NORTHWEST TURFGRASS ASSOCIATION

Proceedings Of the 33rd Northwest Turfgrass Conference

Sept. 25 - 27, 1979
Admiralty Inn
Port Ludlow, Washington

James B. Beard

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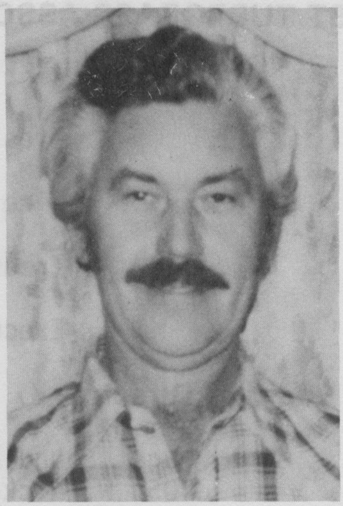

Welcome to Port Ludlow and welcome to the 33rd Northwest Turfgrass Association Annual Conference. Earl Morgan, Program Chairman, along with Tom Wolff and Roy Goss have worked closely to bring us a fine turf program. Dick Schmidt provided us with an excellent golf tournament and day of golf. Our thanks go out to all the others who have made this event a success.

The help this past year of the Board of Directors was exceptional and I want to thank each one for their interest and dedication in serving NTA. It has been a pleasure to serve as your President and I wish Earl Morgan the same support and cooperation that all of you have given to me.

Your Association grows as your support and activity in it grows. Please continue to voice your interest and your ideas to your Board members to make next year even better than the past. I urge you to support, in your way, the additional turfgrass research program which we are sure will come in the near future. Through active research, the Association's purpose and its functions can be better met.

Thank you for the opportunity of serving as President of NTA this past year and Good Luck, Earl, in 1980.

NORTHWEST TURFGRASS ASSOCIATION

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IMPORTANCE OF NEMATODES ON TURFGRASS IN THE PACIFIC NORTHWEST[1]

F.D. McElroy[2]

N. A. Cobb, an early nematologist, once remarked, "... if all the matter in the universe except the nematodes were swept away, our world would still be dimly recognizable ... we would find its mountains, hills, valleys, rivers, lakes, and oceans represented by a film of nematodes." The more we learn about nematode distribution the more we become convinced of the truth of that statement. Nematodes are found from the mountains to the seas, from the poles to the equator. Most of these nematodes are not harmful, but there are enough parasitic species around to keep man busy trying to solve the problems they create.

I have divided my presentation into four major areas. I will begin with a review of nematode biology and parasitic habit, followed by the importance of nematodes on turf outside the Pacific Northwest. I will then discuss diagnosis of turf problems and finally our current knowledge of nematodes in the Pacific Northwest.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Nematologist, Peninsu-lab, Kingston, WA.

NEMATODE BIOLOGY AND PARASITIC HABIT

Nematodes range in length from 0.3 to 2 mm and are thin and colorless. They possess a spear or "stylet" which they use to puncture plant cells to feed. There are two general catagories of plant parasites: those which live only in the soil and feed on the outside of the roots ("ectoparasites"), and those which enter the roots and foliage with their bodies to feed and destroy tissue ("endoparasites"). Eggs are laid either in the soil or in plant tissue. Once the eggs have hatched the larvae pass through a series of molts to become adults.

Nematodes cause damage to plants in many ways. Direct damage may result from feeding causing lesions, galling, and stunting of roots, which in turn causes yellowing, stunting and wilting of tops. Nematode feeding may also indirectly injure a plant by altering its physiology so that it becomes more susceptible to attack by other organisms, and may even break down resistance to those organisms. They may also serve as vectors of viruses and other organisms. The final result is a reduction in yield and/or quality of the crop.

NEMATODES CAUSING DAMAGE TO TURFGRASSES

There are well over 50 species of nematodes which are know to parasitize turfgrasses. However, the pathogenic capabilities of many of these species are not well defined. In certain areas of the United States tests have been carried out in the laboratory and in the field. The importance of nematodes on turf has been dramatically demonstrated. I will briefly review the nematodes studied and the types of damage caused, but I will confine my remarks to those species which may be of importance in the Pacific Northwest. Some species are of importance in the south and southeast but are unlikely to occur in our region.

One of the spiral nematodes (so named because of the "C" shape they assume when relaxed), *Helicotylenchus*, is widely distributed on turfgrass. It appears to be an important nematode in the northern regions of the U. S. Feeding commences in early spring as new root growth begins, and by summer the nematode has limited the roots to the top 1-2 inches of soil. Disease symptoms begin to appear with the onset of high summer temperatures and moisture stress. This nematode reaches extremely high numbers, especially in well aerated turf. Feeding of the nematodes results in cortical destruction leaving the vascular tissues exposed. Attack by secondary organisms causes browning and results in an inability of the roots to take up nutrients and water. This eventually results in a condition known as "summer dormancy" whereby the plants cease to grow even though they are well supplied with water and nutrients.

The lance nematode (*Hoplolaimus* spp.) is another widely distributed nematode associated with damage to turfgrasses. It is found in a variety of soil types and has been shown to cause severe stunting of certain grasses. In one study with bermudagrass it decreased growth by 50%.

The stubby root nematode (*Trichodorus* spp.) also has wide distribution. It feeds exclusively on root tips causing a reduction in root size with shorter rootlets, and stubby tips on the rootlets. It has been shown to cause as much as a 49% reduction in root weight and a 25% reduction in top weight.

The exact roll of the ring nematode (*Criconemoides* spp.) is less clear. It has been implicated as a parasite of turf in several areas. In one study high populations of this nematode were associated with chlorotic symptoms. Nematicide treatment resulted in correction of this problem and a significant increase in grass weight over the non-treated turf.

The importance of the stylet nematode (*Tylenchorhynchus* spp.) is also unclear. While it generally does not appear to be a problem in most areas, it has on occasion been associated with unhealthy turf. This situation was corrected when treated with a nematicide.

Damage caused by the root-knot nematode (*Meloidogyne* spp) is more easily determined under field conditions. Root symptoms may range from slight swellings at infection sites to larger galls or knots on roots. The nematodes actually enter the roots and once feeding has begun the females swell and are no longer mobile. These swellings cause stunting of the roots and tops. Some species may even cause extreme chlorosis and death of the plants.

The cyst nematode (*Heterodera* spp.) is similar to the root-knot nematode and also swells inside the root once feeding begins. However the majority of its body remains outside the root, and may be seen as a cyst on the root. Symptoms consist of overall reduction in top and root growth, and occasionally a distinctive interveinal chlorosis of the foliage, similar to iron deficiency.

Several other species of nematode have been found associated with unhealthy turf but their role in the cause of this condition is even less clear.

DIAGNOSING NEMATODE DAMAGE

This is not an easy task even when you know what you are looking for since the symptoms vary depending upon several factors. Symptom expression depends upon the kind and number of nematodes, type of turfgrass, various types of stress (e.g. drought, fertility imbalance, etc.) and may often be associated with a fungus or other disease problem. To further complicate the picture, the symptoms may come and go. Under conditions of stress, such as hot weather, moisture stress, or poor fertility management, symptoms will become evident. Once these conditions have become more favorable for plant growth the symptoms disappear, only to reappear with reoccurrence of stress.

Generally the above ground symptoms will appear as slight to severe chlorosis, stunting, loss of vigor, wilting, or general decline. These symptoms, of course, reflect what is happening to the root system and are typical of anything which hinders root growth. Therefore they are of little diagnostic value by themselves. Symptoms of nematode damage to roots may be any one or all of the following: absence of young, white feeder roots; shriveled, discolored, stunted, galled or slightly swollen roots; and/or root systems generally confined to the top 1-2 inches of soil. Even the top and root symptoms are not sufficient for positive diagnosis of a nematode problem. However, they are necessary preliminary steps which will enable one to determine if the third step of laboratory nematode analysis is necessary.

If a nematode problem is suspected, it is important to have an accurate diagnosis before applying any control measure. This is especially true in these days when high chemical costs and environmental protection are a concern. The most accurate diagnostic sampling is accomplished by collecting two samples, one from the good area and one from the margin of the poor area. The sample should not be taken from the center of the poor area as nematode populations will be lowest here and not reflect the true situation. Samples are best collected using a special probe made from a one-inch aerator tine. Fifteen to twenty cores from each of the good and poor areas should be collected separately and placed into plastic bags. If such a sampling device is not available, a standard cup-cutter may be used to collect one sample from each of the two areas. These two systems allow sampling of a green without causing any destruction. The third non-destructing method is to collect samples during the normal aerating process. Representative cores can be collected from the various areas making up a sample of about one pint each. This method also serves as a means of monitoring a potential problem green on a regular basis, (e.g. collecting samples once or twice a year). Always make sure the cores do not dry before placing them in the plastic bags, and send them in for analysis immediately.

CURRENT KNOWLEDGE OF NEMATODES ASSOCIATED WITH TURF IN THE PACIFIC NORTHWEST

In 1976 a limited survey of turfgrasses was carried out in southern British Columbia, Canada. Samples were collected from twelve different sites representing golf greens, bowling greens, and playing fields in the Fraser Valley extending from Chilliwack in the east to and including the city of Vancouver. The following nematodes were associated with unhealthy turf. Extremely high populations of the spiral nematode occurred in several locations and were generally associated with poor growth. At one site in particular it was associated with a golf green which failed to respond to treatment with fungicides for control of *Fusarium* patch disease. The roots of grass plants in the damaged areas were badly discolored and the plants failed to produce new growth above ground. In another case this nematode was associated with a golf green exhibiting symptoms similar to "summer dormancy" as described earlier.

Nematicide tests were set up on two golf courses. Four nematicides and one fungicide were applied either as granular or liquid formulations and watered in following application. Of the chemicals used (Nemagon, Vydate, Nemacur, Mocap, and an experimental fungicide RP 26019) Nemacur gave the most consistent control of the nematodes. Unfortunately the experiment was terminated before final evaluation could be made.

As many of you are aware a similar survey was carried out this summer with golf courses in Washington State. This was done through the cooperation of several turf managers, and the sample collection and disease evaluation carried out by Dr. Gary Chastagner at the WWREC in Puyallup. Two sample sites were selected for each green to be sampled, one from a healthy area and one from a poor growth area. Samples from each site on the green consisted of fifteen sub-samples collected using the special probe described earlier. Sampling tests carried out in B. C. proved this to be an accurate and non-destructive sampling technique for use on golf greens. Samples were sent to my laboratory for extraction and nematode identification. Three extraction procedures were used to obtain total recovery of nematodes and roots were examined microscopically to determine disease symptoms. Preliminary identification to genus has been carried out, and this winter slides will be made and nematode species determined.

Only thirteen greens representing eight golf courses (four east and four west of the Cascades) were included in this survey. Table 1 shows the ten parasitic genera found, the number of greens on which they were found, and whether or not they were associated with diseased turf. These findings are similar to those reported for B. C. with three notable exceptions: root-knot, stubby root, and lance nematodes. In fact, the occurrence of root-knot on turfgrass is a first report for Washington and B. C. All of the genera found have been previously reported to be pathogenic at one level or another on grass. Eight of the thirteen greens contained a combination of three to four parasitic genera, and two contained five parasitic genera associated with poor growth.

While this is a very limited survey, representing only thirteen greens for the entire State of Washington, it still gives enough information to indicate that nematodes can be a problem on turfgrass in this state and should be considered along with other pests in attempting to diagnose a problem. We are still unsure of the importance and distribution of nematodes on turf, especially on the west side, since our present samples only represent the Seattle area.

Before the full importance of nematodes on turfgrasses in the Pacific Northwest can be assessed we need at least two additional bits of information. We need samples from a wider area throughout the state to indicate the nematode distribution. Secondly, on selected sites showing these high populations of parasitic genera, we need to establish test plots using nematicides to attempt to bring the turf back into full production. With your continued interest and cooperation we should accomplish both of these in 1980.

Table 1. Nematodes associated with turfgrass on thirteen greens of eight golf courses in Washington in 1979.

Genus	No. of greens with genus	Association with diseased green
Criconemoides (Ring)	11	7
Helicotylenchus (Spiral)	9	4
Pratylenchus (Lesion)	5	2
Tylenchorhynchus (Stunt)	4	2
Paratylenchus (Pin)	4	0
Longidorus (Needle)	3	3
Meloidogyne (Root-knot)	2	2
Trichodorus (Stubby root)	1	1
Heterodera (Cyst)	1	1
Hoplolaimus (Lance)	1	1

GREEN IN ENERGY[1]

J.R. Watson[2]

I am pleased to have the opportunity to share this part of your program with John Monson. There is a need to review topics like "Green Is Energy" for energy is essential to our business. And we must take a leadership role in preserving our turfgrass areas; or, the green industry as we know it today may not survive. The energy crisis dictates that we make some changes in our thinking, our planning and our operations. The changes we need require a strategy, a plan of action.

I commend John for the work he has done and I commend Roy Goss and your program committee for their foresight in developing this program.

Green is energy. The truth, green plants convert the sun's energy into plant substances, some of which may be used to produce alcohol or "gasohol" as it's called when mixed with gasoline. But, I have not interpreted the title as a charge to discuss gasohol even though it is truly "green" energy. Rather, the title assigned says your program committee recognizes the existence of an energy crisis. I do, although I do not wish to discuss whether or not the world is rapidly running out of oil, as some people contend. We have an energy crisis even if only for the fact that it costs so much more today than just a few years ago. We can expect costs to continue to rise, probably at a faster rate than inflation overall, for everything used in turf management derived from petroleum: Fuel for

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] Vice President, The Toro Company, Minneapolis, MN.

powered equipment and to pump water for irrigation and for the fertilizers, herbicides and pesticides that are made from petroleum, petroleum based products, or natural gas.

The turfgrass industry as we know it today will not survive if one of two things or both should happen:

Number one: Energy will become so costly no one will be able to afford to spend the amount necessary to maintain turf. Currently it is estimated that fuel costs make up only 2-4 percent of the total operating budget for most turf facilities. What happens if that escalates to 10-15 percent?

Number two: Energy will become so scarce, for whatever reasons, that it will be rationed and turf maintenance will be given a very low priority.

Either, or both, of those two things could happen, totally, or enough to have an adverse effect on the turfgrass industry.

I submit that we must -- and I emphasize must -- take steps now to minimize the consequences of either of those two possibilities. Essentially, there are three things we must do:

1. We need to convince everyone -- in our community, our state, our region, our nation and the world -- that what we do -- protecting, caring for, improving and expanding the verdant landscape -- is important work.

We know it is important. We know the vital role that green spaces play in our lives. That message needs to be repeated everywhere until everyone understands it. We, as an industry, simply do not articulate our importance to the public -- we talk to each other rather than to others!

2. We need to adopt management practices that will reduce energy use. And develop grasses that require less water, less fertilizer, and less mowing, and are more resistant to disease producing organisms, along

with equipment that will cut or spray more acres per man, and cost less to operate.

3. We need to become more assertive in representing our industry before the legislative, regulatory and administrative branches of our governments, at all levels: municipal, state, and federal. We need to let them know who we are, what we do and why we are concerned about turfgrass management. We can contribute, and we should, to the body of knowledge that will form the basis for legislative decisions affecting energy.

We should play a far more significant role than we have in influencing government action. We should help bring about sensible management of our energy and water resources to accomplish, among other things, avoidance of piecemeal panic restrictions when shortages occur. And, it's my personal opinion that the U.S. should have done a great deal more to establish and to expand the recent trade arrangement with Mexico to gain some security from Mexico's newly discovered oil reserves.

Maintenance practices, as John has ably discussed, can have a tremendous impact on energy use. There are a number of practical steps that will help reduce energy consumption for turf maintenance. Among them:

* Select the most efficient piece of equipment for each job. Generally, reel mowers are more efficient than rotary or flail mowers. The scissors action of the reel mower not only cuts better but requires less power, consequently consumes less fuel. With the same mowing speed, reel mowers will use up to 50 percent less fuel per acre of grass than a rotary. Maintenance of today's reel units may be more expensive than for rotaries, but that could change.

Keep in mind that the number of blades in a reel not only affects the quality of cut, but also the fuel consumption. A five-bladed reel will use eight to twelve percent less power and fuel than a six-bladed reel.

* Use diesel fuel, rather than gasoline. Diesel fuel generally costs somewhat less than gasoline but more importantly the diesel engine has proved itself to be from twenty to twenty-five percent more efficient than the gasoline engine. This means fewer gallons to perform a given task.

* Allocate more funds for higher capacity, labor-saving equipment. Attack the largest part of your operating budget -- labor. In most cases it represents some 65-70 percent of the budget.

* Keep equipment clean and properly adjusted. It will require less power and therefore less fuel. Proper adjustment of belts, bearings, chains and shafts can reduce the friction within the machine and deliver more power for work output. Frequent lubrication of vital parts also will reduce friction.

* The tire pressure of any machine should be maintained at proper levels to reduce the rolling resistance.

* With reel mowers, the bedknife adjustment is critical.

The proper maintenance of the vital parts of any machine is important not only to conserve fuel but also to extend the functional life span of the machine. No part of the machine is as critical as the engine for achieving fuel economy. Just as with an automobile, a properly maintained, well-tuned engine can conserve fuel. Several steps that should be followed concerning the engine include adjusting the carburetor to provide maximum fuel-to-air ratio. Checking the ignition system to insure clean points and plugs, and timing to provide maximum power. The engine air cleaner is crucial. A clogged air cleaner can change the air-to-fuel ratio and use excessive amounts of fuel. Proper adjustments and maintenance in the combustion chamber are important to extended engine life.

*Mowing practices also may be a means of saving fuel.

Some examples:

. . plan mowing patterns that require the least amount of transport between locations.

. . use the least amount of overlap consistent with the skills of the operators -- when did you last hold an operator training program?

. . where possible, eliminate mowing steep slopes and non-play areas.

Equipment-manufacturers must design and make available equipment that will be less costly to operate -- and easier to maintain. Among other things we need to reduce the number of parts and make more parts interchangeable. We need to reduce weight.

Let me discuss a new fairway and large turf area mower my company released for sale in early 1979. I believe it serves to illustrate the trends you can expect from major manufacturers in the future.

Development started on this unit in early 1975. It resembles our current unit, but in actuality is all new. Some of the things of interest:

. . It is an all-hydraulic seven gang reel mower.

. . More than 80 percent of its components are interchangeable with other Toro machines.

. . All seven reels have the same parts number.

. . All seven hydraulic motors have the same parts number.

. . There are forty-four different hoses that have only seven different parts numbers.

.. It can mow up to nine acres per hour.

. . Reversible reel motors allow backlapping on the machine to reduce sharpening frequency and permit the operator to clear the reels without leaving the driver's seat.

. . The safety interlock system cannot be by-passed and it serves an important additional function as a trouble-shooting device.

. . Each reel unit weighs 110 pounds less than our wheel-driven gang mower units.

I submit that all of these features are reflective of a very advanced state of the art for our industry.

To achieve energy conservation all facets of the industry must work together. We must speed the normal sequence of events; we must make things happen, not wait for them to happen or evolve normally. We are not living in "normal" times and we must learn to conserve our energy at all levels to insure energy for our green areas.

Many, in fact most, of the points I've touched on are probably not new to you. For the most part all of us have been acting very much like the old farmer who was visited by a young county agent he had never met before.

The county agent was armed with pamphlets and literature and his mind was brimming, of course, with all the latest ideas on good farming practices. The old farmer looked at him. Moved his chaw from one cheek to the other, then said, "Young feller -- before you start -- just remember I ain't farming half as good as I know how." And, in a way, turf management is a lot like farming, only more so.

We've got to start managing like we know how or the turfgrass industry -- may not survive -- the coming energy crunch.

Thank you.

EDUCATIONAL OPPORTUNITIES IN TURF AT OSU[1]

Tom Cook

Students interested in turf and landscape maintenance at OSU should major in horticulture and select the management option under the landscape curriculum (see attached curriculum outline). For the most part this provides a good general background in plant and soil science and the opportunity to concentrate on specialty courses including turf and landscape maintenance and design. Instruction in turf maintenance is variable depending on student interest but the following list includes potential coursework students might take:

1. HORT 314 Principles of Turfgrass Maintenance

   An introductory course stressing turf I.D., growth and development, stress tolerance, mowing, fertilization, pest control, and soil modification. Lab involves greenhouse and field exercises in establishment, identification, etc.

2. HORT 417 Advanced Turf and Landscape Maintenance

   Interpretation of maintenance principles for use in maintenance programing, writing maintenance specifications, budgeting, estimating maintenance bids, etc. Also considered are specific industries such as sod production, athletic field maintenance, chemical lawncare, etc.

   Labs include field exercise and field trips.

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

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

3. HORT 405 Reading and Conference

   Golf Course Maintenance
   Detailed look at golf course maintenance including structure of clubs and analysis of current maintenance techniques such as topdressing, aerification, mowing, fertilization, disease and weed control, and construction and maintenance of tees and greens. Labs involve field trips to golf courses.

4. HORT 405 Reading and Conference

   Students with special interests may formulate their goals and pursue them via reading and conference. Examples of past projects include budget surveys and a variety of student research projects.

Potential students should consider several factors before entering our program. First, during the initial two years coursework is general and will not normally include courses specific to turf or landscape maintenance, so bring lots of patience. Second, most of your time at OSU will be spent in the classroom. Therefore you need to supplement classtime with lots of work experience (hopefully with more than one superintendent). Third, if you go to a community college for your first two years, take lots of basic courses such as chemistry, math, etc., since these are the classes you need before beginning horticulture classes. Also many applied courses at a community college will not transfer to our program. Finally, if you are out of state remember that tuition is prohibitively high so your best bet is to move to Oregon, establish residency and then apply for admission as a resident. Make sure you check with the registrar at OSU to determine current residency requirements first.

Prospective students should direct correspondence to:

Office of Admissions
Oregon State University
Corvallis, Oregon 97331

1979-80
Horticulture
Landscape Curriculum

Designed for students wishing to pursue careers in landscape construction and maintenance. Consult advisor concerning the specialized options in landscape and turf maintenance or design and construction. (*This denotes the suggested year that the class be taken in proper sequence, 1-Freshman, 2-Sophomore, 3-Junior, 4-Senior). Check catalog for prerequisites.

UNIVERSITY REQUIREMENTS

a) Complete 192 term hours; b) 60 upper division hours; c) 36 hours in major (Agriculture), 24 must be upper division. (Certain courses are specific requirements for University and School or School and Department; they will be listed on the curriculum only once.)

Class	Code	Term Hours	Year	Comments
English Composition	Wr 121	3	1	
PE Activity Courses	PE	3	1	
Humanities and/or Arts		12		This requirement is fulfilled by ALA courses required by Dept. of Horticulture.
Social Science		12		

Approved Undergraduate Courses:
- Anthropology
- Psychology
- Geography (Geog. prefix)
- Sociology
- Political Science
- Economics

SCHOOL OF AGRICULTURE REQUIREMENTS

Communications

Approved Electives 6
- Writing - Wr 214,222,224,233,234,235,316,323,324,327
- Journalism - J 111,212,223,317
- Speech - Sp 112,113

Full-year sequence of a first-year language.

Pass Comprehensive English Exam (Wr 230 may be taken in lieu of, but not for communication credit)

Physical Science

1 year general chemistry (Specified by Dept. of Horticulture).
One of the following series:

Class	Code	Term Hours	Year	Comments
General Chemistry	Ch 104	5	1	
	Ch 105	4	1	
	Ch 106	4	1	
General Chemistry	Ch 201	3	1	
	Ch 202	3	1	
	Ch 203	3	1	

Additional year of physical science (Specified by Dept. of Horticulture)
(See options under Dept. requirement)

Biological Science

1 year biological science required (Specified by Dept. of Horticulture)

Class	Code	Term Hours	Year	Comments
General Botany	Bot 201	4	1	
	Bot 202	4	1	
	Bot 203	3	1	

Mathematics

Class	Code	Term Hours	Year	Comments
Trigonometry	Mth 102	4	1/2	

DEPARTMENT OF HORTICULTURE REQUIREMENTS

Following are the common core requirements (required for all students in either landscape option)

Horticulture Courses Required:

Class	Code	Term Hours	Year	Comments
Horticulture Principles	Hort 201	4	2	
Horticulture Principles	Hort 202	4	2	
Plant Propagation	Hort 311	4	2	
Principles of Turfgrass Maintenance	Hort 314	4	3/4	

Class	Code	Term Hours	Year	Comments
Horticulture Courses Required: (Cont.)				
Principles & Practices of Landscape Maintenance	HORT 315	4	3/4	
Horticulture Seminar	HORT 407	1	(Every fall term)	
Internship	HORT 410	6	Between Jr. & Sr. Year	
Other Agriculture Courses Required:				
Soils	Sls 210	5	2	
Sprinkler Irrigation	AET 326A	3	3/4	
Three terms of the following:				
Woody Plant Materials	*ALA 326	3	2	*Counted as Agriculture hrs. for landscape students only
	ALA 327	3	2	
	ALA 328	3	2	
Herbaceous Plant Materials	HORT 355	3	2	
Biological Science Required:				
Plant Ecology	Bot 341	4	3	
Physical Science Required:				
Plane Surveying	CE 226	3	2	
Humanities and/or Arts Required:				
Graphics	ALA 111	3	1	
Landscape Design Theory	ALA 280	3	2	
Landscape Design I	ALA 290	3	2	
	ALA 291	3	2	
Landscape Construction	ALA 359	3	3	
Business Requirements:				
One of the following:				
Financial Manag. Acctg.	BA 211	4	2/3	
(OR)	212	4		
Basic Acctg. & Fin. Analysis	BA 217	4	2/3	
One of the following:				
Business Law	BA 226	4	3/4	
Real Estate Law	BA 414	3	4	
Management Processes	BA 302	4	3/4	

In addition to common core requirements students in landscape horticulture must select and complete the requirements of one of the following:

Landscape and Turf Management Option

Agriculture Courses Required:

Weed Control	CrS 418	5	4

One of the following:

Nursery Management	HORT 361	4	3/4
Advanced Turf & Landscape Mgmt.	HORT 417	4	4

Biological Sciences Required:

Entomology	Ent 311	4	3/4
Plant Pathology	Bot 350	4	4

Physical Sciences Required:

One of the following:

Organic Chemistry	Ch 226	3	2
Organic Compounds	Ch 213	4	2

At least 1 elective from the following:
AET 211, AE 356, G 200 or G 201, CH 227, Ph 201

Recommended Electives (Students must select at least 12 hours from the following list of courses, including at least 1 upper division agriculture course) Consult advisor concerning other accepted electives.

Agriculture Courses:

Engine Theory and Operation	AET 312	3
Land Drainage	AET 319	3
Soils and Land Use	Sls 321	4
Soils and Fertility	Sls 324	4
Controlled Environ/Crop Prod.	HORT 351	4
Plant Nutrition	HORT 416	4

Biological Science

Plant Physiology	Bot 331	5
Bio-Chemistry	BB 350	4

Humanities and/or Arts

Landscape Construction	ALA 360	3
	ALA 361	3
Plant Composition	ALA 426	3
	ALA 427	3
	ALA 428	3

Business

Organizational Behavior	BA 361	4
Personnel Management	BA 467	3
	BA 468	3

Landscape Design and Construction Option

Physical Science Required:

At least two of the following:
AET 211, AE 356, G 200, or G 201, Ph 201, 202, Ch 226, 213

Humanities and/or Arts:

Landscape Construction	ALA 360	3
	ALA 361	3
Plant Composition	ALA 426	3
	ALA 427	3
	ALA 428	3

Recommended Electives (At least 15 hrs, including 2 upper division courses in Agriculture. Consult advisor concerning other accepted electives.)

Agriculture Courses:

Land Drainage	AET 319	3
Soils and Land Use	Sls 321	4
Nursery Management	HORT 361	4
Adv. Turf & Landscape Maintenance	HORT 417	4
Weed Control	CrS 418	5

Biological Science:

Entomology	Ent 311	4
Plant Physiology	Bot 331	5
Plant Pathology	Bot 350	4

Humanities and/or Arts:

Landscape Design II	ALA 390	3
	ALA 391	3
	ALA 392	3
Landscape Design III	ALA 490	3
	ALA 491	3
	ALA 492	3

Business:

Organizational Behavior	BA 361	4
Personnel Management	BA 467	3
	BA 468	3

TURFGRASS DEGREE EDUCATIONAL OPPORTUNITIES IN THE PACIFIC NORTHWEST - WASHINGTON[1]

J.C. Engibous[2]

It is a real pleasure for me to attend and participate in the 33rd Northwest Turfgrass Conference. Certainly the setting here at Port Ludlow ought to be pleasing to anyone, but I am referring more to being here to respond to your question about educational opportunities for students interested in turfgrasses and their management. I'm sure Ron Ensign and Tom Cook share my enthusiasm for the opportunity to give you some insight into the problems and opportunities facing the universities in training people for your industries.

Let me begin by turning the problem around, and stating what I think your expectations of a college graduate to be. We first have to make an important distinction, that between common sense and knowledge. A college degree does not guarantee common sense; common sense is almost an inborn trait that can be developed through education and experience. Knowledge is what we offer to the serious student in the university which, combined with a reasonable amount of common sense, makes that individual a productive member of your team.

The second major point I want to make is that we cannot, in a four year experience with a student, provide him with all the answers to every problem in a manner so deeply ingrained in his mind that he can

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

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

instantly give the right answer. I am sometimes chagrined when I visit with people out in the agricultural industries and find them critical of the new college graduate because he didn't have the equivalent of a Ph.D. degree in agronomy, soils, insect identification, fungicide use, financial management, purchasing and janitorial services. It took years of experience for each one of you to achieve this level of wisdom, and it is unreasonable to expect a new college graduate to match your performance immediately.

Let us quickly examine what faces the college student who brings his high school diploma and college aptitude test score to Washington State University. Let us assume he is one of the lucky ones, and already knows he wants to pursue a program revolving around turfgrasses and turfgrass management. I say one of the lucky ones, because he will not waste time in the wrong courses. Why this is important will become obvious as I unfold his experiences at WSU.

Because turfgrass falls in the Department of Agronomy and Soils, our student must meet the core course requirements in Agronomy. He must then meet the other core course requirements for a university degree. Since he does not want to be a general Agronomist, but a turfgrass expert, he must take certain required courses relating to the turf management option. He is then free to take whatever other courses he likes, provided those courses are open to him. The core program for any Agronomy student includes seven courses: crop growth and development; crop identification, grading and marketing; weeds; plant breeding; physiological crop ecology; seminar and special problems. The unversity requirements (GURs) represent a total of 14 courses. These include introductory plant physiology, general genetics, soils and general plant pathology. Add on agricultural entomology (or general entomology), biometry, economics (or economics in agriculture). Our student is coming along fine. Now he can work in communications, speech and humanities elective. No turfgrass expert would be complete without 2 courses in introductory biology or intermediate botany and a math course. And finally, he needs introductory chemistry and chemistry related to man (or principles of chemistry) and the double whammy called elementary organic chemistry.

Remember, I said that takes care of Agronomy and the general university requirements. Now he wants to specialize in the curricula options of turf management under the technical group. We lay eight more courses on him at this point. They are turfgrass culture, forage crops, special turf problems, basic landscape designs, turf irrigation systems, principles of management and organization, and principles of applied entomology or plant pest control or diseases of plants.

Where are we after all of this? The core requirements total 16 in Agronomy, 75 for the university, and 18 for the turf option, totaling 109 credit hours. In order to graduate, his record must total 120 hours; this means he has 11 free hours, or 3 to 4 courses of his own free will and choosing. So you want to know why he can't balance a ledger or understand simple elements of business law. There are so many students majoring in business on our campus that such courses are rarely open to students from other colleges. There is also the problem of scheduling classes that compete on the daily calendar. College students, like everyone else, can only be in one place at one time.

My bottom line message boils down to this. The serious student who comes to WSU with the combination of a good high school record, maturity and common sense, is given a tremendous opportunity to equip himself to be an excellent addition to your industries, and greatly increase his earning potential over his career. Most of our students fill that category. Let me assure you that the student unrest days are over, and the college population today is a serious, studious group. If you help us to recruit students, provide the career opportunities, and I mean by that, interesting work, reasonable working conditions and adequate compensation for these students, we will deliver the product that you need.

ACADEMIC OPPORTUNITIES IN TURFGRASSES IN IDAHO[1]

Ron Ensign[2]

The opportunities for academic training in turfgrass sciences are offered in the Department of Plant and Soil Science as a part of the Landscape Horticulture option. This option is for majors interested in professional carrers in the management and operation of commercial nurseries, greenhouses, parks, golf courses, and related industries.

The courses offered for study, other than the basic University and College of Agriculture requirements, are largely science oriented and are not practicum type courses. Each student in the Landscape Horticulture option is required to take a minimum of 132 credit hours of course work which requires eight (8) semesters or four (4) years. About one-fourth of our 125+ students in the department are in this option. The balance of the students are in the Crop Management, Soils and/or Plant Science curricula options.

Some undergraduate students are also permitted to take Special Problem courses during their senior year. Such courses are assigned by the major professor and the students are asked to study special assignments of their interest.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA September 25-27, 1979.

2 Professor, Plant and Soil Science Department, University of Idaho, Moscow, ID.

In addition to these undergraduate educational opportunities, the University of Idaho offers graduate training at the Masters of Science level. The advanced courses depend on the interest and career direction of the students. Thirty (30) semester hours, including a thesis, are required. This degree requires about two (2) full academic years.

The University of Idaho, College of Agriculture is the only institution of higher education in Idaho that offers a complete four-year educational program leading to a B.S. degree in turf related subjects. Two year programs are offered at Boise State University and Ricks College in Landscape Construction - Maintenance and Landscape Nursery, respectively.

In addition to the above academic program the University of Idaho offers special workshops and short courses in plant pesticides, irrigation, soils, horticulture and other topics through the Cooperative Extension Service and Continuing Education. Also, Extension Specialists and Extension Agents conduct special training sessions, arrange for special meetings and educational tours and field days on various areas of interest in the state. Educational materials are distributed through the Extension Service on many areas of crop and soil management, including turf. A wide source of information is available not only from Idaho scientists but from scientists from throughout the U.S.A.

The recommended courses for students in Landscape Horticulture are:

Course	Title	Credits
Plant Science 102	Introduction to Plant Science	4
Plant Science 104	Plant Science Laboratory	1
Plant Science 201	Turfgrass Science and Culture	3
Plant Science 305	Introduction to Plant Pathology	3
Plant Science 338	Weed Control	3
Plant Science 464	Ornamental Plants & Their Management	3
Soils 205, 206	General Soils and Lab	4
Ag. Mech. 315	Irrigation and Drainage	3
Landscape Arch. 288	Plant Materials	3
Landscape Arch. 387	Park and Recreation Planning	3
Landscape Arch. 388	Plant Materials	3
Biol. 201	Introduction to Life Sciences	4
Biol. 203	General Botany	4
Bot. 241	Systematic Botany	3
Bot. 311	Plant Physiology	3
Chem. 103	Introduction to Chemistry	4
Chem. 275	Carbon Compounds	3
Chem. 278	Organic Chem. I Lab	1
Biol. Chem. 380	Introduction to Biochemistry	4
English 103	Basic Skills for Writing	3
English 104	Essay Writing	3
Entomology 322	Economic Entomology	3
Genetics 314	General Genetics	3
Also		
Agricultural Electives		16
Advanced Writing Electives		3
Business and Accounting Electives		6
Communication Electives		2
Humanities and Social Sciences		14
Mathematics Electives		4
Physical Education		2
Unrestricted Electives		14
	Total	132

CONTRACT LAWN CARE[1]

Rodney L. Bailey[2]

I appreciate this opportunity to speak to you today about contract turfcare and to bring you up-to-date on what is developing in the industry. Unfortunately, there has been little participation here at the Turf Conference by people from the contracted services segment of the industry and there should be a great deal more.

With the post World War expansion of industry, commercial establishments, golf courses, cemeteries, public parks and estates of the wealthy came the involvement of the institutionalized lawn-care professional. With development of wealth and estates came the self-employed gardner, typically in this country, the self-employed minority.

In the 1960's and 70's, with a growing public awareness of the environment and the rapid expansion of zoning of commercial and industrial parks and of group community living, there was an explosion in landscaping which offered opportunities for, and attracted, the full-service landscape maintenance service contractor. He proved to be the optimum economic solution for maintenance of these properties, many of which were too small to support the necessary full-time professionals and equipment needed. In a growing number of cases, he has proved to be the optimum situation for maintenance of larger scale government, private commercial, institutional and even golf course properties.

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] President, Evergreen Services Corp., Bellevue, WA.

In the 1970's yet another phenomenon is occurring, developed by those who have applied the technology to put professional lawn care within the reach of the average homeowner. Capitalizing on chemical and spray technologies, and on the potential for volume operations, the lawn care applicators have found how to take the worry elements out of the homeowner's lawn at an affordable price. Recognizing that the homeowner doesn't mind mowing and watering, but that he doesn't like the uncertainty of disease, insect, weed and fertility control, and particularly the expense of it, they visit his lawn 4 to 8 times a year and do it for less than the retail products themselves would cost. The lawn applicators have found a rich market, easily sold on a volume basis and they represent the most rapidly expanding part of the industry.

While they have not had a marked impact on the Northwest market yet, it will not be long before this marketplace potential is realized.

It is difficult to place a figure on the maintenance contract service market nationwide. Closest estimates from ALCA, LAWN CARE INDUSTRY MAGAZINE AND WEEDS TREES AND TURF MAGAZINE would probably place it somewhere between 1½ and 2 billion dollars annually and growing rapidly. Recently, Lawn Care Industry magazine reported 22 companies in the annual volume range of 1 million to 70 million dollars and 16 in the ½ to 1 million dollar range. I personally am aware of several general service maintenance contractors in excess of 1 million dollars annual volume.

With the growth and development of the full-service contract grounds care and lawn service industry, is coming several important benefits to the lawn care profession as a whole. First, the markets are large and growing and they are attracting research dollars and research efforts. Several of the larger lawn care companies (Chem-Lawn for instance, a 60-67 million dollar operation) support their own research and development professionals as well as their own in-house technical training programs.

Second, the market is demanding and receiving attention from the equipment and product manufacturers at a level not noticed before. Many of the mower manufacturers are being forced to recognize that equipment designed for the golf course simply doesn't stand up for the contract maintenance company which trailers it everywhere and may use it 10 hours a day for 10 months of the year. Durability, productivity, maneuverability, operator comfort, serviceability and total life-cycle cost are becoming major design factors. When Jacobsen advertises "We Hear You", who do you think they are listening to? In the last two years I have attended two conferences between industry members and equipment manufacturers specifically aimed at opening communication between contractor users and equipment manufacturers. I wish I had more time to tell you about the exciting feedback communications which occurred at these meetings.

Consider a few of the advances in technology and equipment that weren't available in our industry even ten years ago:

- -Multi-drop-tank spray trucks
- -Articulated gang hydraulic mowers
- -Hydrostatic transmissions
- -Hustler/Groundsmaster rotaries
- -Nylon filament trimmers
- -Back pack blowers
- -Advanced electronic irrigation controllers
- -Slow release fertilizers, herbicides, insecticides
- -Growth regulators
- -Etc.

Finally, the markets are creating a new demand for graduates of 4 year, 2 year, vocational tech. graduates of practical curricula in landscape contracting and maintenance. Educational institutions are responding as never before to a market which only a few years ago had problems placing graduates anywhere. The presentation of curriculum from Oregon State University we heard earlier this morning is an excellent example of the 'new-breed" programs geared specifically for the educational demands of the institutional and contract service grounds maintenance market.

These occurrences all affect and make life better for the turf manager whether he be private, public or self-employed. However, all of these trends and happenings, related to a rapidly exploding market growth, have not come along without problems in the industry. Dr. Goss suggested I talk about a few of these today, the business as well as the technical challenges and problems and that I talk about the extent and use of research and applied technology in the turf care contracting industry.

As a general service landscape maintenance contractor, we focus on all aspects of landscape care including turf care, tree care, shrub and groundcovers, irrigation systems, erosion control, landscape modification and planting. Turf is a relatively smaller portion of the job for us than in the golf course environment and is sometimes non-existent on many of our contracts. Turf is usually less intensively maintained and certainly is less intensively utilized than in the golf course situation with the exception of public park areas. The primary objective is one of appearance rather than "playability" or durability to traffic. As a result of the broader scope of service, turf management has received less technical emphasis, relatively speaking, than it has in either the golf course, public park or high volume lawn care segments of the industry.

The nature of the business is dominated by the customer, his economics and his priorities. Ten years ago we wrote the specification and quoted the budget. The quality objective was typically Class "A". As the business developed, competition increased, and our knowledge of costs became more sophisticated, we were forced to realize that the market frequently demanded Class "B" and "C" approaches from a budget and quality standpoint. Typically, now, the service specification is a managed program where there is a definite price/service relationship, hopefully, mutually understood by both the customer and the contractor. Customer market education is a major challenge, particularly where you are dealing with in excess of 200 separate customers.

The typical commercial service specification, as related to turf care, is usually written to cover the basic services with a specified service level ranging from "A" approach to "C".

The "basic" services are usually regarded as mowing, edging, fertilization, moisture control, weed control, disease and pest control. As to mowing, a sample "A" approach would read, "turf will be reel mowed 32 to 38 times, or as otherwise needed throughout the year at heights between 1 and 1½ inches and at such intervals that no more than 1/3 of the leaf blade will be removed at any single cutting. Clippings to be caught and removed." A typical "C" approach would read "turf to be rotary mowed on scheduled frequencies between 22 and 26 times. Clippings will be removed during rapid growth periods if unsightly."

Other services such as liming, thatching, aerification, manual watering, irrigation repairs and site modification may be included as basic services but are typically quoted as time-and-material "extra" services.

The level of technology beyond basic practice is far from exotic. The emphasis in turf care is toward good, basic, long range practices to encourage turf health which minimizes disease, insect and weed problems. We act to minimize spray and chemical applications and tend toward corrective rather than preventative approaches where chemicals are involved. We are dealing increasingly with an environmentally sensitive public and are constantly in the general public eye on commercial properties. Whenever a spray boom or gun shows up, eyebrows are raised and questions are asked. We have found that most problems requiring chemical control are minimized through controlled mowing heights as low as possible, and through well fertilized, dense, healthy, and pH controlled turfs.

Frankly, our biggest problems result from (1) liability to closely monitor or control watering, irrigation, rain because of our weekly or bi-weekly rather than daily presence on all but the larger commercial sites, (2) loss of control over the property during critical periods, and (3) inability to be everywhere at once when severe weather, disease or pest infestations occur. The second point is the most significant. It has taken a long time to convince the customer market that the 9-10 month seasonal contract costs them more in the long run than does a good 12 month program and that the service/price relationship is for real. Maintenance contracting, commercially, is a low margin business. When a quality contractor loses bid contracts by margins of substance, there is a service difference behind the price difference. This happens frequently in the market. The good news is, however, that most price shopping customers come back; our company has a 95% return rate. However, when they do, we frequently must re-establish a sound, basic program to combat the effects of less-than-adequate fertilization, weed control, pruning, mowing and watering programs.

Our approach to the more exotic problems is to recognize them, identify them and pursue WSU or other source recommendations for solutions. Within the last year we have developed our own program to move ahead technologically and to keep abreast of the latest products and techniques we hear of. Our technology committee, not fully operational yet, is to review and approve new ideas and review alternative practice approaches.

We have experimented successfully with controlled release fertilizers and herbicides and liquid limes. We have experimented with inconclusive results to date on Bio Dethatch and turf growth regulants and we are planning programs with chemical aerators and growth regulants for shrubs, hedges and groundcover areas.

Sometimes these efforts move slowly for multiple reasons. It is difficult to budget for and find time for experimental programs. Finding experimental sites usually requires customer understanding, approval, and hopefully customer budget. Both are, at times, difficult to come by. Frankly, we are typically fighting bigger tigers of a less sophisticated nature. Drainage problems are common as are soil problems. We typically encounter 1-2 inches of topsoil on top of, and not intermixed with, clay, glacial fill or pit run subsoil. It is difficult to get a customer who didn't want to pay for good preparation initially to take the risk on subsoil improvement or modification programs.

The major problem with the experimentation on, and application of, new technologies is the ability of companies and the industry to obtain and train people for practical application at the field level. Herein lies our greatest industry technical, as well as management, challenge for contractors, institution professionals, and lawn applicators alike - that of developing and retaining an industry pool of trained people, at field technician and middle management supervisory levels, who are capable of understanding and applying the technology available to us.

Industry growth is outstripping the supply of trained and qualified people and is creating a competition for these people on a level not previously experienced. Before it pulls us apart, my suggestion is that we get together to support expansion of training at 4 year, 2 year and vocational tech. programs as well as the continued expansion of technical and supervisory symposiums. I come to conferences and symposiums such as this one and am frequently disturbed that only senior managers, owners or technical directors are present. Where are the students, the young foremen, and the in-company trainees? We must reach out with education and training in mind.

Our company has sent foremen and department managers to San Diego, Dallas, Milwaukee and Chicago within the last year to seek technical, supervisory and management training. We are active in our trade associations to support education and training symposiums at the practical field level and we are now underway on our own in-company training program. We are typical of midsized companies in our industry nationwide. Let me urge you to support these types of training and developmental programs in your own operation and trade association wherever you can.

With that, my time is up. I hope I have been able to expose you to what is going on in the maintenance contracting industry and to identify where we are. With my final call to support education, training and development of people, I thank you for this opportunity to have met with you.

H. A. S. DECLINE OF ANUAL BLUEGRASS[1]

J.M. Vargas, Jr.[2]

There are few areas in the world better adapted for growing annual bluegrass than the coastal area of the Pacific Northwest with its oceanic climate. In fact with the moderate year round temperatures and frequent rainfalls, it is hard to imagine any other grass surviving at a 1/2 to 3/4 inch height of cut that exists on most golf course fairways. Then why are people still trying to eradicate annual bluegrass? The problem lies in being overtrained.

The problem of learning how to successfully grow annual bluegrass (*Poa annua*) is one of education or retraining. It has been considered an undesirable weed for so many years tht it is hard for people to accept it as a desirable turfgrass. It is not a weed and if managed properly provides a satisfactory turf in the many areas of the cool season grass belt. Many golf course superintendents either refuse to admit they have any annual bluegrass or else deliberately underestimate how much they have. Part of the reason for not admitting to having annual bluegrass is because of the stigma attached to it being a weed; therefore, if it is a weed, I must be a poor superintendent if I can't control it. The reason for the stigma attached to annual bluegrass came from educators in the universities who were convinced it really was a weedy annual grass that died from high temperature during the summer heat stress period. Because of this attitude, little research has been

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Plant Pathologist, Michigan State University, East Lansing, MI.

done on cultural aspects, disease problems or insect problems on annual bluegrass for fear of being burned at the stake as a heretic or put away in a padded cell. Research was done instead on Kentucky bluegrass and creeping bentgrass which very few people actually had on their golf courses and the results transposed to annual bluegrass which more often than not didn't work.

Annual bluegrass is the largest single component of golf course fairways and greens that are 10 years or older in the northern region of the cool season grass belt. Although most people wouldn't admit to having it anywhere on their course, it has been successfully grown on golf course greens for years, mainly because pest control programs have been practiced on the greens. Annual bluegrass has failed on golf course fairways because similar pest control programs have not been practiced there.

Many a golf course superintendent has spent a great deal of time, money, and effort trying to control annual bluegrass with the arsenical herbicides rather than trying to learn how to live with it. Most lost their fairway, many lost their jobs. The smart ones either stopped their arsenical herbicide programs or else never started them.

FAIRWAYS VS. GREENS

In spite of the fact that good pest control practices are carried out on annual bluegrass greens very poor pest control practices are carried out on annual bluegrass fairways. It is difficult to understand the logic behind this. If annual bluegrass greens have to be treated for diseases and insect problems in order to maintain healthy turf, why then do the same treatments not have to be applied to annual bluegrass fairways in order to keep them healthy? There is a logical explanation, and it deals with the long accepted belief that the annual bluegrass is dying from high temperature stress alone. The fungicides and insecticides were applied to greens for incidental diseases, not for the survival of annual bluegrass. The other reason is preventive pest control programs on greens are believed to be affordable, whereas such programs on fairways are believed to be too expensive. Yet it is hard to understand how a golf course can always find the money for the chemicals and seed used in an annual bluegrass eradication program, but cannot use the same funds on chemicals to save the annual bluegrass that is there. As long as high temperature is considered to be the primary reason for the grass dying, the method of preventing this will be through irrigation instead of pest control. However, it has been clearly demonstrated that high temperature alone was not the reason for annual bluegrass dying, a combination of high temperature stress, *Helminthosporium* leaf spot and anthracnose which caused annual bluegrass to senesce during the hot weather. These factors and perhaps others are now referred to as H. A. S. Decline of annual bluegrass. In addition, an insect problem caused by the Ataenius beetle grub has been shown to be responsible for the loss of annual bluegrass fairways during heat stress periods. Blaming the loss of annual bluegrass on high temperature alone prior to 1975 is understandable since the facts concerning annual bluegrass survival were not known, but the information is available now and yet annual bluegrass fairways are still dying and the blame is still being placed on "that lousy annual bluegrass" dying in the hot weather.

If the history of golf course irrigation is examined we find that initially only golf course greens were watered. The green fairways of spring were allowed to go dormant in the summertime and green up again with the return of fall rains. These fairways were primarily common Kentucky bluegrass, colonial bentgrass and fine leaf fescue. Golfers wanted to have green fairways all summer long so fairway irrigation systems were installed. Fairways were irrigated and mowed closer and the Kentucky bluegrass, colonial bentgrass and fine leaf fescue fairways soon became soft lush annual bluegrass fairways. But the pest control programs that were carried out on golf course greens in order to keep them healthy were overlooked. Common diseases like dollar spot or brown patch were observed on the fairways and treated when they became severe. The problems that weren't recognized were *Helminthosporium* leaf spot, anthracnose (H. A. S. Decline) and the Ataenius beetle grub. These fell into the category of high temperature killing of annual bluegrass and the solution to the problem was to irrigate them.

IT IS EXPENSIVE TO TREAT FAIRWAYS FOR DISEASES AND INSECTS!

What has happened in the past is understandable, and if *Sclerotinia* dollar spot and *Rhizoctonia* brown patch were the only major diseases on annual bluegrass fairways, the statement that it is too expensive to spray on a preventive basis is understandable, even if incorrect. What is meant is that dollar spot and brown patch are unsightly but occur slowly enough that they can be treated on a curative basis, but we are no longer talking about *Sclerotinia* dollar spot and *Rhizoctonia* brown patch, we are talking about large dead areas of the fairway caused by *Poa annua* decline and the Ataenius beetle grub that must be treated if you expect "to have green grass on the fairways." With that in mind, here is the part I don't understand.

From 50,000 to 200,000 dollars are spent to install an irrigation system "to have green grass in the fairways." Thousands of dollars each year are spent on water "to have green grass on the fairways." In addition, thousands of dollars are spent on miscellaneous equipment and supplies such as aerifiers, spikers, vertical mowers "to have green grass on the fairways." From a few thousand up to 15,000 or so thousand dollars are spent for the finest mowing equipment "to have well-manicured green grass on the fairways." Between three to fifteen thousand dollars is spent to fertilize the fairways "to have green grass." But spending between 5-10 thousand dollars a year to treat the fairways for disease and insect problems on a preventive basis "is too expensive." You have over a quarter of a million dollar investment for the purpose of "having green grass on the fairways," and you can't spend five to ten thousand dollars a year to protect it. But you wouldn't think of not watering on a hot day because it was too expensive. Why? Your answer would be something like "because the grass would die." And yet it is too expensive to treat with pesticides to prevent the grass from dying. What difference does it make if the grass dies from drought or disease or if the money is spent on water or fungicide in order "to have green grass on the fairways?" The answer is "none" and you know it.

PUT IT IN YOUR BUDGET

Put the cost of fungicides and insecticides in your budget. Present a strong case for them. Ask them whether or not they want "to have green grass on the fairways" all summer long. If they turn you down, fine, shame on them, but if you don't put it in the budget because you think it is too expensive, then shame on you.

CULTURAL PROGRAM FOR ANNUAL BLUEGRASS FAIRWAYS

Mowing height--1/2-7/8 inch

Watering--infrequently and deep during cool weather.
--light and often during warm weather including syringing when necessary during warm periods of the day.

Fertility--nitrogen 1/2 lb of actual N May, June, July, August and September.
--high phosphorus and adequate potassium (as needed based on soil test).

Fungicide program--annual bluegrass fairways 7 to 12 applications during the year.

The major diseases on annual bluegrass which occur during the growing season are: H. A. S. Decline (*Helminthosporium* leaf spot, anthracnose and senescence), *Sclerotinia* dollar spot, *Fusarium* patch and *Rhizoctonia* brown patch. H. A. S. Decline is the most serious problem and trying to grow annual bluegrass without controlling it is futile.

Insecticide--"Poa" fairways.

Should be applied to areas of fairway where the insects are a problem. Once the problem is present an insecticide schedule should be set up to treat those affected areas on a yearly basis.

SAND TOP DRESSING AT INGLEWOOD COUNTRY CLUB[1]

Charles Nolan[2]

The top dressing of turf is certainly nothing new to golf course superintendents. For my part it goes back some 30 years, only in my part of the world it was called mulching. We as superintendents are facing ever increasing play on our courses. The golfer is demanding better playing conditions, faster greens. This coupled with inflation, puts us in a position where we should be ever searching for new and better ways to give our patrons the course they are paying for, let it be public or private. As we all know, there are many ways to achieve one's goal or to cut a blade of grass.

Before I set out on a topdressing program, I met with Dr. Roy Goss of Western Washington Research Station and some fellow superintendents to hear and see what they were up to in regards to topdressing. After some research I set out on a sanding program. The goal was to restore the greens at Inglewood Country Club or be faced with starting at the hard pan and rebuild. The ongoing sanding program at Inglewood achieved that goal.

So you can better understand why we started on a sanding program, here are a few brief facts about Inglewood Country Club.

Built in 1918, the greens were constructed from existing soils. No drain tile was, or has ever been put in. Inglewood Country Club is located in Kenmore, Washington. We have a rainfall of 35 to 160 inches per year

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[2] Superintendent, Inglewood Country Club, Kenmore, WA.

which occurs during the fall, winter and spring months. Here at Inglewood we get some 45 inches of rain. The summers are typically dry, but golf is played 12 months a year. What the original depth of soil on the putting surface was, I can only guess at 12 inches or so, but in 1970 it was 6 to 7 inches. I believe that through aerifying and cup changing, as much as 6 inches of soil has been removed from the putting surface. The soil structure was broken down so badly that the greens were closed most of the winter months. In fact, they were maintaining 36 greens because the regular greens were so bad. Not only the greens, but the aprons in some areas were 3 to 4 inches deep in mud, and like the greens, were churned up by foot prints making putting impossible.

Our first task was to core the greens with 5/8 inch tines, remove the cores, and topdress with a sand with particle sizes falling between No. 20 and 120 Tyler standard screen, U. S. Series equivalent. We followed up with another coring three months later, again removing the cores and topdressing with sand. Three months later we cored the greens again only this time we verticut the cores, topdressed with sand and overseeded. This was done to marry the soil and sand, thus relieving any layering that might occur.

Our third year we cored four times, verticut and topdressed. It was during the third year that we started topdressing once a week. We have now been sanding lightly each week (weather permitting) for four years. The greens now have a 3 to 4 inch mixture of sand and soil plus a 3 to 4 inch topping of sand on top giving us a total of 7 inches of new mixture to work with. We intend to continue for another two years. At that time we hope to reduce the topdressing program to once a month. We were coring the greens once a year and overseeding, but have found out that we get better greens by coring twice a year, which we are now doing. The course is closed on Mondays until noon. This gives us the time needed to topdress. Starting at 6:00 a.m. three men can topdress all 20 greens in a 3 hour period of time. The equipment we use is one tractor and trailer and one utility cart. They are used to supply the sand. We use a Lely fertilizer spreader equipped with a sand ring, pulled by a utility cart to put down 9 cubic feet, one hopper full of sand on each green. (The time on each green is about 1½ minutes.) The sand is let dry for 2 to 3 hours. By this time, all greens have been sanded and we can start dragging on No. 1 green and continue around the course, thus keeping ahead of any golfers. The light amount of sand drags in quite easily and is barely noticeable. We water Monday night, so on Tuesday morning little or no trace of sand can be seen. We leave the catchers off the mowers on Tuesday. This, plus decaying roots, adds a little humus to our mix.

We have eliminated all thatch problems. As we have none, we experience less disease, our fertilizer bill has been cut in half, verticutting need only be carried out once or twice in the spring as the drag mat eliminates graining better than any machine to date. It also eliminates the use of combs and brushes. As for the putting quality of the greens, they are all so consistent, one can't tell one surface from the other. The vertical and lateral movement of water has been improved greatly, almost eliminating puddling. As for dry spots that plagued us seven years ago, they are non-existent. To date we have experienced little damage to our mowers. The golfer can enjoy his golf course 12 months a year now, the surface stays drier, and there are less foot prints making for much improved conditions.

As for the approaches, we spread the sand very heavy, in some cases 2 or 3 inches deep. We encourage the golfer to walk on the sanded areas until spring, at which time we overseed. In many areas this was all that was required to dry them up from mud to dry turf in only one year. We found that the heavy traffic and compaction by mowers cause the breakdown of the soil structure to the point where infiltration was near zero. After the liberal application of sand and aerification, these areas once again resumed near normal infiltration and percolation. The protective covering of sand has significantly improved the stability of these areas.

To sum up our program at Inglewood, one must say, you must be consistent in topdressing, use a sand described above, put it on little and often. It is worth noting that sand has no structure to be destroyed through traffic or by mowing equipment. Aerifying and topdressing should be considered a permanent practice since layers of grass or thatch can develop over any soil material including sand and reduce the infiltration rate with time. At first you will experience some rough greens but after about the fourth or fifth week, they smooth out. The time and dollars spent will pay great dividends. As they say, try it, you will like it.

WATER — A DIMINISHING RESOURCE[1]

J.R. Watson[2]

I am pleased to have an opportunity to discuss this topic with you. The title "Water--a diminishing resource"--provides the latitude and the opportunity to discuss several aspects of this very vital and important subject. Each year hundreds of people involved with turfgrass and with other aspects of water gather in meetings to discuss water and water related topics. Pick up a newspaper in any man's town and chances are you will find at least one article dealing with the subject. And, recently many industrialists, conservation groups and many political leaders have become concerned. In short, the subject of water receives a great deal of discussion. Rightly so. For water is important; it is our most vital natural resource. And it is an exhaustible, diminishing resource.

Water is really a very serious subject but we don't treat it with the seriousness it deserves. None of us do. Not those of us involved in turf management. Not the farmers, who account for about 45-50 percent or more (some say 80%) of the total amount of water consumed in the U.S. each day. Not the people in industry, who some say use another 40-45 percent of the total. Even those industries that could not exist without access to large quantities of water, like the utility companies, the food processors, the beverage makers, the paper manufacturers; and, certainly not the average householder,

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] Vice President, The Toro Company, Minneapolis, MN.

whose total waste of water -- that's waste, not beneficial use -- each day amounts to millions of gallons. This from the approximate 9 percent that goes for physical and domestic use.

I suppose the main reason we don't regard water more seriously is that we have not been convinced that we're dealing with a scarce commodity. In my home state of Minnesota, it's hard for anyone to believe that water is scarce when you realize we have over 15,000 lakes containing many billions of gallons of water. And, we receive some 30-40 inches of precipitation annually. How can water be scarce under those conditions?

The truth of the matter is that the amount of water on this planet is constant. Just like land, it's not being made any more. The amount of water available for the use of everyone on Earth -- for all purposes -- industry, agriculture, golf courses, and our individual needs -- is the same today as it was at the beginning of time, and it will be the same in the year three thousand if the old planet Earth is still around in the year three thousand.

The amount of water available for our use is less than one percent of the total in existence. The rest is tied up in the polar ice caps and in the oceans -- essentially unavailable to us. Not only is what remains -- that one percent -- a limited, inelastic supply --- we are doing things to it: We are finding new uses for it, constantly. And we're polluting it, faster than nature can purify it.

While I do not want to cast myself in the role of an alarmist, a convincing case can be made that a water crisis is building.

It is unfortunate, but true, that our society has become crisis oriented. It takes some catastrophic event or some action that deeply affects large numbers of us in a personal way before we react with sufficient collective force to cause something to happen. And then our reaction tends to be hasty and impatient -- demanding quick solutions.

A case in point, of course, is the recurring energy crisis. In spite of the severe disruptions caused by the 1973 oil embargo and in spite of repeated admonishments to curtail use, we continue to act as though the supply of fossil fuel were unlimited. And, some agitate against nuclear energy -- the only real hope for alleviation of energy needs in the forseeable future.

That same kind of attitude followed the disastrous drought a few years ago that disrupted lives and livlihoods in Southern California, in the Bay area of Northern California, and many other parts of the U.S., including my home state of Minnesota. Yet, when the rains returned we blithely fell back into our old wasteful ways of water use.

There are other similarities between the energy crisis -- which is real -- and the potential for a water crisis -- which is not yet with us but which could be far more disruptive and hurtful. Both have deep-seated implications. We experience the consequences of conflict with respect to oil every day. Conflicts over water reach more farther back into history -- to Biblical times -- but the forces of conflict continue unabated to this day, as you well know.

Earlier I mentioned only 1% or less fresh water is available for our use. Of that, we have, in the U.S., a dependable supply of fresh water estimated to be about 600 billion gallons a day. This represents approximately 3% of the world's total. For comparison: Canada and Russia each have in excess of 20%. One source (Weigner) reports that in 1960 we used about 270 billion gallons a day. In 1970 this had increased to 370 billion gallons and usage is expected to be 422 billion gallons in 1985 -- if we ignore the tremendous quantities that will be needed to process shale oil, transport coal slurry and other energy demands we seek to throw off the Arab yoke. Water and energy relationships cannot and must not be ignored. They are similar and solutions are closely inter-related.

I attended the National Conference on Water held in May 1977 in St. Louis. A great deal of information came out of that conference but one thing that stuck indelibly in my mind in the report of the proceedings that was transmitted to President Carter is this statement:

"Overall most parts of the nation are short of water now, and consumptive use nationwide will increase by 33 percent by the year 2000."

The water problem really parallels the soil problem. There are still huge quantities of oil in the world, but demand has simply grown faster than supply. So it is with water. Water is a diminishing resource -- not because we have less each day but because we are finding new uses and because demands for old uses are increasing at a very alarming rate. Also, basic to the problem is the fact of distribution or location -- some areas have abundant supplies; others like Tucson are losing water at an alarming rate -- the water table has dropped some 400 or more feet in past few years. The same is happening to those areas overlying the Ogallala Aquifer -- a huge underground water reservoir extending through the Plains area from Nebraska to the panhandle of Texas. Demand has increased dramatically. For example, in the Texas panhandle from some 2 to 3,000 wells 25 to 30 years ago to 70 to 80,000 today. And there are many many other examples.

We had better believe we are dealing with a scarce commodity and we had better start treating it with more respect.

I do not want to deal with the politics of how or what to do about redistribution, alternative uses, or costs, rather I would ask:

What are we going to do about it? What are you and your golf club or turf facility going to do about it?

Three themes or points run through all the water and water related meetings that I attend and I should like to review them briefly.

They are:

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

2. There is a need to impress upon everyone who uses water to grow healthy turfgrasses for a golf course, or for any other recreational purpose, that that is a very important beneficial use of water. They help to cool our cities and thereby reduce energy and they provide healthy recreation.

3. It is time to recognize that wastewater - sewage effluent - is an important source of water for turfgrass irrigation. Further that use of this "recycled" water is in reality "water conservation."

Those of us who are involved in the turf management business are guilty of misuse of water. That's true, but to a far less degree than for most of the other major water users. The golf courses in this country, by and large, have for years had better management than any other type of recreational turf, including home lawns. And that management includes, of course, the use of water. Yet, I would be remiss if I were not critical of the use we have made of some of our accomplishments.

As many of you know, I was the fortunate recipient of a graduate Fellowship sponsored by the U.S.G.A. Green Section when I attended Penn State. Dr. Fred Grau, Director of Green Section at that time, and Professor Burt Musser, my major advisor, considered watering practices to be one of the important areas needing evaluation. That was 1947 -- some 32 years ago.

My dissertation was entitled, "Irrigation and Compaction on Established Fairway Turf." Among the conclusions resulting from this study were the following:

1. Moisture levels exerted a greater influence on turf quality, during the experimental period, than did soil compaction.

2. The moderate use of supplemental irrigation seems necessary to produce high quality playing turf that will remain green throughout the growing season.

3. The unwatered plots were brown and in poor condition for play over an extended period of time.

4. Moderate usage of supplemental irrigation on intensively managed turf will favor development of bentgrass at the expense of the slower growing species, so that, eventually the turf will consist largely of bentgrass.

5. Supplemental irrigation in quantities great enough to maintain a soil at approximately field capacity is unnecessary and encourages disease, and the subsequent invasion of crabgrass and clover.

6. Excessive watering creates a soggy soil condition, promotes shallow rooting of the turf, encourages disease and the invasion of crabgrass and clover -- and, if *Poa annua* had been present or the height of cut lower, I am confident it too would have increased.

That was 1950 -- 29 years ago. Since that time others have investigated other aspects of water, its application and use on golf course turfgrass. Have we made progress? Yes -- we've made a great deal of progress in all phases of golf course management these past 30 years. One of the reasons is that aside from agriculture, nothing that grows has received as much attention as golf course turfgrasses. Research--private, industrial, and university--and extension activity have helped the industry make enormous strides. Knowledge, technology, and management techniques relating to golf course turf have all advanced dramatically. But despite those gains, water and water related problems are still with us.

As an example, let me quote from an article by Dr. Jack Hall of V.P.I., published in the 1978 proceedings of the Rocky Mountain Turfgrass Conference -- one year ago.

"We killed more golf greens in Virginia in 1977 with improper irrigation than any other management factor." Jack went on to say that too often greens were irrigated when the intent was to syringe and when this happens at 90o, temperatures damage is likely to occur. Automatic irrigation systems offer many advantages, but too few have the capability to "mist" water. Only a limited number of manufacturers have equipment capable of properly syringing (misting) and too few system designs incorporate this feature -- it does cost extra but there are costs involved in replacing greens! (For each gm of water vaporized, 540 calories of heat are dissipated.)

There obviously is a gap between what we know and what we practice. Sometimes I think it's a chasm. To date, we seem to have been incapable -- at least unsuccessful -- in bridging that gap. Why? Perhaps it's an economic factor, perhaps improper dissemination of information, perhaps resistance to change, and probably some of all these reasons plus others. Certainly, I don't have an answer. *But I firmly believe that one of the major challenges facing our industry in the next few years is to find a way to narrow this gap -- we simply must find a solution to this problem.* We need to learn more about such things as drought tolerance and rooting characteristics of grasses, water requirements, watering techniques--water application and efficiency--water conservation, soil-air-water relationships, leaching and weeds and their ecological relationship in the golf course environment. Also, we must find ways to avoid pollution and to use recycled water.

And, of course, we have not learned to use water with the kind of efficiency that we must if we are going to play a significant role to help keep this planet from running out of water.

In addition to recommending that we find a solution to the information gap, I should like to also suggest that we -- you, me, all of us here -- do everything we can to generate more knowledge -- more new information, better technology, better products, better equipment --

so that turfgrass management will continue to advance.

That can be done in a number of ways. One is with scholarships. Another is to sponsor research, basic or fundamental research, as my company is doing to support a four-year study of water use rates for turfgrasses at Texas A & M. For we believe knowledge of water use rates is basic and will be of immense value in determining overall water requirements of a particular region, as well as for the future water efficient turfgrasses that grow and that will grow on turf facilities in the future.

There are some 8 or 9 steps for conserving water under drought conditions which I should like to list and which if followed should lead to conservation of our most valuable diminishing natural resource.

1. Treat every day as if you were in a period of severe drought.

2. Establish watering priorities. This means giving highest priority to the most intensively managed areas; for example, on a golf course, the greens, the most valuable part of the course and where the most critical play takes place.

3. Follow sound irrigation practices.

4. Reduce, or avoid where possible, all causes of stress such as salt build-up.

5. Alter mowing and cultivation practices. This includes raising the height of cut wherever possible, which leads to frequent mowing.

6. Expand use of mulch. This is a very important conservation measure.

7. Erect wind barriers, especially where there are large expanses of open spaces.

8. Experiment with anti-transpirants and surfactants.

9. Aggressively seek additional sources of water.

Among the alternative sources are wells and ponds, collections of marginal water and -- the most abundant and most often wasted supply -- treated sewage effluent.

At my company we are convinced that wastewater will become a major source of irrigation water in the future. We believe it must be used widely for all types of irrigations, especially for large turf areas and in agriculture.

We expect to play a strong role in the research and product development necessary to make certain the equipment and the resources will be available for expanded use of wastewater for irrigation.

As many of you are aware, the USGA Green Section, the American Society of Golf Course Architects, the Golf Course Superintendents Association, and the National Golf Foundation, sponsored a two-day conference in November in Chicago to deal exclusively with the subject of wastewater use for irrigation of turf on golf courses and other sports fields.

It was a conference that was long overdue. It will, I predict, encourage significant expansion in the use of effluent for irrigation. The proceedings are available from each of these organizations at a nominal cost. I urge everyone in this room to obtain a copy of the proceedings and to read them carefully and thoroughly. Thank you!

EFFECTIVE COMMUNICATION IS A MULTIPLE RESPONSIBLITIY[1]

Donald D. Hoos[2]

In recent years, the old time profession of "Keeper of the Green" has made rapid strides. Golfers continually demand higher standards of maintenance. To meet these demands, today's turfmen must call on the latest in modern equipment, agricultural research and technical information.

Even though the modern superintendent is first and foremost a grower of grass, the fields from which he draws his information have become extremely broad. He must be capable of providing a high degree of maintenance proficiency, operate economically and keep abreast of new developments. He is a busy man. The job has become more than one of "keeping the green." The turfman is an agriculturist, a supervisor and a manager.

This last description of the turfman as a manager is the area in which I would like to focus our attention today. It has been receiving increasing attention in the last few years and rightly so. With growing budgets and other responsibilities, the time devoted to management by turfmen is increasing. Management has always been a part of our profession, but has received little emphasis. In today's computer society, with its ability to accumulate and store volumes of information and data and critically analyze techniques and procedures, we have developed a management society with a great vocabulary of management terms. It is now time to incorporate these

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Western Director, USGA Green Section, Tustin, CA.

ideas and terms into our vocabulary of agricultural and scientific knowledge to deal with the managers, businessmen and professionals who are our clientele.

What does all this mean? Simply this; we have to be effective communicators. What is communication? It is an exchange of ideas or a conveyance of information. It sounds simple enough and should be. It's probably the most important thing we do in any of our daily activities. We have to communicate to get things done. It is basic to everything -- this exchange of ideas or conveyance of information. It is the one thing that separates human beings from the rest of the animal kingdom and has allowed us to develop a so-called modern civilization. Yet, communication or lack of it in many cases has been the cause of more than one superintendent to lose his job. Therefore, let's examine some of the things that prevent good communication and then look at some of the things we can do to improve communication.

Roadblocks to Good Communication

In my travels I am frequently called by a club official requesting an urgent visit to help analyze a serious turfgrass problem. Upon arriving at the golf course, I may find a simple agronomic problem that the superintendent has already corrected. Yet, I still sense hostility between the club officials and superintendent. The superintendent obviously has good agronomic knowledge and ability, yet has not been able to communicate this to the membership. Or vice versa, the membership desires are not being communicated to the superintendent. A roadblock exists to good communication.

These are some of the roadblocks commonly encountered:

1) Lack of confidence or mutual misunderstanding.
2) Failure to listen or read intelligently.
3) Lack of feedback or failure to arouse discussion on a lateral basis.
4) Failure to apply successful communication techniques.

Perhaps a lack of confidence or mutual misunderstanding is the most common of roadblocks encountered. In most cases, the green chairman or general manager possess very little technical knowledge about grasses, soils, diseases and other agronomic matters. They must rely on the superintendent's expertise to make agronomic decisions. The superintendent must be able to communicate to his chairman or manager the best methods to achieve the best conditioning of the golf course. If the superintendent's inability to communicate these things results in insuffficent materials or manpower to accomplish the desired results, a lack of confidence in his judgement or ability can result. This can lead to second guessing or the superintendent's decisions and oversupervision. The eventual loser in such situations is the golfing member who must then play golf on less than satisfactory turf.

Mutual misunderstandings can be equally troublesome. The old adage "A little knowledge can be a dangerous thing" all too often comes into action to create misunderstandings or misconceptions about the proper way to handle a problem. A club official reads a trade magazine describing the use of a certain chemical to control *Poa annua* in bermudagrass turf in Texas. He decides that this method may eliminate *Poa annua* from his fairways and greens in Washington and directs the superintendent to apply the chemical to the golf course. If the superintendent is unable to explain that this chemical will kill all cool season grasses, then he's going to have an even bigger problem later.

One of the single largest causes of turfgrass loss is the misapplication of chemicals. Usually the explanation for the damage is that the applicator misread the label and applied too much chemical, or he misunderstood the oral explanation given by his superior and used the red material in the green bag instead of the green material in the red bag. One must realize that communication of ideas to all maintenance personnel are equally as important as communication of ideas to club officials and club members.

How many superintendents in the audience think they really know what the majority of their members desire in a golf course? Do you get feedback from the members? If you don't, then you are going to have problems. A lack of open discussion and information exchange between club committees or departments can be disturbing. It is always disheartening when a superintendent tells you about the day he had one green mowed and suddenly there are two groups on every tee waiting for a shotgun start he knew nothing about. Or the time he aerified all 18 greens the day before the member-guest tournament.

Perhaps the worst situation one hears about involving a lack of mutual discussion on a lateral basis concerns the installation of an irrigation system. Too often one hears of a situation where a club accepted the lowest bid on an installation and two years later realizes that it is going to cost them the same amount of money to correct the deficiencies of the system. A little more open discussion in the beginning may have caused them to make the right choice to begin with. Invariably in this situation, one hears the statement, "If they had listened to me in the first place, this wouldn't have happened." Perhaps in this situation, the superintendent didn't make full use of his communication ability to force the right decision to be made.

The failure to apply successful communication techniques in our day-to-day operations creates many of our problems. We might list a few basic steps for good communication that apply to almost everything we do.

1) Know your audience.
2) Know your objectives
   A) Watch your attitude
   B) Know what you want to say.
3) Learn your assets and liabilities.
4) Plan your strategy
   A) Catch interest
   B) Hold interest
   C) Create desire
   D) Ask for action at the end.

The successful superintendent uses good public relations hand-in-hand with basic communication skills. Public relations is quite simply the image you project and the way your project it. As Diane Wilson, staff writer for Golf Course Management points out in an article in a recent issue; "Do you look like a professional who can completely handle a multi-hundred-thousand-dollar-a-year operation? The question is not so much whether your appearance suggests competence (although that helps), but whether your actions and words show you to be a concerned individual who can handle tough problems."

There are many ways you can help project this image. You should listen to complaints. Remember that the person who complains deserves an answer of some kind. He wouldn't complain if he didn't care about the golf course. Do not lose your temper. Be a good listener. If the person or group complaining is a long one, keep eye contact, and nod occasionally so he will know you are listening. After acknowledging the person's anger, calmly explain what is being done about it or thank him for bringing it to your attention. If the complainer sees you as an understanding calm professional who solves problems, his opinion of you can do you much good.

Keep the green chairman, manager and membership informed of your problems and progress. A notice in the club paper or on the locker room bulletin board prior to aerification of greens, resodding or any work detrimental to play will save a lot of headaches and member grumblings.

If unusual weather conditions cause disease or other turfgrass problems, let the membership know about it, what corrective measures you have taken and how long it will take before expected recovery of damaged areas. It is good policy in another way. It helps to keep the turf management program before the member's eyes. They will enjoy knowing about course conditioning and improvements.

Take advantage of consultants such as the USGA Turfgrass Advisory Service and University Extension personnel to help analyze problems. We live in an age of specialization and it is virtually impossible to keep abreast of all the information that is available to you. To seek help, consultation and insure you make the right decision is not a sign of weakness or inability. Medical doctors have been doing this for years to insure correct diagnosis and treatment of patient ills. Corporations do it to insure maximum production and efficiency. A true professional seeks advice and help with his problems. By getting an outside observation from an impartial source, a superintendent can evaluate his program and insure he is using the latest techniques and procedures available.

I've collected a few "foods for thought" that I would like to leave with you. Perhaps as you return to your courses and your day-to-day activities, you can implement some of the communicative skills we've talked about today. The following short thoughts might be worthwhile to consider and keep in mind:

The most profitless things in the world to manufacture are excuses.

Next time, reach for the truth instead of an alibi.

A man may fail many times, but he cannot be called a failure until he starts blaming someone else.

Some people are so busy learning the tricks of the trade, that they don't learn the trade.

COLLEGE EDUCATION AND THE TURFGRASS MANAGER[1]

Stephen Miller[2]

As I look out over the audience assembled here today, I see a group of highly successful turfgrass managers. Let's pause for a moment and consider just how this success was achieved and how our turfgrass expertise was gained.

Many of us have taken college courses dealing with turfgrass management; in fact, some of us have degrees from such institutions. Most, if not all of us, have attended educational seminars and conferences such as this one. Trade magazines, publications, and other literature contribute greatly to our turfgrass knowledge. And, of course there is that grand old teacher - experience.

College education gives the turfgrass manager an excellent foundation to build on. Throughout one's coursework, one begins to gain an understanding of plants, soils, climate, and their interaction. Yet a mere understanding of plants and soils, no mater how thorough, is not by itself enough to become a successful turfgrass manager. There is a great difference between knowing and actually doing. There is a course we don't get to take in college which some of us turfgrass graduates refer to as PE 101 - Practical Experience 101.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Assistant Superintendent, Port Ludlow Golf Course, Port Ludlow, WA.

Consider for a moment a hypothetical situation. Let's take two students, say, just out of high school. We will put one directly into a turfgrass setting, a golf course for example, and send the other to college. The college student will spend the next four years acquiring knowledge, hopefully picking up a small amount of practical experience during summers. The young person on the golf course, on the other hand, will actually be doing and carrying out the tasks necessary for the year-round upkeep of the golf course. At the end of four years the college graduate goes to work on the golf course. At this point in time there probably will be no comparison between the two young people in their respective abilities to get things done. If we want to fertilize fairways, for example, the person who has been doing it for four years will go out and do the job quite smoothly. The new college graduate, however, no longer faces a level research plot of precise dimensions, but must now contend with an area of irregular shape and contour, perhaps even with considerable slope. The first time out is undoubtedly going to be rough - just as it probably was for the person straight out of high school four years ago. Clearly the college graduate will have to do the job a few more times before feeling confident about doing it as smoothly as the person who has been doing it for some time. While the recent graduate may understand more about the timing and nutritional ramifications of the job just completed, the actual application of the fertilizer no doubt will be done more efficiently by the person who has been doing it for a few years.

If we follow these two young people for another four years, I feel we may find a most revealing situation. The person who has been working on the golf course all along will no doubt still be doing a fine job of fertilizing fairways (along with all the other tasks), as well as having a thorough understanding of the cultural actions being taken. The knowledge and understanding gained from college education coupled with a few years experience to develop the ability to carry out jobs smoothly and efficienctly give rise to a well-rounded turfgrass manager.

So, while building a future for oneself in the turfgrass industry, I feel a college education gives one a head start, even if only a slight head start. But college education does not give one all the answers. We are blessed and cursed to be in a business in which no one has all the answers. Whenever dealing with anything biological, there is so much that is not understood - there are simply too many variables. Turfgrass graduates are blessed in the sense that while they are sometimes expected to know everything, they can take solace in the fact that no one has all the answers. Yet all turfgrass managers are cursed in that no one can explain why certain things happen. For example, here at Port Ludlow in the middle of August we had a severe outbreak of *Fusarium nivale* on our 16th green. The green is elevated and the area is open with good air movement. Ambient temperatures never dropped below 50 F. Every square yard of the green was affected yet there wasn't any *Fusarium* on our other greens. We treated the green and cleared up the problem, but no one has the slightest idea why we had such a heavy infestation in that area at that time of year.

Obtaining a college degree in turfgrass management exposes a person to a great many research and experimental projects. Most turfgrass students are also required to undertake research on their own. This exposure lends an understanding of research methods, as well as the ability to interpret research findings. I know that in my own case, this exposure has made it easier for me to understand current research, assimilate it, and put it to practical use.

An advantage to college coursework in any field is the enhancement of one's ability to think. Continual work in the classroom and laboratory instills in a person a thinking process which aids in the ability to think out problems, consider the effects of alternative courses of action, etc.

Probably the greatest advantage of a college education is the personal growth that occurs in just getting through the educational system. Our colleges and universities are by nature highly beaurocratic institutions. One must learn to communicate effectively and be able to work with people. The ability to effectively work with people is of tremendous value in our profession. Whether in a park, golf course, or any other turfgrass setting, we are in a production oriented business - we must get things done. And from this standpoint, we are in a people business. Personnel management has to be one of our top priorities. Very seldom will a turfgrass facility look just the way we want it to - we would probably have to do everything ourselves to achieve that. We must, therefore, be able to work well with others and depend on them. Where necessary, we must train people to do a job that is acceptable to us. In this respect the ability to work with people and communicate effectively with them is indispensable. As one proceeds through a hectic and beaurocratic educational institution, one grows and improves in this most important area.

There are a few areas in which I would like to see turfgrass degree programs improved. As previously noted, one hopefully gets some practical experience during summers while one is in school. But in the Pacific Northwest it is during the late fall and winter seasons when our greatest disease problems arise. While these problems are occurring, turfgrass students are in the classroom. Unless extensive research space is available, the student gets very little exposure to these problems. For this reason I would like to see ways by which turfgrass students may obtain greater experience during late fall and winter. Be it expanded research facilities, or actual work at a turfgrass facility for perhaps an afternoon or two during the week, just getting students out working with turfgrass at this time of year would be greatly helpful.

Another area which should be more heavily stressed would be that of business administration. Modern turfgrass managers are being called upon more and more to be competent business managers as well as agronomic and horticultural experts. As noted by previous speakers at this Conference, we are facing great problems - shortages of our precious natural resources, energy considerations, and inflation. We must become better managers - not only in the agronomic and horticultural aspects of our profession, but in the administrative aspects as well. In all likelihood we will have less manpower with which we must accomplish at least as much as we do now. Equipment, fertilizer, and chemical costs are all subject to the constant spiral of inflation. It is obvious that turfgrass managers are being faced with greater and greater administrative and fiscal challenges. In this area, college education can be especially helpful to the wouldbe turfgrass manager. Turfgrass students are required to take a few business courses and should be encouraged to take more as electives.

It is my firm belief that college education provides a solid foundation in the plant sciences. It also provides the opportunity to gain additional training in areas such as business administration. Such an education, coupled with a few years experience, will no doubt give rise to some outstanding turfgrass managers.

THE CAUSES OF LATE WINTER - EARLY SPRING DAMAGE TO GOLF TURFGRASS[1]

J.R. Watson[2]

During late winter - early spring, fluctuating temperatures and waterlogged, partially frozen soil produce conditions that cause the loss of turf. This loss may be the direct or indirect result of one or more of these phenomena. Direct damage or kill of the permanent grass may occur at any point of the freeze - frozen - thaw cycle so characteristic of this season. Indirect injury may result from attacks by disease producing organisms (mostly snowmold and other low temperature fungi) and by traffic on frozen turfgrass areas.

CAUSES RELATING TO TEMPERATURE VARIATIONS

Turfgrass may be destroyed -- at the time it freezes, during the time it's frozen, during the time it's thawing, or after it's thawed and growth has begun. Some killing probably occurs during each of these periods. This cycle of freezing, frozen, thawing may be repeated several times during each winter and early spring. When associated with intermittent growth in late winter-early spring, damage may be severe. Death as the plant freezes happens most often in the late fall-early winter, but may occur after a period of growth (particularly rapid growth) in the spring when a sudden drop in temperature occurs. This is most damaging when the grass plants are in a non-hardened condition. Ice crystals

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Vice President, The Toro Company, Minneapolis, MN.

form within the cells and this disruption of the protoplasm may cause death. Too, repeated cycles in the spring will exhaust food reserves upon which the plants must draw to initiate growth. For this reason, *Poa annua* is especially vulnerable.

Death during the time the plant is frozen is unlikely to occur unless it is subjected to traffic. This will seldom occur if a good snow cover exists, which is the case most often during the winter months. However, play during the time period under discussion may cause mechanical damage either by attrition or from pressure which forces the ice crystals through the cells, thereby puncturing them and causing death. Play during times the grass is covered with frost has the same effect.

Death at the time of thawing depends on the amount and the state of the "bound" water within the cell (intra-cellular water). Unless adequate bound water is present in the protoplasm, death may result if thawing is rapid or if inter-cellular water re-enters the cell too rapidly. In the latter case, the cell wall is permeable but the protoplasm is unable to absorb the water. Prolonged cold may be conducive to death because it contributes to brittleness of the protoplasm and, if contact (from traffic) is made, the plant is highly susceptible to damage.

CAUSES RELATING TO TRAFFIC

Grass will initiate growth during the warmer periods of late winter-early spring. If the season is characterized by widely fluctuating temperatures, the grass is vulnerable to the freeze-frozen-thaw growth cycle with its attendant problems. Too, the envoirnment produced is highly conducive to disease development. Thus, this may be the most critical phase of the turf management program facing the golf course superintendent. And, he often finds his turf management programs (and, therefore, himself) in direct conflict with the golfing membership, especially those desirous of playing a few early rounds.

Mechanical injury by traffic on partially frozen or wet soil may be immediately evident (visible) or delayed (invisible). Visible injuries (soil displacement) are the footprints and ruts caused by foot and vehicular traffic -- sliding and slipping, walking or rolling -- on partially frozen or saturated soil. Invisible injury stems from soil compaction. Although this type of mechanical damage is not confined to the winter months, soil compaction may be far more damaging during this period than generally recognized. Traffic on partially frozen or wet soil, without the protection of living grass, will exert greater pressure (hence, more compacting force) than during the normal growing season. This results, subsequently, in poor growth and may explain "problem areas" which show up in spring and summer for no apparent reason. Cupping areas are particularly vulnerable in this respect.

Traffic on frosted turf causes the frost crystals to puncture leaf cells and kill the grass. Removal of frost, or preventing play when the grass is frosted, is essential.

Control of traffic during vulnerable periods does not always contribute to harmony between early golfing members and the less enthusiastic golfing and non-golfing members. The responsibility for control rests with the club officials -- president, greens chairman, superintendent and golf professional.

CAUSES RELATING TO ICE SHEETS AND PONDED WATER

Turfgrasses, although essentially dormant during the winter months, nevertheless, carry on metabolic (growth) activity, particularly respiration. During late winter-early spring, as growth activity increases, the grass may suffocate (a) if diffusion of atmospheric and soil gases are reduced or stopped; (b) if excess carbon dioxide accumulates, or (c) if oxygen supplies are reduced to a minimum. Such conditions exist under ice sheets in poorly drained areas where the soil remains saturated for extended periods and, under flooded conditions when ponded or standing water persists. The higher the temperature, the shorter the period of time that the grass can survive these adverse conditions.

Under limited (and rare) conditions, ice sheets and ponded water may act as a lens. When this happens, the sun's rays are magnified to the point where the excessive heat produced may cause a burning or scalding of the turfgrass.

CAUSES RELATED TO REDUCED WATER INTAKE

Desiccation is a "wilting" phenomenon. Like wilt, which occurs during the normal growing season, desiccation occurs when evapotranspiration exceeds water intake. This inability of the roots to absorb water, or for the plant to transport it to or through its system, may result from a shallow, poorly branched root system; diseased vascular system, or, from a reduced or restricted soil water supply. Limited soil moisture may be the result of a "dry" soil (not enough water) or of a frozen or partially frozen soil (water unavailable to the root because of its physical state). Thus, the roots simply cannot take in enough water to offset that being lost by the plant and it "desiccates" or dries up - it wilts. Although more serious during periods when the soil is "on the dry side" or partially frozen, desiccation on high windswept sites may occur at any time. The increased air movement causes excessive transpiration and under limited or reduced soil moisture conditions, the plants may die unless protected.

In late winter-early spring, before the irrigation system has been activated, damage from desiccation may be severe. Water hauled in spray tanks or by other means and applied to critical sites will preclude or minimize loss.

PROTECTIVE MEASURES

Techniques and procedures that protect, avoid and correct the damage that occurs in late winter-early spring are well known to and understood by the golf course superintendent. For the most part, protective measures relate to production of a healthy vigorous grass and to the control, to the extent possible, of the soil-plant environment. When these factors are adversely impacted by anomalous conditions of weather, poor construction or inadequate equipment and supplies, the responsibility for loss of turfgrass must be shared.

I. To Protect Against Temperature Variations

1. Apply sound cultural practices in the fall of the year. This would include properly timed application of balanced fertilizer; cultivation of compacted areas and of such areas as slopes where water infiltration is poor; controlled application of water - to insure satisfactory soil moisture; mowing in accordance with growth requirements - raise height of cut on areas known to be susceptible to desiccation; implementation of disease control programs at the proper time - fall and spring. (Programs to control or eliminate insects, weeds and thatch would have been implemented at earlier dates.)

2. Control traffic, especially during critical periods.

3. Use mulches or covers if warranted.

4. If late winter-early spring play is anticipated, cut cups in the fall and fill with newspaper.

5. Cut temporary greens if needed.

6. Work toward elimination of *Poa annua*.

7. Develop programs to introduce new, improved grasses as they become available. Seed greens lightly each fall to help eliminate *Poa annua*.

8. Avoid practices that stimulate excessive early growth or that produce soft, succulent growth in early spring.

9. Apply fungicides as needed.

II. To Protect Against Traffic

1. Develop programs to control traffic during critical times and on critical sites.

2. Enlist support of all golfers.

3. Take pictures of damage and make presentation to greens committee and membership.

III. To Protect Against Ice Sheets and Ponded Water

1. Improve drainage.

2. Redesign and rebuild if necessary.

3. Leave snow as insulator as long as possible.

4. Apply dark material (Milorganite) to ice sheets to make them porous.

5. Mechanically break up solid (non-porous) ice sheets if temperatures range into 50's or greater for extended periods.

6. Apply fungicides as needed.

IV. To Protect Against Limited Soil Water

1. Water in the fall as late as is needed to insure good fall and winter supply of soil moisture.

2. Use covers and mulches to protect vulnerable sites.

3. Plant superior permanent grasses.

4. Apply those cultural practices needed to insure adequate storage of food reserves and that develop deep rooted, extensively branched grass plants.

5. Apply water to counteract desiccating conditions - haul if necessary.

6. Apply fungicides as needed.

7. Avoid all practices that stimulate early excessive growth or that produce soft, succulent growth.

ATHLETIC FIELD DEVELOPMENT AND MAINTENANCE COSTS[1]

William Lex[2]

For proper field development there should be advance planning. I would say that at least a year before you go to bid on a project the planning should begin. There are many problems that can be avoided and early planning also gives you time to pick the best architect for the job. When the construction is started if you, as Grounds Maintenance Supervisor of the school district or park department, have charge of overseeing the project you should keep a daily record of what is discussed or done on that day as you very well may have to refer back to your records. You cannot rely on your memory! I would recommend that the school district or park department have full control of the project using the architect only if needed for consulting reasons. The person in charge of the project should be on the field at all times when the contractor is working. An example of that would be when we were putting in the drain lines. We used a digger with a lazer beam which is the very best way to put in drain lines. It takes all the guess work out while watching them dig lines. Many times they weren't watching the lights on the digger and we were getting humps in the line which would have stopped or slowed water flow or trucks running over drain lines crushing them. By being on the job site it insures the job is done right and hopefully without problems later.

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1 Presented at the 33rd Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Grounds Foreman, Northshore School District 417, Seattle, WA.

At Northshore School District we renovated Pop Keeney Stadium (about 6½ acres). We redid the football field and baseball field and added a soccer field at a cost of approximately $500,000 including lighting. I will give you the cost of three different types of football fields and the cost of maintaining the type of field we put in.

1) Astroturf 74,100 ft^2 @ $4.50/$ft^2$ Total: $444,600
2) Pat System 74,100 ft^2 @ $3.00/$ft^2$ Total: $222,300
3) Natural turf 74,100 ft^2 @ $1.50/$ft^2$ Total: $111,150
   Football Field
   (without pumps)

The Northshore School District went with number three, Natural Turf. I feel a turf field is the best to play on and over the long run less costly than Astroturf. The drain lines were put in 10 feet apart; filled with washed pea gravel, then 16 inches of washed Number 2 sand. No clay or silt at all.

<u>Number 2 Sieve Count</u>

½"	100%	
¼"	84%	Down Grade 15%
#10	59%	
#40	15%	
#80	5%	Up Grade 5%
#200	1.3%	

Now we come to maintenance of the new field and cost. This should have been planned well in advance. When you go with a sand base field the costs at first are going to be high.

1) Water - You have to keep the sand wet at all times during germination and early growth.

2) Mowing - Mowing at first on a sand base field has to be done by hand.

3) Fertilization - Because of the near perfect drainage you will get with this type of field you will have to fertilize often. We fertilize once a week for five months as in the case of school districts and park departments they want to use the fields as soon as possible so you push for fast growth.

I will break my cost down and give you the cost of maintenance after construction is over and you have seeded your field.

New Field Maintenance Cost - Sand Base Field

Mowing - 1 man 9 hr	$ 90.00	per month
Fertilizer-1280 lb	$ 270.00	per month
Sweeping - 1 man 28 hr	$ 280.00	per month
Water - 2 million gallons	$ 500.00	
Total Cost	$1,190.00	per month
Cost/ft^2	.62¢	per month

After the first year the cost will drop to a more acceptable level. You will also have to add to your maintenance costs the cost of aerating and thatching which is very important in any field maintenance.

The cost of maintaining a field that has been in for some time will give you a better idea what your sand base field will cost in yearly maintenance.

ONE YEAR OR OLDER FIELD MAINTENANCE COSTS

74,100 ft^2 - March-October
$10.00 per man hour

MOWING

1 Man - 2 hr - twice weekly	Cost/month	$ 160.00
Equipment	Cost/month	36.00
Maintenance	Cost/month	80.00
	Cost/year	$2404.00

FERTILIZING

Once Monthly - March-October

1 lb N/1000 ft^2	
Fertilizer - $250.00/ton	$ 500.00
2 men - 2 hr/month	160.00
Equipment	118.00
Cost/year	$ 778.00

SWEEPING

Twice Monthly

2 men - 3 hr	$ 960.00
Equipment - truck and sweeper	72.00
Cost/year	$1032.00

AERATING FIELD

Six Times Per Year

1 man - 1 hr	$ 60.00
Equipment - truck and aerator	$ 81.00
Sweeping - 1 man - 2 hr	$ 120.00
Cost/year	$ 261.00

SPRAYING FOR TURF WEED CONTROL	$ 250.00
TOTAL COST	$4725.00

Cost/ft^2 - 1¢ per year

This cost does not include watering since I did not have an accurate record of the amount of water used. This cost will vary with type of field, and the cost of thatching should be added.

THERE AIN'T NO FREE LUNCH[1]

J.M. Vargas, Jr.[2]

Kentucky bluegrass is the most widely grown cool-season grass in the northern United States and Canada. It is used on homelawns, general turf areas, and on golf course fairways and roughs. Kentucky bluegrass is culturally adapted to a 1½-2 inch height of cut although it can be maintained at higher heights of cut and to minimal irrigation. Kentucky bluegrass has three major diseases, *Helminthosporium* melting-out caused by *Helminthosporium vagans*, *Fusarium* blight caused by *Fusarium roseum* and stripe smut caused by *Ustilago striiformis*. In the western United States striped rust caused by *Puccinia striiformis* is also a major problem. Kentucky bluegrass has several minor problems including powdery mildew caused by *Erysiphe graminis*. The rusts caused by *Puccinia* species, dollar spots caused by *Sclerotinia homeocarpa*, *Corticium* red thread caused by *Corticium fuciforme* and fairy ring caused by various fungi in the class of basidiomycetes. It also has a few insect problems, mainly the chinch bugs, the bilbug, white grubs, and sod webworm.

Maintaining Kentucky bluegrass on irrigated golf course fairways has met with little success. Kentucky bluegrass is not adapted to a heavy irrigation regime. When irrigation is used to keep fairways soft and lush, the 3/4-1 inch height of cut is employed. Kentucky bluegrass disease and insect problems often go untreated on fairways usually under the guise of being too expensive. Under such conditions the Kentucky bluegrass usually disappears and is replaced by annual bluegrass.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

2 Plant Pathologist, Michigan State University, East Lansing, MI.

Annual bluegrass has been cursed over the past 50 years as the number one problem on golf course fairways. Turf experts have often suggested if you can get rid of your annual bluegrass and replace it with Kentucky bluegrass, all your problems are solved. The annual bluegrass that replaced the Kentucky bluegrass, while adapted culturally to the 1/2 to 3/4 inch mowing heights also had its disease and insect problems which were also not treated because it was too expensive and because most of the dying was attributed to high temperature kill. But unlike Kentucky bluegrass annual bluegrass was capable of reseeding itself, from the abundant seed supply in the soil. When the annual bluegrass continued to die season after season, it was cursed as the scourge of the golf course, as something that had to be gotten rid of. Most turf experts offered a very simplistic solution to the problem. Simply get rid of the annual bluegrass in the fairways, replace it with Kentucky bluegrass and all your problems are solved.

Researchers who made such suggestions obviously have never embarked on a program of trying to eliminate annual bluegrass and replacing it with Kentucky bluegrass. It cannot be done until the cultural regime is changed; this consists of raising the height of cut on the fairway to 1½ inches allowing them to become hard and dry in the summertime. Also, the inference was made that once the Kentucky bluegrass was established that one's problems would simply all go away, but it is a matter of trading one set of disease and insect problems for another. Neither species is all good nor is either species all bad. Each has a place to which it is culturally adapted, each should be grown under that cultural system and the pest problems of each should be taken care of. Anyone who thinks he can grow Kentucky bluegrass without taking care of its insect and disease problems is soon going to be managing annual bluegrass at lower height of cut or tall fescue, quackgrass and crabgrass at the higher height of cut, because there ain't no free lunch.

Let us assume we are going to maintain Kentucky bluegrass fairways. First, we need to select the cultivars most adapted for this cultural system. There are really only three which appear aggressive enough to compete with annual bluegrass under such a regime. They are Touchdown, Brunswick and Bensun. Other cultivars which may be used where a lower cultural intensity is invoked are Cheri, Adelphi, Majestic, Baron, Parade and Enmundi. Three or four of these cultivars should be planted in a blend. This blend should be maintained at a minimum of 1 inch height of cut and preferably closer to 1½ inches. Supplemental irrigation should be kept at a minimum. The Kentucky bluegrass should only be irrigated when it begins to show signs of wilt. This will discourage the entry of annual bluegrass into the Kentucky bluegrass turf. While these cultivars offer the best disease control currently available, they are not perfect, and therefore, some type of fungicide management program will have to be followed in order to prevent the Kentucky bluegrass from being destroyed. Insecticide programs will also have to be followed if the Kentucky bluegrass is not to be lost. With this in mind, the following will be a discussion of the disease problems which occur on Kentucky bluegrass.

MINOR DISEASES

Powdery mildew is a problem on some Kentucky bluegrass varieties (i.e. Merion, Baron, Fylking) when they are grown in the shade. The solution is to avoid planting susceptible varieties in the shade, using Kentucky bluegrass cultivars like Bensun (Warren's A-34) and Nugget that are shade-adapted. You may also wish to consider using other species of grass in the shade. The fine leaved fescues will do well in open shade and *Poa trivialis* can be used under dense, moist shade. The leaf and stem rusts are a problem on slow growing turfs, usually due to the lack of nitrogen fertility. The rust problem can be eliminated by increasing the amount of nitrogen or the frequency of the nitrogen application so the turf is mowed at least once a week. If the Kentucky bluegrass fails to respond due to cool weather, applications of a fungicide like Fore, Zineb or Tersan LSR should correct the problem. Dollar spot can usually be controlled in Kentucky bluegrass by increasing the nitrogen; however, chemical control may be necessary on cultivars like Nugget.

Fairy ring is a unique problem. It is really not a disease problem in the sense of a pathogen attacking a grass host; it is simply a fungus growing in the thatch or organic matter, the fungus body (mycelium) which is hydrophobic, forms a water-impervious layer. Consequently, where the main body of the fungus is located, the turf dies from lack of water. The only controls are to remove the fairy ring along with the contaminated soil and replace it with clean soil, or else fumigate the area. Fairy rings are most often found in turf areas where tree branches, roots or trunks have not been removed or where they have been used as fill. Avoiding such practices will help prevent the development of fairy rings.

I am sure most of you do not consider *Helminthosporium* melting-out to be a major problem in Kentucky bluegrass. It is not a major disease problem because of the many *Helminthosporium*-resistant cultivars which have been available for many years. 'Merion's' popularity and wide use can be directly attributed to the fact that it was the first and only *Helminthosporium*-resistant cultivar available for many years. Today, *Fusarium* blight and stripe smut receive all the notoriety as the major diseases of Kentucky bluegrass; however, if it were not for the many *Helminthosporium*-resistant cultivars which are available, *Fusarium* blight and stripe smut would not be important because melting-out would have eliminated the desirable Kentucky bluegrasses long before *Fusarium* blight and stripe smut had a chance to be a problem!

What are the best *Helminthosporium*-resistant cultivars?

There are many cultivars which have excellent *Helminthosporium* melting-out resistance, but this disease cannot be looked at alone. *Fusarium* blight and stripe smut must also be taken into consideration. Merion and Windsor have excellent resistance to melting-out but are very susceptible to stripe smut and *Fusarium* blight. Fylking, Nugget and Pennstar, likewise, have excellent resistance to melting-out, but all are highly susceptible to *Fusarium* blight. Using any of these cultivars will result in an unsatisfactory turf.

Rather than trying to list all the Kentucky bluegrass cultivars that are susceptible to stripe smut and *Fusarium* blight, it is better to accent the positive and list what appear, today, to be the varieties with the best resistance to all three diseases:

Cheri	Enmundi
Adelphi	Parade
Majestic	Baron
Touchdown	Warren's A-20

Since blends give added strength to a turf, especially against such diseases as stripe smut, a blend of 3 or 4 of these Kentucky bluegrass cultivars would be ideal.

This is not to say that these cultivars will always remain resistant or that some new disease won't come along and destroy them. However, based on our present knowledge, these are the best varieties available. At least there is a chance to have a disease-free turf using these resistant cultivars. No such chance exists when you use the disease-susceptible cultivars like Merion, Fylking, Pennstar, Nugget and Windsor.

The use of proper cultural practices consists of watering in the daytime to allow the foliage to dry before dark, maintaining adequate levels of phosphorus (P_2O_5) and potassium (K_2O), based on yearly soil tests, and proper timing of nitrogen applications. Table 1 has a schedule for the Kentucky bluegrass turfs on fairways, park areas, industrial sites or homelawns in the Pacific Northwest. Assuming we start with a cultivar of Kentucky bluegrass which is resistant to *Helminthosporium* melting-out, our two main concerns are going to be *Fusarium* blight and stripe smut. The nitrogen fertility schedule was developed with this in mind. By limiting the nitrogen fertility in the spring, the severity of *Fusarium* blight should be reduced and by limiting the nitrogen fertility in the summer, the amount of turf lost to stripe smut should also be reduced. Not fertilizing in the fall and avoiding lush growth going into the dormant season will reduce the severity of *Typhula* blight and *Fusarium* patch.

KENTUCKY BLUEGRASS TURFS WITH EXISTING DISEASE PROBLEMS

If you have a *Helminthosporium* melting-out problem in your turf now, you must be growing one of the "common types" of Kentucky bluegrass. To control melting-out, you should really begin your fungicide spray program in the fall when the cool, wet weather begins (temperature below 70°F) with a fungicide like Daconil 2787, Dyrene, Acti-dione, Thiram, Tersan LSR or Fore on a 7-10 day basis or Chipco 26019 at 3-4 week intervals. With the arrival of spring, one of the fungicides applied in the fall will have to be applied again on a 7-10 day basis until the warm weather of summer arrives. I think you can see that a fungicide program for the control of *Helminthosporium* can be very time consuming and costly, which all goes back to "do it right the first time," specifically, plant a resistant cultivar.

FUSARIUM BLIGHT

Fusarium blight symptoms appear when the infected plants are under drought stress. Light, frequent waterings during dry periods will help suppress symptom development. Heavy, infrequent waterings are of little use because infected plants have short roots, usually no longer than an inch in length. *Fusarium* blight infected turfs need no more than 20 minutes watering at any time, but they need it daily during warm weather and every two to three days during cool, dry weather. The ideal time to water would be at mid-day when it is the warmest.

CHEMICAL CONTROL

Chemical control can be obtained with any of the benzimidazole systemic fungicides (Tersan 1991, Fungo, Cleary's 3336) provided they are applied properly. This means irrigating the area the night before and drenching the systemic fungicide in before it has a chance to dry on the foliage. You are dealing with a crown and root rot problem, and that is where you need to get the fungicide. It will be translocated upward, but it is not translocated downward. This treatment is very expensive and because of the expense, many people have the idea that one treatment will cure their problem forever. It won't and you will need to treat every year if you don't want the problem to recur. It is no different than spraying your roses or apples every year for their disease problems.

Resistance by some strains of *Fusarium* fungi to the benzimidazole systemic fungicides have been reported. This should not be surprising since the development of resistance to the benzimidazoles has been reported for every other major pathogen they were used on exclusively. This means that you will probably have success in controlling your *Fusarium* blight for 2 or 3 years after which time you may not be able to obtain control.

In Michigan we have also found nematodes to be involved in the development of *Fusarium* blight. The two most common nematodes associated with the disease are, the stunt nematode (*Tylenchorhynchus dubius*) and the ring nematode (*Criconemoides* spp). They appear to predispose the Kentucky bluegrass plants to infection by *Fusarium*. The nematodes continue to feed upon the plant's roots even after infection by *Fusarium* has occurred, causing additional stress on the infected plants. We have been able to control the disease with 3 lb/1000 ft^2 of nematicides like Dasanit. These nematicides are extremely toxic and should only be used by professionals. Because of their toxicity, they should not be used on homelawn turfs, but rather on golf course or general turf areas. The day the nematicides are applied, these areas should be closed to the public. The nematicides should be drenched in order to receive maximum benefit and for safety reasons. In addition to the nematicides, we have shown that the systemic fungicides can reduce the nematode populations when they are drenched into the soil.

STRIPE SMUT

A turfgrass plant infected with stripe smut is infected for life. All plants arising from that infected mother plant will be infected. It is a systemic disease that may remain dormant in the crown of the plant, or it can spread up the veins of the leaves, eventually rupturing the epidermis and releasing many black spores which may attack other plants. Whether you see the spores or not, the plant is always in a weakened condition and the first stress that comes along will kill it. The most common stress is drought. If you have a healthy Kentucky bluegrass turf, it will go dormant when it is not watered and will revive again once water is applied; however, a stripe smut infected turf will die. It is important not to let a stripe smut infected turf dry out.

CHEMICAL

Stripe smut can be "controlled" (more like arrested) with high rates (4-8 oz/1000 ft^2) of the benzimidazole systemic fungicides. The best results are obtained when the systemic fungicides are applied as dormant drenches. However, applying the systemic fungicides as dormant drenches increases the amount of melting-out in the spring. Even *Helminthosporium*-resistant cultivars like Merion become susceptible after such treatments. This means that the stripe smut treatment must be accompanied by a melting-out treatment, and the PCNB fungicides are the only ones which give this long term *Helminthosporium* control over the entire dormant period.

Late spring and early fall applications of the benzimidazole systemic fungicides are also effective against stripe smut, if they are applied when the grass is actively growing. Avoid applying them when grass growth is beginning to slow down because of warm or cold temperatures. While this is not as effective as dormant applications, it does avoid *Helminthosporium* melting-out problems. But what is the bottom line? The bottom line is that these are merely stop gap measures. The systemic fungicides, no matter when they are applied, do not eradicate the disease and it comes back every year. Resistance to the benzimidazole systemic fungicides has been reported for every major pathogen on which they have been used exclusively and resistance to the systemic fungicides in the smuts will also occur. So, you may be able to obtain 2 or 3 years of stripe smut control.

TURFGRASS PERFORMANCE UNDER IDAHO CONDITIONS[1]

R.D. Ensign, V.G. Hickey, W.R. Simpson[2]

The performance of many turfgrasses under Idaho conditions have been reported in previous Northwest Turfgrass Conference proceedings. We have been able to evaluate the performance of most major cool-season turfgrasses under two district environments: the cool and moist air, and heavy soils of northern Idaho; and the arid, warm summer temperatures, and relatively high pH silt soils of southwest Idaho. The latter is more typical of intermountain conditions of Idaho, Oregon, Nevada Utah and western Wyoming.

There turfgrass plots, which were established in 1972 and 1975 respectively at Moscow and Parma, Idaho, are maintained through 1979 and significant notes were recorded.

MOSCOW LOCATION

At this location, about one-half of the 111 cultivars were Kentucky bluegrasses and the balance were fineleaf fescues, perennial ryegrasses, bentgrasses, and others.

These plots were fertilized with a total of six (6) lb of N, two (2) lb of P and four (4) lb of K per 1000 ft^2, applied equally in four applications. The grasses

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] University of Idaho, Moscow, ID.

were irrigated weekly or as conditions required. Three levels of mowing were made; one-inch level, two inch level, and 3 inch level. Notes on color, diseases, and general appearance were taken. A summary of the scores are provided on a separate sheet.

The "best" color of the grasses in 1979 are relatively the same as from previous years. The grasses with outstanding color were:

Early Season 3/29	Mid Season 7/5	Late Season 9/6
KENTUCKY BLUEGRASS		
Adelphi	Adelphi	Baron
Baron	Baron	Fylking
Delta	Fylking	Glade
Garfield	Glade	Newport
Park	Newport	Pennstar
Touchdown	Nugget	Victa
K2-100	Pennstar	Ram #1
	Ram #1	Merit
	P-164	Birka
	Bristol	Continental
	Brunswick	Galaxy
	Majestic	Majestic
FINE LEAF FESCUE		
Barfalla	Biljart	Barfalla
Koket	K4-21	Koket
Fortress	K5-28	Jamestown
Scarlet	Dawson	Biljart
Aberystwyth S-59		Banner
		Fortress
		Kensington
PERENNIAL RYEGRASS		
Servo	Manhattan	Citation
Yorktown II	Yorktown II	Diplomat
	Loretta	
	Norlea	
	NK-200	
	K-137	

MOWING HEIGHT

There were performance differences among cultivars with respect to mowing height. The desired mowing height of bluegrasses appeared to be the 2 inch level although grasses like Glade, Nugget, Victa, Majestic, and Galaxy retained good color and turf quality with the 1 inch clip. The 3 inch height left more residue in many bluegrasses and created a less favorable appearance. The fine leaf fescues generally favor the 3 inch cut, especially late in the season. Biljart (C-26) hard fescue gave excellent quality turf under these conditions.

The higher mowing height of 3 inches was generally most desirable for the perennial ryegrasses. The several cultivars of perennial ryegrasses have been performing very well under these conditions.

DISEASES

The winter diseases were expressed well during the 1978-79 winter periods when we experienced one of the longest winters of snow cover, with over a continuous 100 days of cover. *Fusarium* and *Typhula* were especially destructive on some fine leaf fescues and some perennial ryegrasses. The damage was more severe at the 3 inch level of cut than at the lower cuts. Apparently the extra residue on the turf surface provided better conditions for the snow mold pathogens. Reactions of ryegrasses and fescues to the snowmold pathogens are:

RESISTANT	INTERMEDIATE RESISTANCE	SUSCEPTIBLE
Servo	Omega	Diplomat
Norlea	Yorktown II	Loretta
Biljart	Manhattan	K5-92
Fortress	Pennlawn	Citation
Kensington	Jamestown	K-137
K5-29	Aberystwyth	NK-200
Scarlet	Banner	Pennfine
Wintergreen	K4-21	Halifax
Koket	K5-28	Barfalla
	Atlanta	
	Dawson	
	RV 45 C	

Very little winter diseases were noted on the Kentucky bluegrasses, and all bentgrasses were treated with fungicides.

PARMA - SOUTHWEST IDAHO

Twenty (20) turfgrass cultivars were planted in April 1975 at this location which has an arid climate. The soils are flood irrigated and are generally 7.5+ pH. All cultivars were mowed weekly during the 1979 season at a 1.5 inch and 3.0 inch level. Color readings and quality performances were recorded.

The five outstanding cultivars measured by dark green color for two representative 1979 dates were:

May 16		September 12	
1.5 inch	3.0 inch	1.5 inch	3.0 inch
Victa	Nugget	Touchdown	Touchdown
Nugget	Victa	Belt Turf	Belt Turf
Baron	Touchdown	Biljart	Biljart
Belt Turf	Baron	Victa	Victa
Touchdown	Biljart	Merion	Merion

Cultivars having light green-yellowish appearances were: Delta, Arboretum, Park, Garfield, Cougar, and Barfalla chewing fescue.

MOWING HEIGHT

Affects grass quality. The grasses perform best and give the best color appearances at the 3 inch mowing height as compared to the 1 inch cut. Touchdown, Nugget, Merion and Biljart seem to tolerate close mowing better than other cultivars.

Seasonal performance for color varied. The Septemver color evaluations were superior to the May readings. Cool nights, adequate irrigation, and good nutrition favored better readings and overall turfgrass quality.

Diseases were not noted to be significant problems except Nugget KBG. A distinct dark fading-out symptom was noted in September with this particular cultivar. The causal agent was not identified at this writing. As in the past, some *Helminthosporium* leafspot was noted on some bluegrasses. No other serious leaf diseases of rust or smuts were noted in 1979 at Parma.

Cool nights, adequate irrigation, and good nutrition favored better color readings and overall turfgrass quality.

NEW REGIONAL TURFGRASS TESTS - IDAHO

Turfgrass researchers in the western states have planned a region-wide project to evaluate new turfgrasses for adaptability and desirable turfgrass characteristics. These grasses are from plant breeders and seed companies throughout the world. Currently the cooperating states are Arizona, California, Colorado, Idaho, Nebraska, and Washington. Other states may become involved in a limited basis. The research is planned and coordinated by a Western Regional Turfgrass Committee.

The plots were planted in Idaho May 15-16, 1979 at our Southwest Research and Extension Center at Parma. This is an area which is representative to much of the arid intermountain irrigated area.

The Idaho test has 160 cultivars; 70 of *Poa pratensis* 48 of *Festuca* spp., and 42 of the *Lolium* genera. These are the major cool-season turfgrasses in the U.S.A.

The entries were planted in 2m x 2m plots replicated three times. Uniform planting and management conditions were prescribed by the committee. This includes seeding rates, fertility, irrigation, mowing and note taking. The cultivars are to be uniformly evaluated for emergence, diseases, color, textural evaluation, density, turf quality, weeds, and cutting quality. Data will be recorded periodically over a 3-5 year period.

At this writing only limited data have been taken. It is evident that significant differences in performances and adaptability will be of interest to many turfgrass people.

SLOW RELEASE NITROGEN STUDIES[1]

R.D. Ensign, V.G. Hickey, R.E. McDole[2]

In continuation of a project started in 1978, several slow-release N formulations were compared with more soluble N formulations on 3 northern Idaho golf greens. Objectives were to determine optimum N rates, most favorable timing of applications, and response to different formulations.

The experiments were conducted on three different type construction greens with three different cultivars of bentgrasses. The University of Idaho golf green has an 18 inch sand layer seeded to Seaside bent in 1968. The Moscow Elks green was constructed in 1946 with a find silt loam base, seeded to Highland bent. The Lewiston Municipal Golf Course green, constructed in 1974 of river run sand and decomposed peat, is seeded to Penncross bent.

The fertilizer materials were applied at 6 lb of actual N per 1000 ft^2 per year. The N applications were made in early April, mid June, and early September with the exception of treatment 5, applied in September and April, and treatment 6, applied in September and April, at 8 lb actual N per year. The materials used, and color response follow in Tables 1 and 2.

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] University of Idaho, Moscow, ID.

CONCLUSIONS

The fast-release N materials provided early green-up, with excellent color. The slow-release materials did not give adequate color early in the season. As the season progressed, the IBDU treatments improved in color. By October, when the highly soluble materials were lacking in good color, the IBDU treatments showed excellent color.

Our initial results indicate that the combination of a slow-release and a more rapid release N source, as being made by some fertilizer companies, would be more desirable than either an all fast-release or all slow-release N formulation.

The type of green construction is important in maintaining color. Sand greens are more subject to leaching of highly soluble N materials, so slow-release formulations would have an advantage in maintaining color on sand textured greens. There were less differences among treatments on the green composed of a fine silt loam.

Additional years of testing are needed to assess potential accumulation of slow-release N formulations, and their effect on grass color and quality.

TABLE 1. Fertilizer materials utilized.

Treatment	Source of N	Average seasonal color response[5]
1. Scotts 29-3-3	22.4% WSN[1] Methylene Urea 5.8% WIN Methylene Urea 0.8% Ammonical N	6.1
2. Scotts 22-0-16	14.0% WS Methylene Urea 7.5% WIN Urea	4.5
3. Nitroform-M 38-0-0	Organic Urea Formaldehyde (UF) 27.5% WIN UF 10.5% WS UF	4.1
4. IBDU 31-0-0	Isobutylidene Diurea 27.9% WIN 3.0% WS	4.9
5. IBDU 31-0-0	Isobutylidene Diurea 27.9% WIN 3.0% WS	4.9
5. IBDU 31-0-0	Isobutylidene Diurea 27.9% WIN 3.0% WS	4.9
6. IBDU 31-0-0	Isobutylidene Diurea 27.9% WIN 3.0% WS	5.3
7. Milorganite 6-2-0	Natural organic activated sludge 5.5% WIN	4.4
8. Ammonium nitrate	Nitric N 17% Ammonic N 17%	6.1
9. Ammonium sulfate[2]	$(NH_4)_2SO_4$	5.4
10. Ammonium sulfate Blend[3] 14-4-11-20	$(NH_4)_2SO_4$	5.3
11. IBDU blend 22-2-12	12.4 units IBDU 5.65 Units $AmSO_4$ 2.95 units KNO_3	4.9
12. Ammonium nitrate[4] Blend 23-4-10-4	Nitric 17% Ammonic 17%	5.7

[1] WSN means water soluble nitrogen.
[2] Treatments 9-12 are tested only at the Lewiston Municipal course.
[3] Composed of 50# $AmSO_4$, 8# 42% P_2O_5; 16# K_2SO_4.
[4] Composed of 50# $AmNO_3$, 15# 42% P_2O_5, 50% K_2SO_4.
[5] 1=Dark green; 1=Light green.

TABLE 2. Seasonal response of N formulations[1].

	April	July	October
Slow-Release			
IBDU	3.2	6.3	8
Nitroform	3.2	5.5	3
Fast-Release			
Scotts 29-3-3	6.4	7.1	4.8
Ammonium nitrate 34-0-0	5.8	7.7	7

[1] 9=dark green; 1-light green.

TWO PESTS OF GRASS IN WASHINGTON[1]

R. Lee Campbell[2]

Aphodius pardalis is a tiny white grub which feeds on grass roots, where it may reach populations of as high as 500/ft^2. At high levels of population, infected turf turns brown and, since the roots are generally pretty well eaten away, patches of it can be rolled back like a rug. Beginning in mid-June adults appear and lay eggs. The larvae are the over-wintering stage. This beetle occurs sporadically from southern British Columbia throughout Washington and Oregon and over into southern Idaho. One turf superintendent wiped out an infestation this year with Dylox applied in mid-May. It is probable that any insecticide labeled for control of white grubs would be effective, if it were watered in so that it reached the level where the grubs are. The sporadic nature of these infestations make it inadvisable to treat routinely and I would suggest that all of you just watch for turf turning brown for no apparent reason.

The European cranefly (*Tipula paludosa*) is a pest of lawns, golf courses, pastures, and hay fields in northwestern Washington. The larvae feed on roots, stems, and leaves of a wide variety of grasses, legumes, and other plants; seriously damaging them during heavy outbreaks. Also, the adults, because of their great abundance and their habit of collecting upon the sides of buildings, can be a great nuisance to people. This

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

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

cranefly is a native of Europe, ranging from lower Scandanavia to northern Italy and from Great Britain to the USSR. In this hemisphere, the cranefly was first found in Newfoundland in 1952. It is believed that soil ballast dumped from ships was the original source of the infestation. Here, on the west coast, the European cranefly was first discovered in British Columbia, causing damage to lawns on the outskirts of Vancouver, in 1965. The first find in the United States was in the summer of 1966, at Blaine; and by 1974 there were 30,000 acres of western Whatcom County infested by the cranefly. It has since spread south as far as Seattle and west as far as Port Angeles. The mountains limit its spread to the east. In order to survive, the cranefly needs moist soil during the month of September. Of course our area is ideal for that and our mild winters help too. Dry soil in September really knocks populations down.

Larvae make burrows in the top few inches of the soil. During the day they generally feed just below the ground level, eating small roots and chewing on the crowns of plants, but at night, or on damp cloudy days when the humidity is high, they generally feed above ground. They, in fact, prefer the tender green leaves to the roots and stems; but, they will eat almost any vegetable matter. Some of the recorded hosts are lawn and turfgrasses, cabbage and its relatives (including turnips), beets, wheat, ryegrasses, strawberries, flowers, corn, potatoes, various weeds, buckwheat, lettuce, and peas. Clover is really a preferred host and, if you have an extensive planting of clover, defoliation really looks terrible. You will end up with just the rhizomes; but, after they are through feeding, those rhizomes refoliate and by the middle of June you can't tell anything has happened. Larvae can survive on decaying vegetative matter in the soil even though there are no living plants available; so they are really quite indiscriminate feeders.

From mid-September until winter the very small larvae are in the ground and they do a minimal amount of feeding from now until the onset of cold weather. They overwinter as medium-sized larvae and really don't cause any damage during the fall, but beginning in warm spells in February and at least by early March, they have begun to do a considerable amount of feeding and grow rapidly. The larvae stop feeding about the middle of May, but they don't form pupae immediately, as we would expect. Instead they remain there in the soil all summer long as larvae. They don't feed, but they are active; they respond to stimuli. We really don't know what they are doing during this period or why this resting larval stage is part of their life cycle. Beginning in early August they start to pupate and the pupal period lasts about 11 days. By late August they start to emerge and are most numerous during the first week of September. Ninety-five percent of emergence occurs between August 23 and September 13. Generally the adults disappear after the middle of September. The adults are sexually mature as soon as they emerge from the pupal cases and usually females are inseminated by the males immediately after they emerge. The female quickly begins laying eggs and usually within 8 hours she has laid half of all the eggs that she will lay, and by 24 hours has completed oviposition. The average number of eggs laid per female is about 350. Most of the adults emerge just about sunset or a little after, and have finished mating by midnight. Oviposition, for the most part, is done by late the next morning. Any females that are still alive may fly during the day and, although they have laid most of their eggs the night before, or early that morning, there are frequently still a few eggs left in those flying females. This is one way that the species is dispersed from one area to another. Another factor in dispersal is movement of larvae in infested soil.

It takes a lot of larvae to injure turf. We did an economic study on a hay field in Whatcom County a few years back and determined that anything less than $50/ft^2$ really had little impact on the grass. We've seen some places where as many as $90/ft^2$ were apparently doing nothing to the grass in the way of diminishing stand or permanently injuring the turf. The larger larvae feed mostly on the vegetative part of the plants and once they stop feeding, in the middle of May, the stands recover. The only danger being that, if there is a substantial amount of defoliation, you may get some weeds coming into the bare areas. Always where we have seen heavy cranefly infestations, serious injury has been very spotty. In a 20-acre field you may have only an area 20 ft^2 that really shows damage, even though the craneflies are pretty generally distributed throughout the field. They seem to thrive and do best in low areas of fields where drainage may not be the best; they generally do not do well on high spots or sandy areas. Often where we have seen damage it has been on slopes, and I really don't understand why that is.

Birds really enjoy eating the larvae in the spring and, if you have an infested golf course, the probing of birds and the presence of large flocks may be some distraction to your golfers. If you decide that it is necessary to use a chemical control, the larvae are not hard to kill. We found that Scott's Western Lawn Insecticide or Ortho's 25% EC Diazinon or Geigy's Spectricide 6000 or Ortho's Dursban 5.3% EC, each at the commonly used labeled rates; or FMC Dursban Coated 2G at the higher of the 2 rates that are on the label, all gave nearly complete control of the larvae. The secret to successful control is in timing.

Let's look back at the life cycle and the biology of the beast. The two times when you are likely to be most tempted to apply control measures are in May when you are seeing bare spots in your turf or in early September when there are masses of adults flying about. Neither of these times is really appropriate for chemical control measures. As I have told you, the adults that are flying have mostly laid their eggs, and killing them off is of no great advantage to you, and, as for the time when bare spots occur in the spring, the damage has already occurred, feeding is about over; it is too late at that point to attempt chemical control. Those of you who are thinking ahead have probably had the flash "Ahah, the time to get them is in the fall, after the eggs have hatched and when those young larvae are about --- before they can possibly do any damage and while they are young and tender." Well, true, you can control them easily then, but you <u>may</u> be wasting an insecticide application. We have seen numerous instances where there were large numbers of larvae in the field in the fall, but, for one reason or another, they were unable to survive the winter and by the time spring arrived there were no, or very few, larvae present. So, "yes, it is possible to control larvae in the fall and you will prevent damage by doing so", but you may be wasting money. The thing we suggest is waiting until spring, late February or early March, and then checking to see if you do have a large number of larvae present. If so, then we suggest that, if you want to make a chemical application, you do so before the middle of April. By doing that, you have avoided the possibility of making an unnecessary application in the fall, but you have still gotten your material on in time to prevent the damage that occurs in the late spring. The ideal time is probably mid-March to mid-April. Of course, if you didn't have adults in September, you won't have larvae in the spring.

THE INFLUENCE OF AMMONIUM SULFATE AND UREA ON THE DISTRIBUTION OF AVAILABLE N IN THE SOIL SURFACE[1]

A.S. Baker and S. Kou[2]

ABSTRACT

During a study of nitrogen (N) fertilization of orchardgrass for forage it was found that there was much less nitrification of the reduced N in topdressed ammonium sulfate, $(NH_4)_2SO_4$, than in urea. This occurred because the $(NH_4)_2SO_4$ caused the surface 2 cm of soil to become strongly acidic and the NH_4 ions were absorbed in same locale. The strong soil acidity depressed the activity of nitrifying bacteria. On the other hand, previous to hydrolysis urea can be leached to lower depths because it has not electrical charge. Upon hydrolosis of urea, the soil becomes more basic resulting in rapid biological nitrification. Thus $(NH_4)_2SO_4$ is a superior N fertilizer for turf because the readily available N from this source remains near the surface where most of the root system is concentrated. It is also a good source of sulfur (S) and S deficiencies have been induced by high N applications on forage and turfgrasses in western Washington. There is some evidence that the strongly acidic surface soil condition induced by $(NH_4)_2SO_4$ may discourage annual bluegrass invasion and *Ophiobolus* and *Fusarium* patch diseases.

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] Soil Scientist and Assistant Soil Scientist, Western Washington Research and Extension Center, (WSU), Puyallup, WA.

INTRODUCTION

A study is being conducted at the Western Washington Research and Extension Center to investigate several aspects of nitrogen (N) fertilization of orchardgrass for forage production. The main thrust is to study means of maintaining high yields of forage grass using high N applications without resulting in high levels of nitrate (NO_3) in the forage which may be toxic to ruminants.

Another aspect of this study stems from the fact that negatively charged NO_3 ions are readily leached from the negatively charged soil system while the positively charged ammonium (NH_4) ions are not. Since grasses can utilize both forms of N, anything that will hamper nitrification (biological oxidation of NH_4 to NO_3) will decrease leaching losses of reduced forms of fertilizer N.

It was found that a total of 600 kg N/ha (535 lb/A or 12.3 lb/1000 ft^2) applied in three, equal, split applications during the growing season resulted in dangerously high levels of NO_3 in orchardgrass sampled during the warm part of the season. Although the N in $(NH_4)_2SO_4$ and urea has the same oxidation state, the NO_3 levels in orchardgrass from plots on which $(NH_4)_2SO_4$ was applied were only 1/2 to 2/3 as high as those found in grass from urea fertilized plots. This indicated that the urea-N was nitrified more rapidly than the $(NH_4)_2SO_4$-N. This was confirmed by soil tests. It is this soil test data that we feel will be of interest to people working with turfgrass production and maintenance.

EXPERIMENTAL PROCEDURES

The soil samples were taken at the end of the 1978 growing season; about 2 months after the final N fertilizer application. Five cm (2 inches) of irrigation water was applied immediately following the fertilizer application and there were approximately 14 cm (5.5 inches) of rainfall between fertilization and sampling. Even considering evapotranspiration losses this was sufficient water to cause some leaching beyond the sampling depth. Soil cores were taken to a depth of 12 cm (4.7 inches) and subdivided into the 0-1, 1-2, 2-7 and 7-12 cm depths. These were tested for pH, exchangeable NH_4 and concentration of NO_3. The soil pH was determined in .01 M $CaCl_2$ which prevents pH fluctuations caused by soluble salts but gives pH values that are about 0.6 pH units lower than the pH ordinarily obtained when it is determined in distilled water.

RESULTS AND DISCUSSION

Figure 1 shows that topdressing with $(NH_4)_2SO_4$ resulted in a drastic drop in soil pH especially in the top 2 cm. It is well known that acidic conditions impede the oxidation of NH_4 to NO_3 by the major nitrifying bacteria. Indeed Figure 2 shows that high levels of exchangeable NH_4 were associated with the very acidic top 2 cm of soil while the NO_3 levels (Figure 3) were relatively low when $(NH_4)_2SO_4$ was applied.

Topdressing with urea did not result in as marked a drop in soil pH with respect to the control (or no N) treatment (Figure 1). If sampling had occurred close to the time that urea was applied the soil pH would have been found to be higher than the control because of the following hydrolysis reaction.

$$\underset{\text{urea}}{CO(NH_2)_2} + 3\ H_2O \xrightarrow[\text{urease}]{} CO_2\uparrow + 2\ NH_4OH$$

The carbon dioxide (CO_2) is volatilized and the ammonium hydroxide (NH_4OH) is basic. The slight acidification of the upper soil profile (Figure 1) associated with urea occurred when the NH_4 ions were nitrified to NO_3. The higher initial pH associated with the urea application resulted in rapid nitrification and low levels of residual, exchangeable NH_4 (Figure 2) and higher levels of NO_3 (Figure 3). To avoid volatilization losses of N from urea in the form of ammonia (NH_3) gas it is necessary to water the urea into the soil before it hydrolyzes. Previous to hydrolysis urea is not adsorbed near the surface and moves with the leaching water because it has not electrical charge and is very soluble.

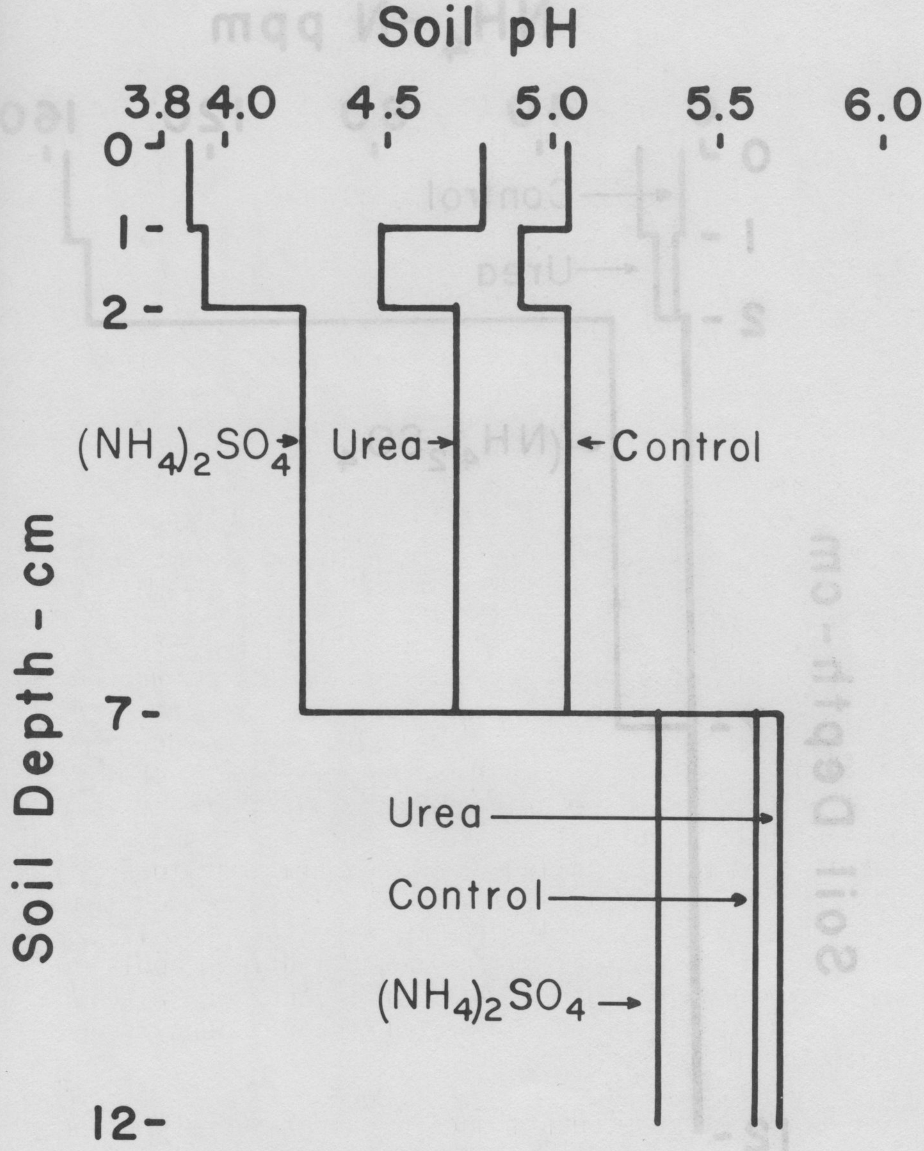

Fig. 1. The effects of no N and 600 kg N/ha as urea and $(NH_4)_2SO_4$ on the variation in soil pH with depth.

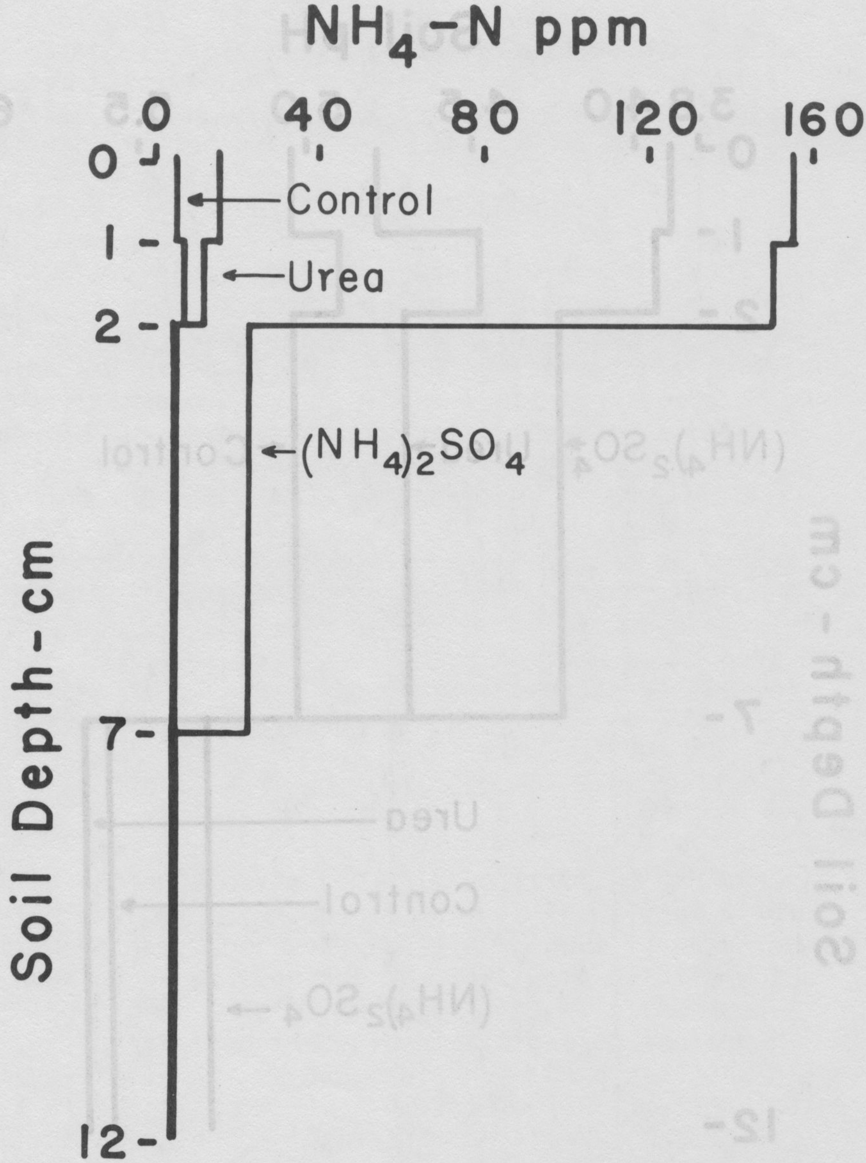

Fig. 2. The effects of no N and 600 kg N/ha as urea and $(NH_4)_2SO_4$ on the variation of exchangeable soil NH_4 with depth.

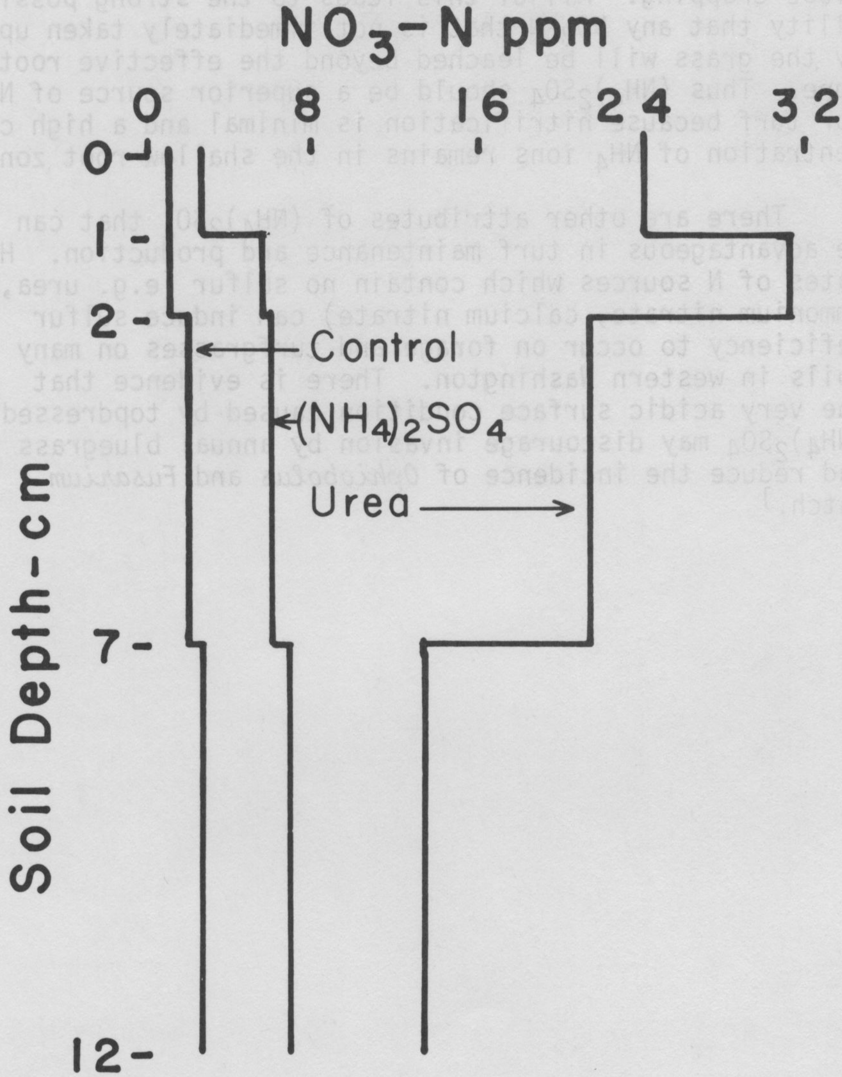

Fig. 3. The effects of no N and 600 kg N/ha as urea and $(NH_4)_2SO_4$ on the variation of soil NO_3 with depth.

The major portion of the root system of most turfgrasses is concentrated near the surface. Moreover well managed turfs receive copious amounts of supplemental water and transpiration losses are minimal because of close cropping. All of this leads to the strong possibility that any NO_3-N that is not immediately taken up by the grass will be leached beyond the effective root zone. Thus $(NH_4)_2SO_4$ should be a superior source of N for turf because nitrification is minimal and a high concentration of NH_4 ions remains in the shallow root zone.

There are other attributes of $(NH_4)_2SO_4$ that can be advantageous in turf maintenance and production. High rates of N sources which contain no sulfur (e.g. urea, ammonium nitrate, calcium nitrate) can induce sulfur deficiency to occur on forage and turfgrasses on many soils in western Washington. There is evidence that the very acidic surface condition caused by topdressed $(NH_4)_2SO_4$ may discourage invasion by annual bluegrass and reduce the incidence of *Ophiobolus* and *Fusarium* patch.[1]

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1 Personal communication with R. L. Goss, Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, WA 98371.

TURFGRASS DISEASE RESEARCH REPORT[1]

Gary A. Chastagner and Worth Vassey[2]

NEMATODES

Thirteen putting greens on eight golf courses were surveyed for nematodes in August and September of 1979. Dr. Fred D. McElroy's report contained in this Proceedings on the incidence of nematodes in turfgrass in the Pacific Northwest contains more information about the survey and the results on the populations of various nematodes found. Table 1 shows the number of various nematodes found and fungi observed in each sample.

Plant pathogenic fungi were only found in 7 of the 26 samples examined. The presence of these pathogenic fungi was not consistently associated with samples obtained from diseased or abnormal turf.

Tests are planned during 1980 to expand the area surveyed and determine the extent of damage being caused by some of the nematodes found during the present survey.

RED THREAD

Recent testing of growth retardants by Drs. John Roberts and Roy Goss have revealed that increases in the incidence of red thread caused by *Corticium fuciforme* can occur following the use of these materials (Table 2). Reduced growth of turf has been shown to

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

[2] Assistant Plant Pathologist and Agriculture Research Technologist III, Western Washington Research and Extension Center (WSU), Puyallup, WA.

result in the increase of red thread and this is probably why increases in this disease are seen following the use of growth retardants.

Thirty-three ryegrass varieties were planted in September of 1978 as part of a Western Regional Variety Trial. Red thread became well-established during August and September, 1979, and data collected on September 6 revealed that the percent area covered by red thread varied between 8 and 53%. The varieties with significantly less red thread were Pennfine, Citation, Acclaim, Yorktown II, and Loretta, while Servo consistently had the most.

FUSARIUM PATCH

Most of our effort this past year on this disease has been to develop a greenhouse system to study the interaction between this disease and sulfur. A solution culture method has been developed which will allow us to determine if there is a direct relationship between sulfur and susceptibility of bentgrass to this disease. Through such studies it is hoped that we will have a better understanding of why we consistently see a reduction of the incidence of this disease in association with the use of sulfur or sulfur-containing materials.

During the 1978-79 winter, *Fusarium* patch was widespread on our 'Highland' bentgrass/*Poa annua* test plots near Puyallup. On March 19, a test plot was established to determine the effectiveness of 11 fungicides in aiding this diseased turf to recover. Treatments were replicated five times and applied on March 19, April 9, and April 30 in the equivalent of 10 gal water/1000 ft^2. Applications of sulfur (16 oz a.i./1000 ft^2) and Chipco 26019 (1-4 oz a.i./1000 ft^2) resulted in the fastest recovery (4 weeks) of the diseased turf. Other materials tested were Fore 80W, Tersan 1991, Bayleton, and the experimental fungicide CGA 64251 at the rate of 2.5 to 10 g a.i./1000 ft^2. Applications of this fungicide resulted in a dark, blue-green slowly growing turf.

TABLE 1

RESULTS OF NEMATODE/TURFGRASS SURVEY[a]

Course code	Green no.	Condition[b]	Relative number of nematodes per pint of soil										Fungi observed in sample
			Pratylenchus (lesion)	Criconemoides (ring)	Tylenchorhynchus (stunt)	Paratylenchus (pin)	Trichodorus (stubby root)	Longidorus (needle)	Helicotylenchus (spiral)	Hoploluimus (lance)	Heterodera (cyst)	Meloidogyne (root knot)	
79107	3	H	-	33	-	-	-	-	-	-	-	-	*Rhizoctonia* sp.
	3	D	-	33	-	-	-	-	-	-	-	-	*Rhizoctonia* sp.
79108	9	H	-	5,095	-	-	-	-	-	-	-	-	none
	9	D	-	17,250	-	-	-	-	-	-	-	-	none
	1	H	133	3,030	466	133	-	-	-	-	-	-	none
	1	D	-	7,725	-	-	-	-	-	-	-	-	none
79109	9	H	-	1,166	-	-	-	-	833	-	-	-	*Collectotrichum* sp.
	9	D	-	1,732	533	-	-	-	533	-	-	-	none
	11	H	-	2,231	333	-	-	-	1,000	-	-	-	none
	11	D	200	500	-	-	-	-	800	-	-	-	none
79110	2	H	-	-	-	1,598	-	-	-	-	-	-	none
	2	D	-	-	-	-	-	-	-	-	-	-	none
79135		H	-	4,096	-	-	67	-	38,861	-	-	-	*Rhizoctonia* sp.
		D	-	12,055	-	-	1,099	167	23,334	-	367	-	*Collectotrichum* sp.
79136	4	H	400	-	-	-	-	-	34,965	-	-	603	none
	4	D	900	400	-	-	-	-	73,993	-	-	2,065	none
	16	H	33	-	-	-	-	-	25,541	-	-	-	none
	16	D	-	-	-	-	-	-	1,398	-	-	1,232	none

Table 1.

Results of Nematode/Turfgrass Survey (continued)

Course code	Green no.	Condition[b]	Pratylenchus (lesion)	Criconemoides (ring)	Tylenchorhynchus (stunt)	Paratylenchus (pin)	Trichodorus (stubby root)	Longidorus (needle)	Helicotylenchus (spiral)	Hoploluimus (lance)	Heterodera (cyst)	Meloidogyne (root knot)	Fungi observed in sample
			Relative number of nematodes per pint of soil										
79137	8	H	67	266	-	-	-	-	33	-	-	-	none
	8	D	33	533	-	-	-	-	-	-	-	-	*Colletotrichum* sp.
79138	8	H	-	466	-	1,998	-	-	22,045	167	-	-	none
	8	D	-	1,399	-	2,764	-	67	159,340	200	-	-	none
	PS	H	-	2,431	-	733	-	-	55,744	-	-	-	none
	PS	D	-	10,922	-	1,099	-	-	70,729	-	-	-	*Fusarium nivale*
	PN	H	-	1,465	400	-	-	-	1,365	-	-	-	none
	PN	D	-	1,698	2,464	-	-	133	179,253	-	-	-	none

[a] Samples collected during August and September 1979.

[b] Condition of turf when samples collected: H = healthy or normal; D = diseased or abnormal.

TABLE 2. Effect of growth retardants on the incidence of red thread on a mixture of Astoria bentgrass and red fescue.[a]

Growth retardant	Rate/Ac	Percent area diseased[b]
None	-	8.3 x
Maag	0.25 lb. a.i.	10.7 x
Maag	0.50 lb. a.i.	10.0 x
Maag	0.75 lb. a.i.	11.7 xy
Embark	0.25 lb. a.i.	15.0 xy
Embark	0.50 lb. a.i.	30.0 yz
Embark	0.75 lb. a.i.	35.0 z
Sustar	1 gal	56.7 w

[a] Growth retardants applied on May 23, 1978, disease data taken on June 15, 1978.

[b] Numbers followed by the same letter are not significantly different, P = 0.05, Duncan's multiple range test.

CONTROL OF *VERONICA FILIFORMIS* (SPEEDWELL) 1978-1979[1]

Roy L. Goss[2], John Roberts[3] and S.P. Orton[2]

A new experimental herbicide coded as ACR 1255 (Dikegulac) was compared with our standard treatment of DCPA (Dacthal) for the control of speedwell. The ACR 1255 material was applied at a rate of 15, 20 and 25 l/ha while Dacthal was applied at 13.5 kg/ha active ingredient. The results of the 1978-79 test are summarized in Table 1.

The first applications were applied in July 1978. Although the concentration of speedwell was rather light, significant control of *Poa annua* occurred particularly at the 20 and 25 liter rate of ACR 1255.

The experiment was moved to a site at Tacoma Country and Golf Club where more extensive populations of speedwell could be tested. The site was a mixed stand of bentgrass and *Poa annua* with populations of *Veronica* ranging from 35 to 70%. Treatments were applied on October 3, 1978, and early frost and freezing temperatures occurred lower than in normal years to produce some interesting results. Phytotoxicity ratings

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[1] Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27th, 1979.

[2] Agronomist/Extension Agronomist and Agricultural Research Technologist II, Western Washington Research and Extension Center, WSU, Puyallup, WA.

[3] Extension Turf Specialist, University of New Hampshire, Durham, NH.

were high with ACR 1255 when applied in October with 25 l/ha resulting in 80% yellowing of the plots. Dacthal produced no yellowing. Data shown in Table 1 indicate that by spring, 95% control of speedwell was obtained by all treatments and there were no indications of phytotoxicity by March, 1979 from any treatment. There was an apparent interaction between temperature and ACR 1255 which indicates that this material probably should not be applied as late as October. We would judge from these tests that the latest application date should be September 1, approximately.

Tests were continued in 1979 and were initiated on 4/26/79. On May 17, 1979, observations were made. There was no discoloration to desirable turfgrasses and a significant yellowing of *Veronica* was evident. There was 90-100% depression in flowering of the *Veronica*. during its maximum flowering period.

On July 2, 1979, there was 96% control of *Veronica* with ACR 1255 at 25 l/ha as compared to 47% for DCPA (Dacthal) at that time. Later observations not shown in these data have shown that control with Dacthal continued to a point of 93% by August 1979.

We have a continuing interest in discovering other materials for the control of *Veronica filiformis* other than DCPA (Dacthal) since there have been reports of inadequate control of *Veronica* with DCPA due to soil variability. The availability of Dikegulac for the control of speedwell is solely in the hands of the MAAG Agrochemicals Company and its availability will be predicated upon the extensiveness of its use in other cropping areas.

TABLE 1. Control of <u>Veronica filiformis</u> (speedwell) 1978-1979 tests.

Treatment	Rate/ha	Mean control % 1978	1979
ACR 1255	15 l	95	90
ACR 1255	20 l	95	96
ACR 1255	25 l	95	96
Dacthal (DCPA)	13.5 kg (a.i.)	95	47

Phytotoxicity 12/11/78: 25 l = 8; 20 l = 6; 15 l = 5;

Dacthal = 0. Mean % Veronica = 50%.

THE INFLUENCE OF NITROGEN SOURCES AND VARIABLE RATES OF S AND P ON BENTGRASS COLOR, *POA ANNUA,* QUALITY AND *FUSARIUM PATCH DISEASE*[1]

Roy L. Goss[2], John Roberts[3] and S.P. Orton[2]

The results reported in this paper are a continuing report of a project that was established in the summer of 1975 on a 75% sand-25% sawdust media. The test area was seeded to Emerald creeping bentgrass and maintenance fertility practices were conducted during the summer and fall of 1975, and the treatments shown in Tables 1 and 2 were initiated in the spring of 1976.

Poa annua seed were distributed uniformly over the area to insure a "start" of this weedy grass to determine the effects of treatment during ensuing years.

Fertilizers are applied to these plots from January 13 through December 14 of each year at approximately 2-week intervals to apply the total amount of nutrients shown in Tables 1 and 2. The only variability in the application schedule is that in Treatments No. 10, 11 and 12 where all sulfur is applied in the spring. All other sulfur applications are made uniformly throughout the year. All nutrients applied are expressed in their elemental form and not as oxides.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

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COLOR RESPONSES

March ratings for color as shown in Table 1 indicate that high sulfur treatments produced the best color although mean color ratings were lower than other periods of the year. This effect has generally been observed in the past and is possibly due to the fact that the availability of sulfur is less when soils are cold, therefore, higher levels of S make more sulfur available during this period of time.

April ratings were generally higher than March. During 1979 April was one of the warmer months on record for many years and produced this more rapid greening and growth. The ranges of color responded similarly to those in March.

May ratings were depressed somewhat except for the high sulfur treatments. Most treatments receiving sulfur were about the same as in April although somewhat depressed. All plots treated with Milorganite rated very low and had thin turf. This effect has been noted for 2 or 3 years and efforts are being made to determine this cause.

All June ratings were high with all sources of nitrogen. Plots receiving additional sulfur were best except with Milorganite. There were little differences in color with respect to sulfur variability. It should be noted that the Milorganite ratings significantly improved during June. We don't understand why this happened except for the possibility that trace minerals were applied in May, although Milorganite should be well supplied with micronutrients. No doubt, warming trends during June also caused release of nitrogen and other nutrients from Milorganite. It should be noted also that during the month of June six plots rated near perfect.

In July all plots rated high but lower than June due to heat stress. Milorganite, on the other hand, was not affected in the same way as urea and ammonium sulfate and continued to hold a trend of good quality.

August ratings were moderately high for all plots and all of the nitrogen sources were holding well.

It should be pointed out that *Ophiobolus* patch disease invaded some of the plots before treatments were initiated in 1976. Some of the *Ophiobolus* is still active but is diminishing under high applications of sulfur.

POA ANNUA

Poa annua got off to an early start in all plots since they were overseeded with viable *Poa annua* seed. Due to the slow start of Milorganite initially, *Poa annua* made significant increases within those plots but this trend may change with time.

The lowest percentages of *Poa annua* were recorded with urea at 10 lb, phosphorus at 0.5, potassium at 3, and sulfur at 4.5 lb/1000 ft^2. This plot was rated at 21.3% *Poa annua*. All other plots rated higher than this with Milorganite averaging 73% indicating that sulfur has not exerted a controlling effect on *Poa annua* in the Milorganite plots at this time. The above statement in regard to the poor start of the plots with Milorganite and the high levels of P within Milorganite may possibly account for this high level of *Poa annua* and possibly may persist.

It is expected that *Poa annua* percentages will change within the next two years according to previous experience in other research. In general, significant responses to sulfur with regard to *Poa annua* decreases have generally been observed after 4 to 6 years.

QUALITY

All plots have maintained good quality throughout the duration of this test with the exception of brief periods of poor quality from Milorganite treatment early in the spring. The highest quality of turf was recorded with high sulfur treatments and low phosphorus on plots treated with urea. The addition of sulfur has made little difference on ammonium sulfate treated plots, but there has, likewise, been no adverse effect from additional high applications of sulfur. It should be pointed out that no *Ophiobolus* patch disease has occurred in any of the ammonium sulfate treated plots with additional sulfur added.

FUSARIUM PATCH DISEASE

All ammonium sulfate plots show the least amount of *Fusarium* patch disease regardless of the sulfur level and can be seen in Table 2. High sulfur levels significantly reduce *Fusarium* patch disease in all urea-treated plots. Some of the highest *Fusarium* counts occurred within the urea treatment and especially those plots not receiving sulfur. Milorganite treated plots continue to exhibit good resistance to *Fusarium nivale* although somewhat more susceptible than those treated with ammonium sulfate.

It is planned that this test will continue for two or three additional years.

TABLE 1. The effects of N sources and variable rates of S and P on bentgrass color.

Treatment	March	April	May	June	July	August
U-10 P-2 K-3 S-0	7.0	7.5	6.3	8.3	8.5	8.1
U-10 P-2 K-3 S-1	7.5	7.8	6.8	8.9	8.9	8.1
U-10 P-2 K-3 S-2.5	7.8	7.8	7.0	8.6	8.1	8.4
U-10 P-2 K-3 S-3.5	8.0	7.8	6.5	8.6	8.5	8.9
U-10 P-2 K-3 S-4.5	8.3	7.8	7.8	8.4	8.3	8.8
U-10 P-.5 K-3 S-1	6.5	7.5	5.8	8.5	8.3	8.4
U-10 P-.5 K-3 S-2.5	7.0	8.3	7.8	9.0	8.8	8.8
U-10 P-.5 K-3 S-3.5	6.8	7.8	8.3	9.0	8.5	8.8
U-10 P-.5 K-3 S-4.5	6.5	7.8	7.5	9.0	8.3	8.9
U-10 P-.5 K-3 S-2.5 Spring	7.0	8.3	7.8	9.0	8.3	8.8
U-10 P-.5 K-3 S-3.5 Spring	7.8	8.3	7.5	9.0	8.5	9.0
U-10 P-.5 K-3 S-4.5 Spring	7.0	8.5	7.3	9.0	8.5	8.9
AS-8 P-.5 K-3 S-0	7.5	7.5	7.3	8.1	8.1	8.0
AS-12 P-.5 K-3 S-0	7.5	8.8	7.5	8.3	8.0	8.9
AS-10 P-.5 K-3 S-0	7.8	8.0	7.3	8.5	7.9	8.6
AS-10 P-.5 K-3 S-1	7.5	7.8	7.3	8.5	7.9	8.9
AS-10 P-.5 K-3 S-2.5	7.8	7.8	7.5	8.1	8.0	8.6
AS-10 P-.5 K-3 S-3.5	7.8	8.0	7.5	8.5	8.0	8.6
AS-10 P-.5 K-3 S-4.5	7.5	8.0	7.3	8.4	8.1	8.6
M-10 K-3 S-0	5.5	6.0	4.0	8.0	9.0	8.0
M-10 K-3 S-1	6.0	5.8	4.0	7.6	9.0	8.0
M-10 K-3 S-2.5	6.0	6.5	4.0	7.6	8.5	8.0
M-10 K-3 S-3.5	6.0	6.0	4.0	7.3	8.9	7.9
M-10 K-3 S-4.5	5.8	6.0	4.0	7.6	8.9	8.0

TABLE 2. The effects of N source and variable rates of S and P on Poa annua, quality and Fusarium patch.

Treatment	% Poa annua	Quality	% Fusarium
U-10 P-2 K-3 S-0	23.8	8.1	18.8
U-10 P-2 K-3 S-1	38.8	8.4	11.3
U-10 P-2 K-3 S-2.5	37.5	8.4	12.5
U-10 P-2 K-3 S-3.5	31.3	8.5	5.5
U-10 P-2 K-3 S-4.5	46.3	8.3	2.8
U-10 P-.5 K-3 S-1	33.8	8.1	31.3
U-10 P-.5 K-3 S-2.5	30.0	8.9	7.5
U-10 P-.5 K-3 S-3.5	37.5	9.0	7.0
U-10 P-.5 K-3 S-4.5	27.5	8.8	10.0
U-10 P-.5 K-3 S-2.5 Sp.	33.8	8.6	12.8
U-10 P-.5 K-3 S-3.5 Sp.	30.0	9.0	6.5
U-10 P-.5 K-3 S-4.5 Sp.	21.3	9.0	6.5
AS-8 P-.5 K-3 S-0	45.0	8.1	2.5
AS-12 P-.5 K-3 S-0	40.0	8.3	0.5
AS-10 P-.5 K-3 S-0	40.0	8.4	4.5
AS-10 P-.5 K-3 S-1	47.5	8.5	0.5
AS-10 P-.5 K-3 S-2.5	48.8	8.1	1.25
AS-10 P-.5 K-3 S-3.5	41.3	8.5	1.25
AS-10 P-.5 K-3 S-4.5	36.3	8.4	1.75
M-10 K-3 S-0	70.0	7.6	7.0
M-10 K-3 S-1	72.5	7.5	5.3
M-10 K-3 S-2.5	75.0	7.8	1.5
M-10 K-3 S-3.5	78.8	7.5	7.0
M-10 K-3 S-4.5	70.0	7.8	2.5

REGIONAL TURF VARIETY EVALUATIONS[1]

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

During the summer of 1978 the Western Washington Research and Extension Center joined with the states of Colorado, California, Idaho, Arizona and Nebraska in the establishment of uniform turfgrass variety evaluations. The trials included only named varieties of 33 perennial ryegrasses, 55 Kentucky bluegrasses and 43 chewings, spreading, and hard fescues. All varieties were seeded at Puyallup in September of 1978. Many of the bluegrass varieties and fescue varieties are repeat evaluations from those begun in 1973. However, a number of new Kentucky bluegrass and perennial ryegrass varieties have been added.

The greatest information from these tests will be obtained from the perennial ryegrass tests. Recent development of improved turf-type varieties of perennial ryegrass has resulted in increased use of ryegrass throughout the United States, particularly in the stress environments. Greater attention to management may be required to get perennial ryegrasses to perform really well and for users to be really happy with their performance. The evaluation of these varieties will help to identify adapted types and will be an important part of the developmental use of perennial ryegrasses in the Pacific marine climates.

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1 Presented at the 33rd Annual Northwest Turfgrass Conference, Admiralty Inn, Port Ludlow, WA, September 25-27, 1979.

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Turftype varieties presently on the market include Manhattan, Pennfine, Birdie, Citation, Omega, Derby, Regal, Yorktown, Yorktown II, Diplomat, Fiesta, Dasher, Blazer, Loretta and Caravelle. All of these varieties have improved finer texture, persistence, mowability and attractiveness. Experimental varieties, some included in these tests, may show even greater improvement in mowability, disease resistance and tolerance to heat and cold.

These new perennial ryegrasses may give species relief to problem areas. They can provide quick temporary turf in heavily shaded situations. Their quick establishment and good wear tolerance make them very useful on school grounds, play areas and parks receiving heavy use. The improved mowability, the finer texture, attractive appearance and rapid establishment of the better turftype ryegrasses make them especially valuable for overseeding putting greens, fairways and lawns. These evaluations will be interesting to follow over the next three years and provide needed improvement in our knowledge of turf variety performance and adaptability to this area.

TABLE 1. Sand green - fertility tests

lbs/1000 ft^2/yr					Mean color 4-24-78	Mean Poa annua 4-24-78	Mean color 6-20-78
	N	P	K	S*			
U	10	2	3	0	8	16	8
U	10	2	3	1	9	12	8
U	10	2	3	2.5	9	15	8
U	10	2	3	3.5	9	8	8
U	10	2	3	4.5	9	14	8
U	10	.5	3	1	9	8	9
U	10	.5	3	2.5	9	6	9
U	10	.5	3	3.5	9	6	9
U	10	.5	3	4.5	9	9	8
U	10	.5	3	2.5(S)	9	6	9
U	10	.5	3	3.5(S)	9	5	9
U	10	.5	3	4.5 (S)	9	6	8
AS	8	.5	3	0	9	9	7
AS	12	.5	3	0	9	4	8
AS	10	.5	3	0	9	8	7
AS	10	.5	3	1	9	8	8
AS	10	.5	3	2.5	9	7	7
AS	10	.5	3	3.5	9	8	8
AS	10	.5	3	4.5	9	8	8
M	10	0	3	0	5	50	9
M	10	0	3	1	5	53	9
M	10	0	3	2.5	5	50	9
M	10	0	3	3.5	5	48	9
M	10	0	3	4.5	5	48	9

U = urea

AS = ammonium sulfate

M = Milorganite

P and K = Elemental

* = All S applied throughout the year except (S) - applied in Feb., Mar., and April.