many natural materials are poorly granulated, dusty, and horrible smelling. As manufacturing processes improve I expect to see improved granulation, reduced dust, and better odor control. When that occurs producers will have a much better product for consumers to use. More "user friendly" is the term that comes to mind.

The bottom line is that natural fertilizers can produce excellent quality turf when used as part of an ongoing program of fertilization. Current products need better granulation, less dust, and better odor to be widely accepted. The threshold level of nitrogen in western Oregon for good turf response is 2 lbs N/1000 sq ft/application. Top quality turf will probably require (6-8+ lbs total N/1000 sq ft/year in western Oregon.

NATURAL WEED CONTROL

If you believe lawns should only be composed of grass then weed control without chemicals becomes a real challenge. Given available technology the best strategy is to maintain dense vigorous turf for as much of the year as possible. This requires regular fertilization, regular mowing, and regular irrigation. If fertility is low you can expect encroachment from clover. In most cases the hungrier the turf the greater the clover. If irrigation is inadequate you will see rapid encroachment from false dandelion and common dandelion. If mowing is inadequate more weed seed will be produced between mowings. You'd be surprised at how clean you can keep turf with good turf culture and periodic hand weeding. Unfortunately good culture won't eliminate weeds that are already in the turf. When weeds are present I usually resort to strategies such as vigorous vertical mowing just as clovers begin to flower followed by heavy fertilization with nitrogen to stimulate grass growth. In some cases slice seeding weak lawns with perennial ryegrass will further increase competition provided other cultural practices are upgraded as well.

Another approach and one we've been looking at for several years is to purposely plant grasses and selected broadleaf species together. The idea is to create a more stable ecosystem that is relatively uniform and visually attractive. We have considered many different components mixed with a variety of grasses and planted alone. My idea is that neither grasses or broadleaf plants will be stable if planted alone. In mixtures the grasses provide winter cover and fill in the gaps and the flowers perform best in the spring, summer and fall, providing both cover and floral display.

Our current mixes include common yarrow, Achillea milifolium, English daisies, Bellis perennis, Roman chamomile, Chamaemelum nobile, and strawberry clover, Trifolium fragiferum. We have also looked at white clover, Trifolium repens in the past. The most successful grass components have been perennial ryegrass, red fescue, and tall fescue. In Corvallis Kentucky bluegrass has also mixed well but it might be too competitive in other climates. Under our conditions colonial bentgrass has been too competitive reducing broadleaf components to isolated weedy clumps over a period of two to three years. Chewings fescue has also out-competed the flower components in as little as two years. Hard fescue is weak initially but over 3-4 years tends to out compete the broadleaf plants. The best grasses appear to be the least aggressive ones.

When we plant mixtures typically the grasses dominate the first year but by the second spring the broadleaf components look real strong. The flower cycle starts

in March with the lawn daisies which flower well until June. If present white clover starts flowering in mid to late June and continues through July. Strawberry clover flowers intensely from August through September in Corvallis. Because we mow regularly (i.e. once/3 wks) yarrow rarely flowers. Roman chamomile has not flowered in our trials but does contribute a fresh pineapple smell every time it is mowed.

Our intention in developing these mixes was to create a lawn that would be mowed, would not be fertilized, and would receive minimal irrigation. Current trials are mowed once every 3 weeks at 2" with clippings returned, and are irrigated once a month June through September. With this approach stands have remained stable, plots are green all summer long and we see a succession of flowers. Even without flowers the turf is uniform and provides a pleasant appearance.

To be sure this strategy is not for everyone. It definitely requires a change in perspective as to what constitutes a lawn. There may be a potential hazard created by the clover which definitely attracts bees. There is no guarantee undesirable weeds will not encroach or that the planted broadleaf plants will persist indefinitely. It is also likely that mixes will need to be very regional in order to persist. Finally, flower components are not cheap and costs will definitely be higher than straight grass seed mixes.

In spite of the pitfalls noted above I'm very optimistic that ecologically stable mixtures can provide acceptable ground cover. Planted in appropriate locations they can reduce if not eliminate the need for broadleaf herbicides on lawn turf. We are really just at the early stages with these mixes. In the future we may find many more highly desirable components to enhance appearance and utility.

NATURAL DISEASE CONTROL

From the perspective of homelawns, schools, and parks disease control is not a serious problem in the Pacific Northwest. Most diseases we deal with are cosmetic and not likely to kill or damage lawns severely. In the case of devastating diseases such as Necrotic Ringspot we have management and cultural options we can pursue to avoid having to deal directly with the disease.

The basic strategies for natural disease control that have evolved over time include genetic resistance, cultural management, and more recently biological controls.

Genetic Resistance - As busy as grass breeders have been in the last 25 years it seems inevitable that new cultivars would be developed with resistance to common turf diseases. Unfortunately it sometimes seems that we find new diseases almost as fast as we create new varieties of grass. The resistant grass you plant today may be tomorrow's susceptible grass. Still it makes good sense to carefully select grasses for turf that are as resistant to common diseases as possible.

In areas west of the Cascade mountains Red Thread Laetisaria.. fuciformis is one of our most common disease problems. You can make this disease problem bigger or smaller, depending on what grasses you plant. A mixture of perennial ryegrass and red fescue (regardless of varieties) will create a worst case scenario for this disease. By substituting hard fescue, Festuca longifolia for the red fescue you can significantly reduce the extent of disease development because hard fescues are relatively resistant to this disease.

In Table 2, I have listed commercial varieties of fine fescue in the 1983-87 national trial along with red thread resistance rankings. Keep in mind resistant cultivars are not immune to red thread. If you plant them you will see red thread but it certainly won't be as bad as it will be on other susceptible varieties.

Cultural Management

How you maintain your turf definitely impacts disease severity. The primary factors you can manipulate are fertilization, mowing, and irrigation. In addition you can modify the environment via design, pruning, and related activities.

Diseases such as stripe rust, crown rust, and red thread are most severe on grasses that are growing slowly. If you plant straight ryegrass and maintain it under low fertility you can expect to see rust and red thread. If fertility is adequate but turf is growing slowly from drought as it often does in western Oregon in the fall you can expect to see lots of rust. If you fertilize adequately but remove clippings every time you mow you can expect to see more rather than less rust and red thread. The real goal is to produce vigorous grass with minimal stress from drought or low fertility. If you do this and you have pure perennial ryegrass turf it will still get lots of red thread because perennial ryegrass is highly susceptible to this disease. Cultural practices may increase or decrease disease severity but will rarely eliminate either rust or red thread.

Some diseases such as Fusarium patch are strongly affected by cultural practices particularly fertilization and site manipulation. In general high nitrogen

fertility will increase Fusarium patch activity. Nitrogen source also affects Fusarium activity. Many years of research on bentgrass turf at WSU in Puyallup clearly showed that turf fertilized regularly with ammonium sulfate had less Fusarium patch disease than turf fertilized with straight urea. Milorganite (natural organic) also reduced disease when compared to urea.

In a homelawn situation with turf that is primarily bentgrass, Fusarium patch will often be worse in shaded areas or enclosed areas where dew hangs on turf for long periods.

10 Designing turf areas so air movement remains free and pruning to minimize shade may reduce Fusarium patch activity. Unfortunately bentgrass is susceptible to this disease and you can only influence its severity not whether it will occur.

There are many other interactions between disease and cultural practices which are beyond the scope of this paper. Suffice it to say that turf growing vigorously with adequate but not excessive fertility, with adequate but not excessive irrigation, with minimal thatch, under good site conditions, and mowed regularly within the optimum mowing height range for the grass will have less disease than turf maintained under extremes. It will still get diseases it is susceptible to but not as often or as severe.

Biological Control

In the ideal turf environment grass would be growing in its optimum pH range in a soil that had a rich and diverse micro flora and micro fauna. There would be balance between good and bad microbes. With optimum growing conditions turf would have few problems with disease. If we could improve microbial balance in less than ideal situations by adding organisms to the system perhaps we could control diseases. This makes for a nifty story but does it really work? In some cases the answer may be yes but we certainly don't have much to offer commercially at this point in time.

Manufacturers have long claimed that natural organic fertilizers control diseases. This is an easy claim to make but a hard one to prove via research. I haven't seen any good research that supports the claims of products currently on the market. Product claims are only as good as the other treatments they are compared to. I believe these people when they say they saw less disease but was this due to the overall turf cultural program which included optimum irrigation, thatch control, mowing, etc. or just due to the nitrogen source?

There is serious research being conducted using specific fungi that are antagonistic to common pathogens. Researchers in Canada and the U.S. have demonstrated that Typhula phacorrhiza can suppress development of gray snowmold caused by Typhula ishikariensis and Typhula incarnata (Burpee 1987). The next step is to produce a marketable product of use to consumers, one that will achieve acceptable levels of control over a wide range of conditions.

Biological control of turf diseases will very likely become an important part of disease management strategies. Unfortunately it may take a long time to come up with effective products for a wide range of common diseases.

NATURAL INSECT CONTROL

Biological Control

Biological control of insects in turf is one of the most exciting developments to occur in the last 20 years. Since New Zealand scientists (Prestidge et al 1982) reported an endophytic fungus was associated with resistance to Argentine stem weevil in perennial ryegrass researchers have scrambled to determine how and to what extent endophytic fungi confer resistance to insect pests. So far endophytes have been associated with insect resistance in tall fescue, perennial ryegrass, hard fescue, and Chewings fescue. Insects affected by endophytes include sod webworm, chinch bug and billbugs (Funk et al 1989).

Endophytic fungi are transmitted by seed where they grow adjacent to the aleurone layer. When the seed germinates the fungus spreads to the endosperm and then into the 12 developing seedling. Fungal growth appears to be intercellular. In mature plants, fungal growth has been observed in rhizomes, leaf blades, flower stems, and seeds. Apparently the fungus does not grow in roots.

Since endophytic fungi are seed borne they must be present in viable form at the time the grass is planted. Under normal conditions endophytic fungi will remain viable in seed for about 18 months. Under cold dry storage viability can be extended.

In the Pacific Northwest the role endophytes will play in insect resistance is not clear. Certainly where billbugs, chinch bugs, or sod webworms occur regularly they will be highly desirable. Where these insects are not consistent problems it's not clear what to expect. We also don't know much about the impact of endophytic fungi on our common insect problems such as European cranefly. It will take time

and more research to help answer these questions.

Cultivars of perennial ryegrass, fine fescues, and tall fescue reported to have high levels of endophytic fungal infections are listed in Table 3. Keep in mind that endophytic content will be highest in fresh seed that has been stored less than 18 months.

Other biological control strategies include bacterial parasites such as Bacillus popilliae which controls larvae of Japanese beetles and fungal parasites such as Beauveria sp. which attack Chinch bugs. We know very little about the value of these in the Pacific Northwest because of the absence of Japanese beetles as lawn pests and the sporadic nature of Chinch bug activity throughout the region.

Cultural Management

Because insect pressure is generally low in the Northwest cultural practices can go a long way towards minimizing insect damage. For example, Chinch bug damage can generally be avoided on vigorous turf that is irrigated enough to avoid drought stress. Lawns that are allowed to go dormant or are continually drought stressed during summer are often severely damaged by Chinch bug activity. In similar fashion turf that is vigorous and adequately fertilized will tolerate much higher populations of European cranefly larvae than weaker lawns under lower fertility.

SUMMARY

We are fortunate in the Pacific Northwest to have a climate conducive to growing healthy turf. Pest pressure is lower than in most other parts of the U.S. Intelligent turf culture utilizing adequate fertilizer, proper water management, thatch control, careful grass selection, and a healthy tolerance for pests on the part of users will produce acceptable turf with minimal need for pesticides.

REFERENCES

1. Burpee, L.L., Kaye, L.M., Goultry, L.G., and Lawton, M.B. 1987 Suppression of gray snowmold on creeping bentgrass by an isolate of Typhula phacorrhiza. Plant Dis. 71(1), 97-100.

2. Funk, C.R., B.B, Clarke, and J.M. Johnson-Cicalese. 1989. Role of endophytes in enhancing the performance of grasses used for conservation and turf. In

Table 1. Fertilizer Effects on Thatch Depth and Microbial Activity

after three years of treatments

Product	Analysis	N Source	lb N/ 1000/year	Soil pH	Thatch (mm)	Microbes*
Simplot	21-2-21	70% SCU	12.0	5.7	22.9	552
Ringers	9-4-4	Feathermeal	12.0	6.2	22.5	810
Chemlawn	Various	Urea, SCU	12.5	6.0	20.9	676
Check	----	----	----	6.4	12.3	670
LSD(.05)					1.6	344

* μg Formazan/10g soil/day

Table 2. Red thread resistance among fine fescues in the 1983 NTEP trial at Corvallis, OR.

Red Thread Ratings**		Red Thread Ratings**	
8.8	Reliant	7.4	Highlight
	Spartan	6.6	Wilma
8.6	SR 3000		Tatjana
	Waldorf		Enjoy
8.5	Ivalo	6.5	Shadow
	Biljart	6.3	Pernille
	Aurora	6.2	Jamestown
	Waldina		Koket
	Logro		Atlanta
8.4	Valda	6.0	Beauty
	Scaldis	5.8	Checkeranner
8.2	Bighorn	5.5	Longfellow
8.0	Pennlawn		Boreal
	Weekend	5.4	Estica
7.9	Epsom	5.3	Unknown
7.8	Tamara	5.2	Robot
7.7	Magenta	5.0	Lovisa
7.6	Wintergreen	4.8	Ensylva
7.5	Banner		Commodore
	Victory	4.3	Ceres
	Mary	3.9	Ruby
	Center	3.4	Flyer

** Red thread 1 = severe disease, 9 = no disease

Table 3. Grass cultivars reported to have high levels of endophyte infection

Perennial ryegrass	Pinnacle
All-Star	Prelude
Birdie II	Repell
Citation II	Regal
Commander	Sherwood
Cowboy	Sunrye 246
Dandy	SR 4000
Dasher II	SR 4100
Omega II	Hard Fescues
Pennant	SR 3000

THE TEN GREATEST SINS OF GOLF COURSE MANAGEMENT[1]

Larry W. Gilhuly[2]

---

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Western Director, United States Golf Association, Green Section, Lake Forest, California.

There are many positive aspects involved in the field of golf course maintenance. The ability to work outdoors with Nature, seeing the sun come up early in the morning while the dew is still on the grass and providing a healthy recreational benefit to a segment of the population are just a few of the many and varied benefits of working in the golf course field.

While there are many positives associated with golf courses, there are certainly a fair share of frustrations. In 1990, one of the agronomists with the USGA Green Section decided to poll the staff with the following question, "What are the ten greatest problems or sins in golf course management?"

The answers from this question were compiled and is the source of this presentation. You may find some of the answers surprising while others will be entirely predictable. However, it does provide a brief glimpse at the problems we all face in the golf course industry dealing with a demanding client (golfers) and the whims of Nature.

With the above in mind, the USGA Green Section staff provided the following results in descending order beginning with:

10. Equipment. Although this area is improving in the Western United States, it is very common to visit many golf courses and view old equipment or a lack of certain key pieces.

    For those of you who have not yet started a five or ten year equipment program, it is imperative to have this replacement in motion to provide continuity of equipment replacement. Since most private clubs change green committees and directors at a rapid pace, this document becomes extremely important in minimizing downtime, labor and parts replacement.

As a side note, we found many of the public golf facilities have more modern equipment than their private counterparts, yet their largest drawback is the next sin.

9. Labor. It is always amazing to visit golf courses that expect the conditions on the course to be equal to those found on television. Little thought is given to the amount of extra preparation required for television golf and the lack of these hours available at the local course.

   While standard numbers cannot be recommended due to the variety of facilities, every maintenance operation should have some amount of weekly manhours required for regular maintenance operations. These can then be compared directly with the maintenance requirements of the facility spacing to justify further additions in labor. Without this type of approach, the lack of labor will continue to be a problem at your course.

8. The amount of play. Essentially, there are four major pests on golf courses. Three, (weeds, insects, and fungus) can be controlled through various products. The fourth, golfers, can also be controlled in a variety of manners. Most importantly, the areas around greens and tees require permanent cart paths with curbing to direct all vehicular traffic. Near the greens, a distance of at least 3$ to 50 yards should become the demilitarized zone for vehicular cart traffic. The use of paint and signs along with good marshalling is the most effective and least disruptive, however, ropes are very effective in controlling traffic.

   In addition to moving vehicular traffic to permanent surfaces, foot traffic must also be controlled. In this manner, the best results can be achieved through ropes and intensified cultural programs in traffic areas around greens and tees. Increased aerification, fertilization, and overseeding continue to provide the best results when dealing with excess traffic.

7. Excess trees and tree management. There is no doubt that trees are an integral part of every golf course and must be included for several reasons. However, the planting of trees on the south side of greens and tees, or mass plantings of trees in key areas can only lead to turf loss or the requirement of tree removal in the future.

   In addition to placing trees in the wrong location different varieties are placed on golf courses that simply do not belong. Varieties that have

extensive aboveground root systems, susceptibility to wind and winter damage, poor disease tolerance, and high requirements for debris removal are examples of trees that should not be used on golf courses.

When selecting trees and their locations, use of the golf course superintendent, knowledgeable members that understand trees, and a trained arborist can reduce mistakes.

As a whole, most of the golf courses in the United States do not spend enough money for tree care. With some courses reaching $2 million or more in tree value, the amount of money needed to maintain this area of the course is inadequate. Regular root pruning, the removal of undesirable trees, and planting trees for the future needs to be improved throughout most of the West.

6. Pesticide storage and the maintenance building. This area has improved during the past several years with many new facilities being installed throughout the Western United States. However, there are still glaring examples of unsafe structures that provide inadequate storage for equipment, dirty and unhealthy work areas for mechanics, atrocious lunchroom and locker room facilities, and cramped offices for superintendents.

   Pesticide storage has improved, however, this is an area that we are all beginning to feel the squeeze of federal, state, and local regulations. If you have not addressed this issue thus far, it would be a very good idea to place this area at the top of the list for capital improvement within the next two years if problems currently exist.

5. Club official/green chairman continuity. This was a surprising response when compared to the previous categories. However, the lack of continuity in this key position is extremely frustrating for the golf course superintendent and a poor business practice. Imagine a multi-million dollar business changing the manager every year and still trying to produce a profit. Any company that operates in this manner will quickly find their company name listed under Chapter 11!

   As a general rule, the Green Section recommends terms of 3 to 5 years for the green committee chairman. The chairman does not necessarily need to be a member of the Board of Directors, yet he/she and the superintendent should attend all board meetings that relate to the course.

If your club is in a situation where this length of term is not possible, then make sure the upcoming chairman has at least 2 to 3 Years experience on the committee before becoming the chairman.

As a final note, at clubs that do operate in this type of revolving door policy, try to establish a long-range plan, or master plan, that is voted in accepted by the membership. In this manner, individual preferences can be eliminated and the golf course superintendent is provided a blueprint for positive change.

4. The use of pesticides. The maintenance facility and pesticide storage area potentially provide the highest risk to the environment. However, the public's perception is that golf courses are dumping tons of poisonous chemicals needlessly that will all filter into the groundwater, be consumed by adults and children and turn us all into a gelatinous goo.

   Unfortunately, perception is reality to many people and we are obviously in the midst of a battle to prove that golf courses are not bad for the environment. The USGA Executive Committee has devoted several million dollars to finding the true answers to these questions over the next five to ten years. In the meantime, as the users of pesticides and protectors of the golf course environment, every effort should be made to minimize pesticide and fertilizer usage while providing the type of standards desired by your membership.

   The use of slow-release fertilizers applied at frequent intervals will minimize nitrate leaching and the control of traffic will produce healthier turf to minimize weed encroachment and maximize turf growth. Establishing more natural areas on a golf course reduces water, herbicide, and fertilizer usage, thereby reducing the potential for environmental concern.

   The days of fighting the "environmentalists" should be over. Let us all attack this manner is a pro-active approach by doing everything we can to produce a quality product while using a minimal amount of pesticides and fertilizers.

3. East green speeds. This particular category was not surprising after viewing greens the past fifteen years. The standard recommendation from the Western Regional office of the Green Section is to maintain greens at a moderate level (8' 6") with smoothness the primary criteria. If the member-

ship wants more speed, it is the superintendent's job to make them aware of the problems, yet at the same time advance the speed as far as prudent. If possible, try to establish maintenance standards in writing that state the desired speed of the membership. In this manner, if disaster occurs, a document is available that details the decision to maintain extremely fast greens was based on membership desires, not the superintendents.

2. Overwatering. Our old friend, Poa annua, has a tendency to thrive in situations where there is ample water. Although some improvement has been noted in the past few years, the overwatering of greens, tees, and fairways continues to be seen on many courses. Quite often, it is the deficiencies of the irrigation system that are at fault. However, golfers must move away from the mind set of a totally green golf course and we must convince memberships that by reducing water applications the potential for environmental problems is reduced.

   By slightly raising mowing heights on greens, (especially in the winter) bentgrass can be promoted and drought tolerant ryegrasses and fescues can be promoted in fairways and roughs to the exclusion of Poa annua. By reducing Poa annua, we again reduce the potential for environmental problems.

1. Communication and public relations. How many of you have taken a course in public speaking? How many have attended a local hearing on an environmental issue or issues that will affect golf courses in the future? How many of you have called politicians when important votes are being contemplated in areas involving golf courses?

These are just simple examples of an area that the USGA agronomists felt is the weakest area of the golf course maintenance industry. Many of us do not know how to effectively speak to the media, the general public, our membership, or even the green committee. Every effort should be made by everyone in attendance that deals with golf courses to improve in this area. It is the perception of competency that we will be judged by those outside the industry. We, as a group, must show that the golf course superintendents and the golf course industry is wellversed in the problems of the environment, water usage, and providing habitat for animal life in urban areas. We cannot fight with our detractors or we too may end up with a similar situation as the logging industry in the Pacific Northwest. We need to invite environmental advocates that will listen onto our golf courses to explain the operation and ask for their assistance. We must show the public that we are serious

and we must document all of the positive attributes currently being conducted on the golf course for the environment and the establishment of habitat. We need more positive stories about golf courses, not more negative ones about course closures and environmental pollution.

Has the gauntlet been thrown down to those of you in attendance? You bet it has and it is now time for each and every one of you to pick it up on an individual and group basis and address these issues. You owe it to yourself and the industry you represent the game of golf!

GOLF COURSE MAINTENANCE FACILITIES[1]

Jeffrey L. Gullikson[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Golf Course Superintendent, Longview Country Club, Longview, Washington.

The new maintenance facility at Longview C.C. began as a slide presentation to the board of Directors in October of 1988. The purpose of the presentation was to point out the short falls of the current facilities. After the presentation, the board decided to tour the facility at the next meeting. During the Boards tour of the maintenance area, they saw for the first time a dangerous and desolated facility. The old facility consisted of four buildings; a main shop which housed some equipment, a repair area, lunchroom, and office; a fertilizer shed which contained fertilizer, seed, and some large equipment, including a diesel tractor; a large open shed where the majority of our equipment was stored; and a small storage shed. All four of the buildings were rotting and falling apart. The fertilizer shed was an extreme danger due to the explosive relationship diesel has with nitrogen. After the tour, the Board of Directors decided that Longview Country Club needed a new maintenance facility.

The first step I took in designing the shop was to visit other golf courses which had new or recently remodeled maintenance shops. While visiting these shops, I talked to the superintendents about their working conditions. This was done to get ideas for our shop and also to investigate any potential building code problems which were encountered by others. The shops and superintendents that I visited included; George Abel at Club Green Meadows, Alan Nielsen at Royal Oaks Country Club, Dick Fluter at Oswego Lake Country Club, Larry Proctor at North Shore Golf Course, Rick McCoy at Glendale Country Club, and Randy White at Everett Golf and Country Club. Longview Country Club is very thankful for the input they received from these superintendents. Their insights provided the foundation of our design.

After my visits to the other maintenance facilities, I drafted a proposed facility which included the highlights of the other facilities. The proposed plan also took into consideration the short falls of other facilities and the suggestions of the superintendents on what they would like to have in a maintenance facility. I then took this plan down to the city building department to get their input on the project. Items which were discussed, included building site, building size, zoning ordi-

nances, set backs, drainage runoff, handicapped access, traffic flow, parking, water and sewer needs, building use, fire protection, safety, and neighbors views. I also shared my drawing with all of the contractors in the club to get their input and advise. After I had collected all of the information from the superintendents, city officials, and contractors, I put the final plan together which was sent out for bid.

The plan called for a 120 X 60 foot metal building with 16 foot eves. Inside the shop is a large equipment storage area, a repair area, grinding room, parts room, mens and womens restrooms, a drying room, lunch room, and office. By having a high ceiling, a second floor could be added above the lunchroom, office, restroom, parts room and grinding room. This upstairs storage area measures 960 square feet and is an excellent storage area for irrigation pipe, sprinklers, drainage supplies, golf course supplies, and miscellaneous items. Also featured in the building are; oversized overhead doors which allow a tractor to pull a 5 gang mower into the shop; a drive thru repair area between the equipment storage area and outside; carpeted office and lunchroom; heat and air conditioning in the office, lunchroom, rest rooms, and parts area; a separate grinding room with a large exhaust fan and vacuum line; a two foot concrete sidewall at the base of the shop to prevent damage to the building; a large overhead crane in the repair area; air, and 220 volt outlets throughout the shop; and showers in both rest rooms.

In order to save money on the project, it was decided that the maintenance staff would install the water and sewer lines to and from the facility. In the beginning, this was to be done during the winter months when work on the golf course is slow, and the golf course labor is available. The soil which these lines were to be installed was initially thought to be clay, however the project was delayed until the spring and the clay turned to rock as soon as we began to dig. This over sight to re-direct golf course labor saved the club in excess of $100,000. However, the golf course conditioning suffered as a result of this decision.

Even with all of the preliminary work, the construction of the facility did not go as smoothly as planned. Items were added and deleted as the project progressed, the City of Longview changed their minds on what was required, contractors (all of which were members) were delayed in finishing up projects, and the members became anxious when the golf course conditioning began to slide.

In the end the project turned out well. The building and utility lines were finished before the rains came, the golf course recovered from the neglect, and the members were pleased with the final product. To celebrate the completion of the project, the maintenance staff sponsored an open house for the members. During the open

house, members could tour their new facility, visit with maintenance employees, and discuss past and future golf course projects, while enjoying free drinks and hors d'oeuvres.

In addition to the main shop, the new maintenance facility at Longview Country Club also includes a separate fertilizer/pesticide storage area, and a new equipment wash. The fertilizer and pesticide storage building was remodeled from the existing fertilizer shed in 1989. The newly remodeled building which measures 20 feet by 40 feet is separated into two sections which are divided by a solid wall. Fertilizer and seed are stored in one section which measures 30 feet by 20 feet, and pesticides are stored in the other section. Both sections have concrete floors, added insulation, separate heating and ventilation systems, and entrance doors.

The equipment wash rack at Longview Country Club allows equipment operators to easily wash off equipment and collect clippings. The wash water and clippings are then separated with the water empting into the sanitary sewer and the clippings remaining in the catch basin for removal. The equipment wash features a 24 foot long by 30 inch wide by 4 foot deep trench which is sectioned into two parts by a sheet of 3/4 inch plywood. The first 20 foot section is covered with metal grating which allows grass and water to flow freely into. The second 4 foot section is covered with a metal plate to prevent grass from entering. The principle of the grass/water separation is the flow of the wash water from the large section up and through a 4 inch pipe, which connects the two sections, and into the smaller enclosed section. Once the water is in the enclosed "separating area", it must travel up and through another 4 inch pipe before entering into the sanitary sewer line. The water in the sanitary sewer line must then pass through an oil/water separator. After passing through the separator, the water continues down the sanitary sewer system. While the water travels down the line the grass clippings are left behind in the large section of the wash rack. Removing the grass from the large section of the wash rack is accomplished with the use of a backhoe. In order to scoop out the grass, a 28 inch blade is attached to the end of the backhoe bucket. The bucket is then lowered into the trench to remove the grass. At Longview Country Club, the debris removed from the wash rack is mixed with soil and composted for further use on the course.

EFFECTIVE COMMUNICATION[1]

William B. Griffith[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Golf Course Superintendent, Veterans Memorial Golf Course, Walla Walla, Washington.

My part of today's presentation will focus on communicating with golf boards and golfers as costumers. I am currently the superintendent at Veterans Memorial Golf Course, an 18 hole municipal golf course, owned and operated by the city of Walla Walla. VMGC has a 500+ golf membership club for tournaments, handicappings, and weekly specialty groups such as the women's club. The golf club has a board of directors which acts as an advisory group to the city concerning the golf course. I attend each of their monthly meetings and give a report on the golf course as well as answer questions regarding golf course condition, upcoming projects, and listen to any input the golfers might have. In addition, this golf board has a facilities committee that meets monthly and I attend those meetings as well.

My interaction with this board has proved to be quite an educational experience and over the past four years has evolved into a very positive relationship. I would like to share with you some of the principals that I have learned in working with this group.

1. BE APPROACHABLE - When a golfer comes up to you with a question are you immediately on the defensive? Do you assume that the question is meant as a criticism and is attacking your character or capabilities as a superintendent? Have you heard and really understood the question or are you focused on the way in which the question was asked. We need to develop an open attitude so that our golfers will feel the freedom to ask questions and can express how they feel about course conditions.

2. BE non-defensive - Do you strike fear in the hearts of the golfers when they have a question or comment? Do you think that the best defense is a harsh offense? The reality is that they will quit asking you and tell everyone else of the problem or question.

3. FOCUS ON THE QUESTION - Many times golfers will ask a question in such a way as to accuse, ridicule, vent frustration, or criticize. It is very

important that we focus on what is being asked instead of the way it's being asked. We need to remember to respond to the question and that may take some patient searching beyond the surface. Often times our board members are asking questions that members have asked them and we need to be careful not to kill the messenger just because we don't like the message.

4. BE HONEST - Sometimes being honest means admitting that we are less than perfect, that we might not have all of the answers, and that we are not in total control (mother nature has a way of showing us that). People can usually tell when we are being totally honest and will respond positively to that honesty. In the long run being less than honest will catch up with you.

5. BE THE INITIATOR - When I report to the golf board each month, I make sure that I discuss any obvious problems that exist or that I might have heard about. I explain the problem, why it has occurred, and what we are doing to bring about a solution. If I don't address the obvious then they might assume that I am ignoring the problem and they will be sure to want to talk about it, usually in a negative way. When I address these things then I find their focus goes past the problem and on to the solution.

Most of the problems between golf course superintendents and their boards usually result from the board being frustrated that the super does not listen to their concerns, or will not talk through problems and/or suggestions regarding course conditions. Many times the board has asked the superintendent to do something that is nearly impossible or is not in the best interest in growing good quality turf. The superintendent, instead of communicating honestly with the board, puts on his bulls mask and simply says "it won't work". Don't think for a minute that open, honest, approachable, and self initiated communication will make you seem less professional in the eyes of your board and golfers, it will build a much better relationship with them and you will be perceived as being more professional.

ESTABLISHING AN ORGANIZATIONAL SAFETY AND HEALTH COMMITTEE AND AN ACCIDENT PREVENTION PROGRAM[1]

William B. Griffith[2]

[1] Presented at the 45th Northwest Turfgrass Conference, Coeur d'Alene Resort, Coeur d'Alene, Idaho, September 16-19, 1991.

[2] Golf Course Superintendent, Veterans Memorial Golf Course, Walla Walla, Washington.

All employers of 11 or more full-time, part-time, or seasonal employees in the states of Washington, Oregon, and Idaho are required, as part of an accident prevention program, to have a designated safety committee composed of employer-selected and employee-elected members.

Following are the State of Washington administrative rules pertaining to safety and health committees and accident prevention programs:

WAC 296-24-045 Safety and health committee plan.

(1) All employers of eleven or more employees, shall have a designated safety committee composed of employer-selected and employee-elected members.

(a) The terms of employee-elected members shall be a maximum of one year. Should a vacancy occur on the committee, a new member shall be elected prior to the next scheduled meeting.

(b) The number of employer-selected members shall not exceed the number of employee-elected members.

(2) The safety committee shall have an elected chairperson.

(3) The safety committee shall be responsible for determining the frequency of committee meetings

NOTE: If the committee vote on the frequency of safety meetings is stalemated, the Division's Regional Safety Educational Representative shall be consulted for

recommendations.

(a) The committee shall be responsible for determining the date, hour and location of the meeting.

(b) The length of each meeting shall not exceed one hour except by majority vote of the committee.

(4) Minutes of each committee meeting shall be prepared and filed for a period of at least one year and shall be made available for review by noncompliance personnel, of the Division of Industrial Safety and Health.

(5) Safety and Health Committee meetings shall address the following:

(a) A review of the safety and health inspection reports to assist in correction of identified unsafe conditions or practices.

(b) An evaluation of the accident investigations conducted since the last meeting to determine if the cause of the unsafe acts or unsafe condition involved was properly identified and corrected.

(c) An evaluation of the accident and illness prevention program with a discussion of recommendations for improvement where indicated.

(d) The attendance shall be documented.

(e) The subject(s) discussed shall be documented.

(6) All employers of ten or less employees and employers if eleven or more employees where the employees are segregated on different shifts or in widely dispersed locations in crews of ten or less employees, may elect to have foreman-crew meetings in lieu of a safety and health committee plan provided:

(a) Foreman-crew safety meetings shall be held at least once a month, or if conditions require, weekly or biweekly meetings shall be held to discuss safety problems as they arise.

WAC 296-24-055 Safety bulletin board. There shall be installed and maintained in every fixed establishment employing eight or more persons, a safety

bulletin board sufficient in size to display and post safety bulletins, newsletters, posters, accident statistics and other safety educational material. It is recommended that safety bulletin boards be painted green and white.

WAC 296-24-040 Accident prevention programs. Each employer shall develop a formal accident-prevention program, tailored to the needs of the particular plant or operation and to the type of hazards involved. The division may be contacted for assistance in developing appropriate programs.

(1) The following are the minimal program elements for all employers:

(a) A safety orientation program describing the employer's safety program and including:

(i) How and when to report injuries, including instruction as to the location of first-aid facilities.

(ii) How to report unsafe conditions and practices.

(iii) The use and care of required personal protective equipment.

(iv) The proper actions to take in event of emergencies including the routes of exiting from areas during emergencies.

(v) Identification of the hazardous gasses, chemicals or materials involved along with the instructions on the safe use and emergency action following accidental exposure.

(vi) A description of the employer's total safety program.

(vii) An on-the-job review of the practices necessary to perform the initial job assignments in a safe manner.

(b) A designated safety and health committee consisting of management and employee representatives with the employee representatives being elected or appointed by fellow employees.

(2) Each accident-prevention program shall be outlined in written format.

EDITOR'S NOTE

The following **Proceedings** papers, that were presented at the 45th Northwest Turfgrass Conference, were not submitted for publication:

MOTIVATING EMPLOYEES	Richard D. Akerman Northwest Landscape Industries
QUINCIOVAC-POSTEMERGENCE CRABGRASS/VERONICA/CLOVER CONTROL AND MORE	Stanton E. Brauen Research & Extension Center Washington State University
SPORTS TURF MAINTENANCE	Jon C. Hooper Grounds Maintenance Department University of Washington
SURFACE MANAGEMENT OF PUTTING GREENS	Thomas W. Cook Department of Horticulture Oregon State University
EFFECTIVE COMMUNICATION	David P. Jacobsen Farwest Equipment Company
TURF AND THE ENVIRONMENT	Thomas J. Hoogheem Monsanto Company

NORTHWEST TURFGRASS ASSOCIATION

P.O. Box 1367
Olympia, Washington 98507
(206) 754-0825