PROCEEDINGS

of the

15th ANNUAL NORTHWEST TURF CONFERENCE

Sept. 27-28-29, 1961

WASHINGTON STATE UNIVERSITY PULLMAN, WASHINGTON

NORTHWEST TURF MEMBERSHIP DUES

	Annual Dues
PARK DEPARTMENTS	
Less than 150 Acres Total Area	$20.00
150 Acres or More	$40.00
CEMETERIES	
Less than 400 Interments per Annum	$20.00
400-600 Interments per Annum	$25.00
600-800 Interments per Annum	$30.00
More than 800 Interments per Annum	$40.00
GOLF COURSES	
Less than Eighteen Holes	$20.00
Eighteen Holes or More	$40.00
Nursery, Landscaping, and Ground Spraying Firms	$20.00
Architects and Engineering Firms	$20.00
Equipment and Material Supply Firms	$20.00
Participating Membership	$10.00
Associate Membership	$ 5.00
All Others	$20.00

1. Annual Dues payable on or before May 15th each year. Dues are based on annual due date nonprorated.

2. Membership includes registration fee for one person at Annual Turf Conference. Other persons from member organization registration fee $5.00

3. NO INITIATION FEES ARE CHARGED.

4. Nonmembers may attend the annual Conference by paying a $10.00 registration fee. For further information on dues, contact Northwest Turf Treasurer.

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Three Lakes Public GC	P. O. Box 234	Wenatchee, Wash.
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Veterans Memorial GC		Walla Walla, Wash.
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Wandermere GC		Spokane, Wash.
Ken Fetters		Auburn, Wash.
Cabinet View CC		Libby, Mont.
Diamond Alkali Co.	3945 S. W. 57th Ave.	Portland 1, Ore.

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BUDGETING FINANCES I

Bill Sanders[1]

There are certain basic concepts in golf course budget preparation and presentation that will generally hold true, regardless of a club's financial position or their golf course maintenance requirements. These practices and ideas should be carefully considered during the entire budget year, and, of course, particularly at the time of budget preparation.

1. Determine what your club desires as a standard of golf course maintenance. Certainly no contractor would bid on a job without specifications to determine what his costs might be. A golf course superintendent cannot pinpoint his labor, materials, and equipment needs that closely. However, by having a detailed discussion with your green's committee, or other governing body, a fairly accurate maintenance program may be planned in advance.

2. Have itemized and complete records of labor, materials, and equipment costs. These may come either from the current job or a previous one. Again a comparison will be made to the contracting business. Generally a contractor's bid is based chiefly upon past records of costs on similar jobs. Without these records he would be bidding blindly and probably foolishly. A golf course superintendent is confronted with a similar situation only without the profit consideration to be figured. Only by past experience and cost records can a budget for any future period be intelligently conceived.

3. Terminology is of considerable importance. Label your budget "Maintenance." If any construction is planned, submit a separate budget with explanatory matter entitled "Construction." Too often superintendents are trapped into spending part of their maintenance money on construction projects that come up during the year. Extra money must be appropriated either at budget time or during the year when projects have to be assumed.

4. Do not submit a budget for more than you actually need with the idea of probably having it cut back anyway. This practice has been standard in many clubs but is basically a poor business approach. You, as the superintendent, should certainly be in a position to know your projected costs for the coming year. You will instill a great deal more confidence in your business ability if you can say: "This is what you will receive for this amount of money. These are the things that you will have to sacrifice if less money is appropriated." It is a rare club officer or committee head who cares to take the definite responsibility for less maintenance. If, for financial reasons, a budget cut is absolutely necessary, be sure and be able, from past cost records, to explain exactly what that cutback will entail.

5. Submit monthly reports to all directors and greens committeemen regarding expenditures and work progress for that month. Midyear and end-of-year budget comparison to actual costs should also be included with these reports. This will help keep club officials well informed and able to talk intelligently to club members regarding the golf course. This is important. No club official likes the feeling of having a responsibility and never knowing

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[1] Superintendent, Riverside Golf & Country Club, Portland, Oregon.

exactly what the current status of that responsibility is.

6. Coordinate your budget categories with the system used by the clubs' bookkeeper. Make monthly itemized checks to insure continuity and accuracy. This is simply common sense as well as good business practice.

7. Use purchase orders or a similar device. This will simplify accurate record keeping, and consequent ease of budget preparation.

8. Pay particular attention to equipment budgeting. Too often when budgeting is not properly planned and coordinated, all major equipment wears out at once and usually at a financially inconvenient time. If your equipment replacement value is $25,000 and the estimated life 10 years, your equipment budget should be $2,500 per year. Equally important, any money not spent from this category during the budget year should be carried over to the following year. This gives a superintendent the financial discretion to buy at the opportune time rather than spending equipment allotments merely through fear of future budget cuts.

9. Keep a mental record of budget progress in comparion to actual costs. As the year goes by, you are then prepared at any time to discuss intelligently any phase of your operation with interested parties.

10. Respect the financial confines of your budget. By anticipating your needs and finishing the year reasonably close to budget expectations you will build confidence among club officials concerning your business ability. Subsequent budget requirements will be easier to obtain and certainly the superintendent will place himself in a much better position from every standpoint.

BUDGETING FINANCES II

Henry Land, Sr.[1]

Comparison of Surveys Conducted by National and Local Organizations

"NATIONAL SURVEY OF STATISTICS CONDUCTED BY HARRIS KERR, FOSTER & CO., ACCOUNTING FIRM FOR GOLF AND COUNTRY CLUBS FEATURED IN THE CLUB MANAGEMENT MAGAZINE, DEC. 1960 ISSUE"

Cost per Golf Hole, 1959-1960

	East	South	Mid-west	West	Average
Salaries & Wages	1,846	1,787	1,850	2,584	1,961
Course Supplies, Contracts	439	481	472	281	429
Repair to Equip., Course Bldgs., etc.	231	261	206	405	255
All Other Expenses	134	215	93	422	178
TOTAL EXPENSES	$2,650	$2,744	$2,621	$3,692	$2,823

THE RISE IN GOLF COURSE MAINTENANCE COSTS

Yearly Average Costs per Hole

1951-52	1952-53	1953-54	1954-55	1955-56	1956-57	1957-58	1958-59	1959-60
$1,878	$2,088	$2,194	$2,246	$2,404	$2,497	$2,628	$2,729	$2,823

This is a 50% increase in eight years between 1951-52 & 1959-60.
70% of the 1959-60 totals of $2,823 was for wages.

NATIONAL SURVEY TAKEN FROM THE HORWATH ACCOUNTING MAGAZINE JUNE 1961

	10 Country Clubs (Dues under $100,000)		20 Country Clubs (Dues of $100,000 to $200,000)		14 Country Clubs (Dues of $200,000 to $400,000)	
	1959	1960	1959	1960	1959	1960
Membership Dues and Assessments	$77,000	$80,000	$135,000	$148,000	$256,000	$272,000
Golf Course Grounds Expenses per hole						
Payroll	1,223	1,261	1,824	1,927	2,250	2,347
Supplies & Contracts	431	482	478	497	488	556
Repairs to Equip., Course Bldgs., Fences, Bridges, etc.	153	164	229	219	244	230
Water, Electricity, Etc.	45	52	137	154	183	203
TOTAL	$1,852	$1,959	$2,668	$2,797	$3,165	$3,338
Ratio to Member Dues	43.2%	44.3%	36.3%	34.7%	28.8%	28.6%

[1]Sandpoint Golf and Country Club.

GOLF COURSE MAINTENANCE BUDGET FOR 1961
SURVEY TAKEN BY THE NORTHWEST GOLF COURSE SUPERINTENDENTS ASSOCIATION OF 10 PRIVATE GOLF CLUBS IN THE PUGET SOUND AREA

	1	2	3	4	5
Wages					
Foreman (per Month)	----	$475	$475	$495	----
Mechanic (per Month)	$450	----	$425	$485	----
Year Round Greenskeepers					
Number	7	7	3	3	5
Wages (per Hour)	$2.00	$2.05	$2.00	$2.15	$2.00
Summer Labor					
Number	2	3	4	4	4
Wages (per Hour)	$2.00	$1.60	$1.65	$1.50	$1.60
Overtime	yes	yes	yes	yes	yes
Paid Holidays	6	6	no	6	6
Paid Medical	yes	yes	no	yes	no
Total Wages (12 Months)	$49,000	$44,205	$39,995	$42,200	$36,860
Materials and Other Expenses					
Misc. Supplies	$ 2,220	$ 6,700	$ 4,076	$ 200	$ 500
Seeds, Fertilizer and Chemicals	5,200	3,900	4,600	4,100	3,500
Top Soil, Sand, and Gravel	2,500	800	1,000	2,000	2,000
Light and Power	2,675	1,400	1,800	2,200	600
Maintenance and Equip. Repair	1,500	2,500	2,059	1,000	2,000
Gas and Oil	1,500	1,500	1,825	1,500	1,500
Meeting and Travel Expenses	320	120	240	120	600
Total Materials and Expenses	$15,915	$16,920	$15,600	$11,120	$10,700
Total Budget	$64,915	$61,125	$55,595	$53,320	$47,560
Cost per Hole	$ 3,606	$ 3,396	$ 3,089	$ 2,962	$ 2,642

GOLF COURSE MAINTENANCE BUDGET FOR 1961
SURVEY TAKEN BY THE NORTHWEST GOLF COURSE SUPERINTENDENTS ASSOCIATION OF 10 PRIVATE GOLF CLUBS IN THE PUGET SOUND AREA

	6	7	8	9	10
Wages					
Foreman (per Month)	$420	----	$420	$400	----
Mechanic (per Month)	----	----	$420	----	----
Year Round Greenskeepers					
Number	4	5	2	3	4
Wages (per Hour)	$2.00	$2.06	$1.95	$1.90	$321/M
Summer Labor					
Number	3	3	4	5	2
Wages (per Hour)	$1.75	$1.50	$1.50	$1.50	$2.68
Overtime	no	no	yes	no	yes
Paid Holidays	5	6	4	no	6
Paid Medical	no	no	no	no	no
Total Wages	$34,200	$41,658	$32,922	$32,270	$25,399
Materials and Other Expenses					
Misc. Supplies	$ 978	$ 1,240	$ 1,515	$ 820	$ 1,843
Seeds, Fertilizer and Chemicals	6,250	1,500	1,850	2,885	1,225
Top Soil, Sand and Gravel	250	1,000	750	1,000	500
*Light and Power	---	850	1,800	1,200	800
Maintenance and Equip. Repair	1,850	1,500	1,550	2,220	1,000
Gas and Oil	1,600	1,000	1,300	1,500	1,500
Meeting and Travel Expense	600	---	420	210	---
Total Materials and Expenses	$11,528	$ 7,090	$ 9,185	$ 9,815	$ 6,868
Total Budget	$45,728	$48,748	$42,107	$42,085	$32,267
Cost per Hole	$ 2,540	$ 2,708	$ 2,339	$ 2,338	$ 1,793

Average cost per hole in the Puget Sound Area is $2,743.
Superintendent's annual salary was included in total wages.
*Light & Power on Course No. 6 was included in Clubhouse budget.

SNOW MOLD INVESTIGATIONS IN EASTERN WASHINGTON

T. H. Filer and A. G. Law[1]

"Snow mold of turf" in the Pacific Northwest must include both Fusarium Patch caused by Calonectria graminicola (Berk and Br.) (conidial stage Fusarium nivale (Fr.) CES.), and Gray snow mold caused by Typhula itoana Imai, which occur together to give a disease complex. Snow mold of turf is the most destructive disease in many parts of the Northwest. It is very common in eastern Washington, northcentral Idaho, and western Montana where snow covers the turf for long periods. Attempts to control snow mold on turf in this region have been only partially successful. Tests were undertaken to determine the rate and kind of chemicals that would provide the best control of snow mold. This is a report on these tests.

The fungicide tests were conducted on golf greens at Spokane and Pullman, Washington. All tests were conducted on three replicated plots 5 x 10 feet in size. The fungicides were applied as a spray with water as diluent at the rate of 5 or 10 gallons per 1,000 square feet. The nozzle pressure was approximately 30 psi. The materials were applied in three applications (October, November, January) or in one application on one of the above dates.

Results of Fungicide tests are shown in Table No. 1 and Table No. 2.

Three applications of any of the materials provided efficient control even of severe infections; two applications of Tag (PMA), Panogen, Calo-clor, or Cadminate provided adequate control at both locations. One application in October or November of Tag, Panogen, Calo-clor, or Cadminate resulted in a low percentage of snow mold at Pullman. One application of Tag gave little control at Spokane (Table No. 2).

Panogen was the only chemical that did not cause any discoloration of the turf. Tag and Calo-clor produced the greatest damage on turf in the October treatments. Cadminate treatments showed some temporary injury to turf in the October treatments.

The results would indicate that 2 ounces of Tag (PMA) or 3 ounces of Panogen (Methylmercury dicyandiamide) in two or three applications will give good control at both Pullman and Spokane. The results also indicate Cadminate and Calo-clor in three applications are best for the Spokane area. It appears that Cadminate and Calo-clor are more effective against Typhula itoana, the dominant organism in the Spokane area, and less effective against Fusarium nivale, which is more common in Pullman.

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[1]Research Assistant, Department of Plant Pathology, and Professor, Department of Agronomy, Washington State University, Pullman, Washington.

TABLE 1. The Effect of Three Applications of Fungicides on Snow Mold at Pullman and Spokane in 1960-61

Treatment	Dosage[a] per 1000 sq. ft.	Amount of Water per 1,000 sq. ft.	Per cent control Pullman	Per cent control Spokane
	ounces	gallons		
Tag (10% Phenyl mercury acetate)	2	5	96	95
	2	10	92	93
Panogen (Methylmercury dicyandiamide)	3	5	92	98
	3	10	97	96
Cadminate (60% organic Cadmium)	3	5	93	99
	3	10	93	100
Calo-clor (Mercurous chloride 60% and Mercuric Chloride 30%	3	5	84	98
	3	10	93	100

[a]Total amount of material at each date (Oct. 20, Nov. 17, and Jan. 10).

TABLE 2. The Effect of One Application of Fungicides at Different Dates on Snow Mold at Pullman and Spokane in 1960-61

		Per cent control					
		Pullman			Spokane		
Treatment	Dosage[a] per 1000 sq. ft.	Oct.	Nov.	Jan.	Oct.	Nov.	Jan.
Tag	2	91	93	77	69	82	75
Panogen	3	95	89	77	91	91	87
Calo-clor	3	99.4	91	73	98	82	68
Cadminate	3	100	86	72	99.9	81	75

[a]Total amount of material in one application in five gallons of water.

PANEL DISCUSSION OF NORTHWEST TURFGRASS DISEASES

C. J. Gould, WSU, Chairman
N. A. MacLean, UBC, Canada
I. C. MacSwan, OSU, Corvallis, Oregon
C. J. Gould, WWES, WSU, Puyallup, Wn.
Ted Filer, WSU, Pullman, Washington

Introduction

Dr. C. J. Gould

As many of you know, we have a unique area here in the Northwest, distinct in many respects from the rest of the country. The more those of us concerned with turf work on it, the more we realize the turf also is distinct and unique, and unique in its diseases. We have found our disease complex resembles that of England much more than it does that of other parts of the United States. The more we work on turf diseases the more complex the total picture becomes. This afternoon we will try to present to you our latest thinking on the turf disease picture as we now know it to exist in the Northwest, hedging with the fact that continued investigations may reveal other diseases or change the relative importance of the various diseases included in the complex.

We have four men here from the Northwest; two Scotch-Canadians, one Texan, one hillbilly from West Virginia. We are going to hear from one of the Scotch-Canadians first. Dr. MacLean was educated at WSU and worked on botrytis disease of row crops, a serious problem on the west side. We were happily associated at that time--at least I think so. My colleague got his doctorate degree and went to California. Apparently he didn't like the climate there, because he came back to the Northwest to the University of British Columbia and has been there several years. It has been a challenging experionce in more ways than one. Mac started out the first year with one ulcer and one graduate student. The next year he had two ulcers and two graduate students. Last year when I saw him, he had three graduate students and three ulcers. This year he is assistant to the dean and has four ulcers. You see what administrative jobs do to you. With that, I'd like to turn this over to Mac, who will present the disease picture in B. C. We prefer at this time not to get into control measures because we could spend all day on that, but to try to clarify the disease picture as such. Dr MacLean:

Turfgrass Diseases in British Columbia

N. A. MacLean[1]

As I said before, this is my alma mater, and it is always a joy for me to come down and visit. Certainly it is thrilling to see how it is growing. Pullman has changed and the university has changed over a few years. Before getting into the disease picture as we see it in B. C., I'd like to bring you greetings from B. C. people, superintendents and also those at UBC. We would like to invite you to attend our 5th annual conference next year. We don't know whether it is to be in Vancouver as it has been in the past at the university or whether we should follow Dr. Macan's suggestion and hold the conference in Victoria next year. Macan has certainly given us a very warm

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[1] Pathologist, UBC, British Columbia, Canada.

invitation to come to Victoria, so perhaps we should change our site.

Now as to diseases in B. C. We are becoming quite concerned with the disease picture on turf, not only on golf courses but on our playing fields as well. I think perhaps we use turf a little more in B. C. than you people do here. We have a game called cricket, and we have many cricket pitches. We play soccer and rugby as well as football. So we have many, many playfields, parks, and golf courses, and we are building new ones all the time. But we do have a very definite disease problem. Unfortunately, our disease problem is not static; it changes from year to year. You cannot pinpoint a time when a disease is going to occur in our area. You may expect Fusarium in the spring or in the fall, or Red Thread in the spring, but it doesn't occur this way. We had a lot of Red Thread this year. Last year we had very little. This year we had very little Fusarium Patch, and we had a lot of it last year. We are finding Ophiobolus Patch where we didn't expect it to occur, and we are finding a lot of Typhula. You will appreciate that B. C. in area comprises many, many square miles. You can put Washington, Oregon, and California in B. C. and tuck in a little bit of Idaho in the corner. So we have many environmental conditions, and we have many problems.

At the present time we are making a survey of diseases throughout the lower part of B. C. We have a National Research grant along with a grant of $800 that provides student help.

Dr Gould has mentioned we do have some graduate students. We have six this year--two of whom will work on turf and will be supported by the National Research Council. So this is the first thing we are doing, and I am sure Dr. Gould will agree as well as McSwan and others that our problems in B. C. are much the same as you have in Washington and Oregon. After you get down into Oregon and California, problems change a little bit. At the present time we are interested in Fusarium Patch, primarily on putting greens, of course. With Red Thread we are concerned with playing areas as well as golf courses, cricket pitches, and football fields. Ophiobolus Patch is showing up in some of the courses down through the Fraser River area and particularly in the Okanogan area through Kelowna and Vernon. We run into some Rhizoctonia--not too much, but enough to warrant some study. With the new areas being seeded, we are finding some damping off caused by Pythium spp. Rhizoctonia. We have leaf spot, rusts, etc., but we are not too concerned with leaf spot. This is the picture as far as diseases are concerned.

Now what are we doing about it? We are teaching faculty mostly at B. C. and have very little in the way of money as far as travel or outside experiments are concerned. Necessarily, we limit ourselves to laboratory studies. We are most interested in the nutritional requirements of the fungi that are attacking the grass. We leave the control work to Dr. Gould and others to the south who have had more experience and are doing a good job. I don't feel we can add anything. We are interested in growing fungi in various media--amino acids and different types of sugars and starches, carbohydrates, etc. We are interested now in carbon-nitrogen relationships. How this will apply later in that field we are not quite sure. These all are things students can do in labs.

We are also very much interested in nutritional response of some of these organisms. We found some years ago quite an error on our part. Some diseases such as Fusarium Patch would be limited after a very wet season, and we didn't know why. But we planted and inoculated some soil with some of these species of Fusarium--we feel there is more than one species. We feel we perhaps have F. solani and F. roseum showing up in some of our courses. I think perhaps we also have four or five rust varieties.

We found that after a very, very wet season--of course you know in the Northwest it doesn't rain but the tide comes in once in awhile--particularly in Vancouver where we get 60 to 70 inches of rain and in some areas perhaps as much as 140 inches, we got less Fusarium Patch the following year So last year we undertook a project in which we kept the soil above 80 per cent of its moisture-holding capacity, and found in making reisolation, that we are able to recover Fusarium only about 5 per cent of the time. So we feel we have hit on something here. Of course, you couldn't do it on a golf course as a control measure. The only thing is to put the course under water for a number of weeks, but we are studying the anaerobic and aerobic responses of these organisms. Necessarily we find that Corticium is certainly not an anaerobe; it has to have aerobic conditions to thrive and grow. We find that Fusarium sp. on the other hand, thrives fairly well in anaerobic atmosphere. And my guess would be that desiccated in large cylinders and with dry ice, and other artificial means, and growing the organism under anaerobic conditions, we will find that it does fairly well but certainly much better than Corticium and Rhizoctonia. Pythium does very well too.

We are very much interested in soils amendment studies. We have a project now with Canadian Forest Products in which we are using bark--that is, Douglas fir bark. We are adding phosphorus to the bark, at rates of 3, 6, and 12 per cent, and we have some products now on the Los Angeles market as high as 15 per cent that are being used on golf courses in the Los Angeles area. We are using these products particularly in building new greens and also as top dressing, and we are having some success with crops other than turf We also found this last week that when we top-dressed some of the turf for playgrounds it is showing up very well. We will be continuing this, and I hope that next year, if you are in Vancouver, or wherever we are, you can see what we are doing. I might suggest at this time too before I sit down that there are four of us in the plant science department actively engaged in turf, and I'm sorry the others are not able to be here today. But I know that you met Dr. Wonhon, Mr. Brink, and Mr. Watanabe before. Certainly they will continue to participate in this conference, and they have asked me to welcome you all back to B. C. next year.

Notes on Turf Diseases in Oregon

Iain C. MacSwan[1]

The accepted standard for fine lawns in Oregon, as in other areas, has risen in recent years. The general prosperity of the people has allowed them time and money to spend on lawns when troubles occur. Also, the availability of new fungicides and fungicide combinations has made it easier to do something about the diseases. The increased desire for good-looking lawns has been reflected in the increased number of inquiries to county extension agents and other university staff members for answers to lawn and turf problems.

Turf diseases in Oregon have not been systematically surveyed. Our knowledge of the types and incidence of diseases comes principally from observations by plant pathologists, agronomists, county extension agents, seed and

[1]Plant Pathology Specialist, Oregon State University, Corvallis, Oregon.

chemical company representatives, the Plant Clinic at Oregon State University, and others.

The two major turf diseases in Oregon are considered to be Fusarium Patch and Red Thread. Fusarium Patch is probably the most damaging. Red Thread is very prevalent on bents and fescues during the winter months.

The third most important disease is either rust or fairy rings. Rusts are severe on bluegrasses. The problem of rust has increased directly with increased plantings of bluegrasses. Fairy rings are a common nuisance and one of the most frustrating because of a lack of practical control measures.

Brown patch caused by Rhizoctonia sp, is reported to be common in early summer (June). The incidence of this disease decreases considerably, in Corvallis at least, after the water bills for the month of June are received.

Damping-off occurs in newly planted lawns in western Oregon and sometimes severely in southern Oregon (Medford). Pythium sp. and Fusarium sp. are probably the causal organism. However, no doubt other fungi are also a part of the disease complex.

Fading-out caused by Helminthosporium sp. and Curvularia sp. occurs frequently, but has not been a major problem. Similarly, Helminthosporium foot rot has been of little concern.

No survey has been made for the Ophiobolus disease, reported by Dr. C. Gould, Washington State University. However, we believe it to be present in Oregon, and in the past it has probably been confused with fairy ring.

Other Oregon turf troubles are: slime molds, algae, mushrooms, puff balls.

Chemical control of turfgrass diseases in Oregon has been based principally on the research conducted in other parts of the country. Dr. Gould's work at Puyallup has been much appreciated because we felt that his recommendations were getting closer to the needs of Oregon. We have been following his recommendations closely and watching his work with interest.

The turf variety plots established in many Oregon counties by Dr. Norman Goetze, extension farm crops specialist, Oregon State University, will give us an opportunity to do some screening and testing of fungicides.

The increased desire for fine lawns in Oregon has emphasized a need for information and training in turf diseases, causes of diseases, and diagnosis and control measures. One of the first steps in attempting to satisfy this need will be the training of county extension agents. In cooperation with Dr. Goetze and other extension specialists a one-day short course for some county extension agents will be held in Corvallis on October 16. We hope that programs of this type--with county extension agents and others - are continued, in order that the level of turf disease control in Oregon may be raised.

Turf Diseases in Western Washington

Charles J. Gould[1]

The more we study the turf disease picture in western Washington, the more complex it becomes. However, in one respect the status remains the same--our disease complex resembles England's more than it does any other section of the United States.

The definite diagnosis of turf diseases is no easy matter, particularly of samples sent through the mails or kept in closed containers for more than 24 hours. Under such conditions scores of nonparasitic fungi overrun the turf, accompanied by bacteria, nematodes, algae, protozoa, and other organisms. In such specimens we have always found Curvularia, Rhizoctonia, several Fusaria, and many other miscellaneous fungi. Unless definite fruiting bodies of known parasites are present (such as of Ophiobolus, we only make an "educated guess" as to the cause, considering such factors as the time of the year, climatic conditions, type of grass, etc.

It is especially necessary in identifying turf diseases to consider the time of year and preceding climatic conditions. Thus, new infections of both Fusarium and Ophiobolus may vary from tan, through brown, to bright reddish-brown in color, whereas old spots are almost always gray, resembling those of Dollar Spot. New Fusarium spots are more distinct than are old ones. The Red Thread pathogen may cause trouble in dry weather, but the red threads of the fungus are seldom evident at that time. The Ophiobolus Patch fungus attacks grass in the spring but doesn't produce its fruiting bodies until fall.

More than one pathogen may be present in a diseased area. Thus, we have found Red Thread and Fusarium Patch fungi together, as well as those of Red Thread and Ophiobolus, and many other "minor" fungi. The status of these minor fungi is uncertain. For instance, we had assumed previously that Colletotrichum (causing Anthracnose) was only a weak parasite, but its widespread appearance in 1961 makes us suspect that it may become quite active on heat-injured grass and that, once established, it may persist for a long time.

We also believe now that we are fighting more than one type of Fusarium. Although F. nivale (Fusarium Patch) still appears to be the major type, other species have been found in high-cut grass, particularly in warm weather.

Our known diseases are listed below in a rough order of their importance in western Washington. Pertinent facts, including control recommendations, are contained in the following charts.

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[1] Plant Pathologist, Washington State University, Western Washington Experiment Station, Puyallup, Washington.

LOW-CUT (Putting green) TURF

(Most important)
<u>Fusarium</u> Patch/-- <u>Ophiobolus</u> Patch -- Red Thread -- Brown Patch

HI-CUT (Lawns, etc.) TURF

(Most important)
Red Thread/-- <u>Fusarium</u> -- Fairy Ring -- <u>Ophiobolus</u> Patch

Matting -- Colletotrichum -- Slime Mold

GOLF GREEN TURF--Recommendation for Disease Control in Washington in 1962

Charles J. Gould, M. R. Harris, and Ted Filer*

Disease	Symptoms	Type of Weather	Presence in Washington		Recommendations for Control	
			Western	Eastern	Cultural	Fungicidal**
FUSARIUM PATCH (*Fusarium nivale*)	Spots grey, brown or reddish-brown, round, 1-2" at first, sometimes becoming less distinct, ringlike & 2-6" in diam.	Cool Moist	Very Common	Common	Avoid excessive nitrogen, promote air drainage	PMA types (3/4 oz. of 10% type) or cadmium chloride (1 oz. of 20% type) in 10 gal. water per 1,000 sq. ft. every 2 weeks of alternate
SNOW MOLD (*Typhula incarnata*)	Irregular, dead bleached areas, 2"-24" with a grey mold, usually near melting snow	Cold Wet	Common	Common	Avoid late fertilizing	Mercury compounds as per manufacturer's recommendations before snowfall
RED THREAD (*Corticium fuciforme*)	Spots ring-like 4"-24". Weeds or annual blue-grass in center	Cool Moist	Infrequent	Rare	Use adequate nitrogen	Under test. Meanwhile try heavy applications of cadmium or organic mercury fungicides
OPHIOBOLUS PATCH (*Ophiobolus graminis*)	Areas reddish-brown at first, later brown to grey, usually circular, 2"-24" or larger. Both shoots and roots are killed	Cool Moist	Common-?	Common-?	Avoid high time and high nitrogen	Drench in spring using 20 gal. water per 1,000 sq. ft. Try mercuries
COPPER SPOT (*Gloeocercospora sorghi*)	Copper-colored spots 1-3". Color rubs onto handkerchief	Hot Humid	Infrequent	Rare	Try adding lime in small amounts	Use cadmium or mercury fungicides as per manufacturer's recommendations
BROWN PATCH (*Rhizoctonia solani*)	Greenish, brownish-black or brown, thinned areas, spreading rapidly 1"-36"	Hot Humid	Rare	Infrequent	Avoid high nitrogen and frequent watering	Use inorganic mercuries or mixtures of mercury and thiram fungicides
DOLLAR SPOT (*Sclerotinia homeocarpa*)	Bleached, dead spots, 1"-2"	Warm Moist	Unknown	Infrequent	Apply adequate nitrogen and water	Use Dyrene, cadmium or mixtures of mercury and thiram fungicides
Damping off of young seedlings. (various fungi)	Dying of young seedlings, singly or in clumps	Cool Moist	Fairly common	Probably common	Avoid excessive watering after seeding	Treat seed & spray young seedlings with captan or thiram. Fumigate soil with methyl bromide

*Plant Pathologist, Washington State University, Western Washington Experiment Station, Puyallup, Washington; Extension Plant Pathologist and Graduate Assistant in Plant Pathology, Washington State University, Pullman, Washington. Nov. 15. 1961.

**Simple or common names are available for most materials. Therefore, in the interest of space, tradenames are not used in this chart except for Dyrene for which a simple name is not yet available.

LAWN TYPE TURF--Recommendations for Disease Control in Washington in 1962

Charles J. Gould, M. R. Harris, and Ted Filer*

Disease	Symptoms	Type of Weather	Presence in Washington: Western	Presence in Washington: Eastern	Recommendations for Control: Cultural	Recommendations for Control: Fungicidal**
RED THREAD (Corticium fuciforme)	Bleached or tan-colored irregular areas 2"-24" with red fungus strands 1/8-1/4" long on leaves	Cool Moist	Very Common in fescues	Rare	Adequate nitrogen fertilization	Under test. Meanwhile try heavy applications of cadmium or organic mercury fungicides
FUSARIUM PATCH (Fusarium nivale)	Browning and thinning of turf in large (4-18") rather indefinite spots	Cool Wet	Common	Common	Promote air drainage. Avoid high nitrogen	As for golf green turf
FAIRY RING (Marasmius oreades in West. Wash.)	Rings of dark green grass and sometimes dead areas, with or without tan mushrooms 1-2" in diameter	Cool Moist	Common	Fairly common	Adequate fertilization and watering	Suppress with drenches of phenyl mercery acetate. Eliminate with methy bromide. See Wn. St. Ag. Stn. Circ. #330.
HELMINTHOSPORIUM BLIGHTS (Helm. spp.)	Tan to purple spots on leaves, or root and crown rot resulting in yellowing and thinning of turf	Varies Moist	Common on bluegrasses	Common	Water in morning, pick up clippings. Don't let grass get matted	Dyrene, zineb, captan, or phaltan
OPHIOBOLUS PATCH	See under golf green turf		Common-?	Common-?		
MATTING (Unidentified basidiomycete)	Clumps of brown matted grass with white mold around bases	Cool Moist	Fairly common	Present	Reduce cutting height. Remove thatch. Apply nitrogen	Probably not needed Try broad-spectrum types, if it appears necessary
ANTHRACNOSE (Colletotrichum sp.)	Gray or tan-colored stems & leaves with small black fungus bodies	Cool Moist	Common	Common	Adequate fertilization & watering. Remove clippings	Try mercury or broad-spectrum fungicides
RUST (Puccinia graminis)	Reddish or brown-to-black powdery spots. Mostly on Merion bluegrass	Warm Dry	Uncommon	Fairly common	Increase nitrogen. Water during dry periods	Usually not necessary. Try sulfur, zineb or cycloheximide + thiram, if needed
POWDERY MILDEW (Erysiphe graminis)	Grey-white powdery masses on leaves and stems, which may yellow and die	Warm Humid	Uncommon	Common	Fertilize and water to maintain vigor. Promote air drainage	Usually not necessary Try sulfur or cycloheximide + thiram, if needed.

*Plant Pathologist, Washington State University, Western Washington Experiment Station, Puyallup, Washington; Extension Plant Pathologist and Graduate Assistant in Plant Pathology, Washington State University, Pullman, Washington. Nov. 15, 1961.

**Mixtures of two or more fungicides are usually best for home owners to use, not only because several pathogens may cause trouble but also because of the difficulty of positively identifying some of them. Several suitable mixtures are on the market. Check labels to be certain they contain the types of fungicides listed above, if a specific disease is suspected. Trade names are not listed except for Dyrene for which a simple common name is not yet available.

Disease Survey in Eastern Washington

T. H. Filer[1]

Fusarium Patch

Fusarium Patch of turf in the Northwest is associated with *Fusarium nivale* (Fr.) Ces. The first symptom of disease is the pink mycelial growth which appears on golf greens in October to November, coinciding with cool, moist weather condition. The disease may continue all winter and for as long as cool, moist conditions prevail, usually throughout February and March in eastern Washington and northern Idaho. No snow is necessary for the disease to occur.

Snow Mold

Sumptoms of the disease associated with *Typhula itoana* Imai do not appear in the fall prior to snowfall and are evident only after snow melts in the spring. *Typhula itoana* incites disease development only when the turf is covered with snow.

Powdery Mildew--*Erysiphe graminis* DC

The foliage appears yellow or chlorotic with a covering of white powdery mildew on the upper leaves. These symptoms often occur in the spring. In late summer small, brownish-black dots (fruiting bodies) appear among the powdery growth. The mildew usually causes little damage to established turf, but may cause damage to young grass seedlings. Control: sulfur dusts. Distribution: general in U.S.

Dollar Spot--*Sclerotinia homoeocarpa* F. T. Bennett

Injured areas are first brown, later bleached straw colored, about two inches in diameter. In sever disease outbreaks, the small spots coalesce to form large, irregular patches. When the fungus is active, a fine, white, cobwebby growth of mycelium may be observed in the early morning while dew is still present. Dollar spot becomes active when soil surface temperatures reach a minimum of 60° F and increases in severity with increasing temperatures, maximum injury occurring at 80° F. It is most noticeable when growth is slow due to low soil moisture, yet when there is enough soil moisture from dew and sprinkling to permit the pathogen to develop. It is present but rarely does damage to turf in eastern Washington. When the environmental conditions are satisfactory for the fungus, the pathogen can cause severe damage to turf.

Helminthosporium Blight--*Helminthosporium* spp.

The most noticeable symptoms are scattered circular to elongate leaf spots with prominent, reddish-brown to black borders. The spots are at first dark brown in the center but become straw colored to white. This fungus can also cause a foot rot in which the whole leaf sheath is affected, the stem and crown are killed, and discolorations occur on the underground parts.

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[1]Research Assistant, Plant Pathology Department, Washington State University, Pullman, Washington.

Distribution is general in U. S., and the disease is common in the eastern part of Washington and northern Idaho. Disease occurs in cool, rainy weather in early spring. It may also occur in the fall. Control with organic mercury.

Melting-Out--Curvularia geniculata (Tracy and Earle) Boed.

Melting-out is a disease caused by Curvularia geniculata. The fungus is considered by many workers to be only a saprophyte, not capable of causing a disease. Nevertheless, it does cause considerable damage to turf in certain areas of eastern Washington. In the Walla Walla and Yakima areas and along the Snake River where the temperatures are 90°F or higher for prolonged periods, the fungus is very common in the summer months. Since the fungus is at best only a weak parasite, the symptoms are apparent only when the grass is under stress and the environmental conditions are more favorable to the fungus than to the grass. The symptoms are poorly defined, giving the general appearance of dying out of the turf in irregular patches, not in rings but in streaks. The grass becomes chlorotic and then brown. Control by Kromad.

Brown Patch--Pellicularia filamentosa (PAT) D. P. Rogers

The sumptom most commonly connected with brown patch is the typical "smoke ring" of grayish-black mycelium on the outer edge of the ring when the fungus is actively growing. The leaves become water soaked and black, later collapse, and then become light brown in color. The fungus spreads from a central point, leaving a circular, wilted, brown area usually from one inch to one foot in diameter, but it may reach 20 feet across. The "smoke ring" is more evident on taller turf than on the greens. This fungus causes damage when temperatures from 73°F to 90°F coincide with high humidity. The fungus becomes inactive at temperatures below 72°F and temperatures above 95°F. Controlled by organic mercury and terraclor.

Anthrachose--Collectotrichum graminicola (CES) Wils.

The symptoms of this disease easiest to detect are the black spots on the leaves or culms. The black color is due to prominent spines on the scab-like lesions. The real damage is to the roots, crown, and culm of the grass plant. Due to the extremely high temperatures over a long period of time during the past summer, Anthracnose was a serious problem in most of eastern Washington. This fungus can attack any and all parts of the grass if the environmental conditions are favorable for the pathogen. The parasite requires high temperatures, with the most severe damage to grass occurring when the temperatures are above 90°F. The greatest damage occurs in August and September. With temperatures above 54°F the fungus can cause some damage. Use organic mercury.

Insect Damage

A very common problem in the fall of the year is worm damage, including that caused by the sod web worm and the cut worm. Both cause very similar damage so we can consider them as one. The most common symptom is damage to the root system. Large patches of turf can be lifted from the soil in sheets. Present findings are based on the number of larvae (worms) found in a six-inch diameter of sod. Average figures are derived by examining at least six samples taken from different parts of the fairway. The root system of each sample is carefully torn apart and examined closely. If an average of two or more larvae per sample is found in late summer, it has been shown by Dr. Harwood that damage is severe enough to require control. One larva per sample is considered serious in the spring when the larvae are larger. The most effective sprays based on pounds of actual insecticides per acre are 2 pounds of DDT plus 0.9 pounds of Lindane, or 3 pounds of Heptdchlor or 5 pounds of Toxaphene.

Nematode Damage

Parasitic nematodes have been isolated from numerous turf samples. It appears that the nematodes are causing some root damage as well as making avenues of entrance for fungi which cause root or foot rots. Nematodes may become a serious problem in green and other turf areas in the Northwest. Studies should be undertaken in the near future to determine the amount of damage actually caused by nematodes.

TURF MANAGEMENT IN HAWAII AND JAPAN

W. H. Bengeyfield[1]

There is nothing we dislike and avoid more consistently than being made to think. It is much more comfortable to ignore some of our problems or to make excuses for their existence rather than to face up to them. You may take exception to some of the points I plan to make this afternoon. I hope you do take exception. For if you do, you will have accepted the challenge, and both you and I will be forced to think about it rather than to ignore it or to develop excuses for its existence.

During the next 20 to 25 minutes, we are going to travel from the west coast of the USA to the Hawaiian Islands, Wake Island and to Japan. This is a distance in excess of 6, 000 miles and by jet it is over 10 hours flying time at 600 miles per hour. In a conventional aircraft, it will take something like 30 hours in the air.

One of the great truisma of any traveling agronomist (or perhaps for any individual traveling) is that every area feels that its conditions are different than anywhere else and therefore, its problems are different. At least this has been a truism in my job with the USGA Green Section. Every region visited has, to a greater or lesser degree, the feeling that its problems are different because its conditions are different. I think it is safe to say that this feeling exists in the Pacific Northwest. It is only in honesty that I confess I do not completely agree with this philosophy. There are certain fundamentals in turf management, as in any science, that are applicable here, in California, Colorado, England, Hawaii, and Japan. The fundamentals include disease control, nutrition, soils, irrigation, drainage, mowing practices, grass species, etc.

If you will concede that these are fundamentals and the building stones of good turf management, then we have no problem. Certainly there are local situations that may cause an adjustment or a modification. But the problem and real danger in our work is when we accept the statement "My conditions are different" as an excuse for turf that is less than our best. I urge you to guard against this type of thinking because it hurts you as an individual, it hurts you as a professional turf manager, and it retards turf progress

Throughout the United States today there are approximately 2, 300 USGA member clubs. This summer, three of your Pacific Northwest courses participated in USGA events. Ken Putnam had an outstanding Walker Cup course at the Seattle Golf Club. The USGA National Women's Amateur was held on the fine golfing turf prepared by Henry Land at the Tacoma Country Club. John Jaslowski's Broadmoor Country Club was conditioned for the USGA Girl's Junior Tournament.

In our 50th state of Hawaii, there are eleven USGA member clubs. Approximately half of these are military courses, and the remaining half are closely divided between private clubs and municipal or public fee courses. Unquestionably there will be many new courses built in the Hawaiian Islands within the next five to 10 years. At the moment, I believe four are under construction or in the planning stage. The Hawaiians love the game of golf, and

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[1]Western Director, USGA, Green Section.

the ever-increasing tourist trade will demand more courses that are better maintained. The total area of Hawaii is larger than the combined size of Rhode Island and Connecticut. The tallest mountain ranges to 13,800 feet, and the Islands are unbelievable in their beauty and plant life.

The soils of Hawaii are a lifetime of study in themselves. They vary greatly and range from heavy clays to volcanic cinders to coral sands. Dr. Sherman of the Agronomy Department of the University of Hawaii showed us very unusual and strange soils. One clay soil had a shiny, slick surface similar to marble. However, when dropped into a beaker of water, this clay soil literally exploded and disbursed immediately through the water as would a drop of coloring. This soil comes from a very arid section of Hawaii, and I'm not certain what would happen if a heavy rain occurred.

Speaking of rains, these Islands have officially recorded a rainfall in excess of 600 inches in one year. This was on the island of Kauai. However, on the big island of Hawaii cactus plants grow on the Leeward side of the mountain ranges. In Honolulu, from eight to 10 inches of rain falls annually. At the Oahu Country Club, less than five miles away, their annual rainfall is between 60 and 70 inches. So we see, rainfall varies greatly.

The major grasses of the Hawaiian Islands are naturally warm-season types. Bermuda Grass, St. Augustine Grass, the Paspalems, and Henry's Crabgrass, have wide distribution. However, putting greens are largely of seaside bent although some new ones have been established in Penncross. Some of the public fee courses have Bermuda greens. Surprisingly, Poa Annua does not seem to be a major problem on greens. The Hawaiian Department of Agriculture is very strict in its laws, and it is difficult to introduce new grass species. Sugar cane is a grass, and officials are continually on guard for grass diseases and insects. However, the Oahu Country Club has brought in Tifgreen Bermudagrass, and it is being grown under controlled conditions by the Hawaiian Agricultural Department.

The fundamentals of good turf management seem at home in Hawaii despite the great variance in soils and rainfall. The Oahu Country Club has recently hired an agronomy graduate of the University of Hawaii, Mr. Masa Kawahara. Because he has applied sound agronomic principles to the management program at the course, it has made tremendous forward strides in the past two years. Sound fertility practices, disease and insect control, improved drainage on all newly built greens, elimination of tree root competition, and other sound maintenance practices have paid off at this club. Conditions may be different, but the fundamentals apply.

Four thousand miles to the west of Honolulu lies Tokyo and the islands of Japan. This total land area is smaller than that of California and has over six times as many people. To compare it to the states of Washington and Oregon combined, the land area is about 12 per cent smaller while the population is 20 times greater.

I am far from being an expert on Japan or any of its activities. However, I did have an opportunity to visit a few courses there and gathered some notes that may be of interest to you. Japan is a delightful country with many customs that seem strange, but only at first.

The average work force on an 18-hole course will be about 21 persons. When needed, additional women are hired for construction projects and other work. The golf course superintendent receives 25,000 yen per month or about $70.00. The golf course worker receives about 15,000 yen or $42.00 a month. The superintendent at the Showa Golf Course was an ex-farmer about 45 years old. His workers are paid $1.00 a day and work from 8:00 a.m. to 5:00 p.m. They have a morning break of 10 minutes and an afternoon break of 15 minutes, which seemed to be self-imposed or self-controlled.

The Japanese prefer to use sod rather than seed in establishing new plantings. This may seem strange, but it works. In fact, in areas where new golf courses are being built, local farmers find that they can make more money by raising sod for the golf course than they can by raising food for the market. The government is concerned over this, and acreage controls are being discussed.

Golf at this times seems to be only for the very rich or for officials of larger companies that pay the bill for so many memberships annually. Private clubs are usually rated as to the size of their bath rather than the condition of their course. The bigger the bath, the wealthier the club. One club boasts a bath that will hold 150 people. Wealth and politics seem to be closely associated. I'm told there are no public fee courses opened to the Japanese public, and there seems little inclination to develop such courses. However, many of the military courses are open to local industrialists and business officials so that a small part of the general public may occasionally be able to play. Caddies and golf course workers are allowed to play.

The Japan Golf Association is quite active and holds about one tournament per month. The private clubs and the Japan Golf Association carry on their own research work in turf. There seems to be no state-supported turf projects.

At the present time, several new courses are being built in Japan, and these are designed by Japanese landscape architects who are familiar with the game. There appears to be a contest between east Japan and west Japan as to who can build the best golf course and the biggest bath.

Because of the very humid summers, the Japanese have had difficulty growing Bentgrass greens. For this reason, every 18-hole course has 36 greens. One is for winter play and this is Bentgrass, while the other is for summer play and a fine-leaved Zoysia is used. The Bent greens are reseeded every late summer or fall.

Climatic wise, the Tokyo-Yokohama area is similar to that of the mid-Atlantic states including Washington D.C. We know that turf growing conditions during the summer months are very difficult in the mid-Atlantic region. However, by using the fundamentals of disease control, proper irrigation techniques and other management practices, our fellow superintendents along the Atlantic coast are able to maintain good Bentgrass greens throughout the summer. By observing the fundamentals, I believe the Japanese superintendent could do the same.

There are plenty of weeds, but they present no great problem. Crabgrass is one of the notorious ones. Most of the weeding is done by hand, and as many as 500 women have been used to hand weed an entire golf course. They weed everything, including the roughs.

On a particular military course visited, there were no golf carts and approximately 300 rounds of golf a day are played. The vast majority of caddies are women, and they are excellent. They not only carry clubs, but carry a bag of soil with seed for divot repairs.

Japanese players are very accurate on their short game, but the long hitters from the USA will outdrive them by 100 to 150 yards off the tee. However, on their own golf courses, the Japanese players should not be underrated. They play excellent approach shots and will sink many. A 10-foot putt is almost considered to be a gimmy.

The greens will average between 4,000 to 5,000 square feet. They are aerified as are the fairways. Fertility of all areas seemed to be very low, however, and is one of the fundamentals that is being overlooked in Japanese turfgrass production. Now for some slides of these countries.

I should like to emphasize again, however, that certain fundamentals are worldwide in their application. We should use them and not overburden ourselves with the theme that "Our conditions are different." There is so much to learn; so much to do; and provincialism will not help us attain these goals.

TURF ROUNDUP--1961

James M. Latham, Jr. [1]

The year 1961 has brought several changes to the turfgrass management profession. Primarily these changes have taken place in maintenance operations. The stress is more than ever before to provide the best golfing turf more days per year. With this goes a drive to present the most uniform turf possible. These goals are not new, but with golfing costs increasing more pressure is brought to bear on the superintendents to provide them.

Weatherwise, most of the nation had difficult problems to overcome. The upper Midwest had one of the driest winters ever; that is, they didn't receive the usual snow cover. The northeastern region received much more snow than usual. The southeast had one of the coolest and wettest summers on record, while southern Florida was dry most of the time.

In Milwaukee and most of Wisconsin greens cracked open during the winter, and many greens were severely damaged from winter desiccation. Tests conducted in Milwaukee expanded some of Jim Watson's work on winter protection. Where liquid and dry applications of snowmold prevention materials were made, the dry formulations produced earlier green color. This may have been due to the activated sludge carrier rather than the liquid vs. dry comparison.

Ice rinks are quite popular in our area, but usually result in complete loss of turf under the ice. At Kern Park, a sheet of polyfilm was used under a portion of the plot. Results were excellent. This spring the only grass in the area was under the polyfilm. When the sheet was removed in April the *Poa trivialis* was seven inches high. Seed of Pennlawn fescue and *Poa trivialis* germinated quite well under the sheet. Disease control is necessary under the plastic as indicated by Watson's tests and confirmed by these. Caloclor mixed with activated sludge was used according to previous recommendations. We found this year that the polyfilm must be taken off early. At Brynwood putting green grass grew to $1\frac{1}{2}$ inches by April 15. In Toronto three hot days severly damaged the turf underneath.

Dr. Ray Keen at Kansas State has developed several new strains of Bermudagrasses that have more cold tolerance than existing varieties. Where U-3 and Tifgreen show 40 to 50 per cent winter kill at Beltsville, some of the experimental hybrids suffer less than 10 per cent loss.

After three years of testing in Athens, Georgia, only Seaside bent shows poor results. All of the seven other bents are acceptable putting surfaces and offer no major management problems. These are Penncross, Cohansey, Arlington-Congressional mixture, Old Orchard, Washington, and Nimisila. Field experience continues to show that Penncross is an excellent grass, but its aggressive nature requires close maintenance. Where not maintained adequately a puffiness develops, eventually leading to a scalped and easily footprinted surface.

Norlea Perennial Ryegrass has been released for sale in Canada. This new variety offers a more long-lasting and more uniform turf. The cost is now $1.75 per pound.

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[1] Agronomist, Milwaukee Sewerage Commission.

While on the subject of grasses a word of warning is needed. So far, there is no certification program for stolon bent nurseries. Many people are buying planting stock of these bents, then finding out later that the grass is either mixed, contaminated with weeds, or has poor viability. Even with certification there is a hazard of troublesome weeds even though not classified as noxious. Wilted planting stock is also a problem many times. Care should be exercised in selection of a source of planting stock and timing of shipments to avoid the possibility of poor stands of grass.

Poor-quality seed, purchased on price alone, is always a possibility. Last fall many Florida courses used a cheap Seaside bent for overseeding. A weed problem developed as a consequence, and expensive hand weeding was necessary.

Generally there are few major weed problems today. Nutgrass and Poa annua remain, but other weeds can be successfully controlled with existing chemicals. DSMA and the hormone materials such as 2, 4, 5-TP are coming into widespread use. Sodium arsenite is regaining stature as a weed-control agent. Much testing of the preemergence materials is being done on the golf course level. The mixed results shown this year indicate that weather, soil conditions, timing, and method of application are quite important.

Sterilization of topdressing material is becoming more important as the source of clean topsoil is reduced. Soil pasteurizing, methyl bromiding, and composting are all being used successfully to accomplish weed-free topdressing.

New diseases still crop up to puzzle pathologists. In recent years Bermudagrass fairways in the transition zone have been plagued with devastating attacks of "spring deadspot." This disease strikes the dormant grass and kills before spring greenup. Last winter similar spots showed up on Tifgreen putting greens across the upper South. No single causitive organism has been identified.

This summer, Merion fairways in the Philadelphia area exhibit a similar disease that almost completely killed fairways in Lancaster, Pennsylvania. Again, no single pathogen has been identified. This is serious enough for the Merion Bluegrass Foundation to set up a grant for its study at Penn State.

In the machinery line, spikers are again coming into widespread use. Power spikes, three gang units, and homemade outfits are being used both north and south to open the thatch, break through crust, and assist in seeding operations. They are proving to be a quite useful tool and do not incur the wrath of golfers, since the marks are almost invisible after mowing.

Nematode control is finally receiving the attention it deserves. At Merion, Pine Valley, and Ponte Vedra, Nemagon applications have made a tremendous improvement in putting green turf. Deeper, more prolific root systems are the result of nematode control, and hence a healthier plant.

More and more, beautification plays a part in quality golf course maintenance. Flowers are not too much trouble to plant, especially the annual, seeded types. Beautification is also noted in proper placement of trees and saving the desirable native trees. Cart paths enter the picture also. Emil Picha at Oak Ridge in Minneapolis achieved beauty in laying out cart paths near the clubhouse. He used graceful curves and wide paths rather than abrupt, straight-line layouts.

Carts continue to be a problem, but when clubs recognize the problem and plan to maintain their traffic, the difficulties are reduced. Some clubs own and operate the carts. By so doing, they are better able to restrict use during bad weather, and assign the revenue to course maintenance to help repair cart damage to the turf.

There are not "normal" years any more. We are all more cognizant of weather, golf play, and expenditures. We are becoming aware that modern turf management is not a day-to-day operation, but a continuing, long-range development program. Turf areas must continue to improve. Static management programs always result in gradual, then sudden decline. Complete renovation may then be the only way of recovery.

Large, expensive (but time-saving) equipment is now the key. Can you imagine fertilizing 36 fairways every two weeks? It's being done right now in New Jersey. Monthly applications are quite common. How about mowing fairways four to five days a week? It's being done. So is spiking twice a week, aerifying fairways five or six times a year, and topdressing greens once a month. Adequate machinery, safe chemicals, proper fertilization, and skilled management are combined to do these things with fewer laborers than ever before. We can, through reasonable economics and planning, give the golfers better playing conditions, longer seasons, and the beautiful grounds they pay for and deserve.

SOME PATHOLOGICAL PITFALLS IN PRACTICE

Charles J. Gould[1]

Disease development is a complex which is made up of three parts: fungus, host, and favorable conditions. The last part includes such factors as temperature, moisture, soil type, nutrition, etc. Sometimes, by altering these factors, we can appreciably retard fungus development. Conversely, certain practices may accelerate it. Let's look at a few of the possible pitfalls before discussing our research results during the past year.

SOILS. Most turf-disease-producing fungi live or survive in soil. That is one reason why soil fumigation can reduce losses from damping-off and similar diseases. SOIL TYPE is quite important--for instance, turf grown in heavy, compact, and poorly drained soils usually shows greater losses from Pythium and Fusarium fungi than does turf grown in well-drained soils. (This may be caused by larger amounts of carbon dioxide, a change in the balance of microorganisms, or some other factor.) SOIL AERATION--Letey of UCLA mentioned recently (California Turf Culture) that plant resistance to pathogens is influenced by aerification of soils. Presumably, the addition of such materials as perlite and pumice should aid in disease control by lightening heavy soils. Such mixes are under test in cooperation with Dr. Goss. However, too light soils may also encourage certain fungus development since the leaching of nitrogen is increased and the turf is thus rendered more susceptible to pathogens such as the Red Thread fungus.

SEED SOURCE is highly important, since many turf pathogens, including Rhizoctonia, are seed borne. It doesn't help much to fumigate soil if infested seed is planted. Therefore, we suggest using one of the standard fungicides (such as thiram or captan) for seed treatment and also for postemergence sprays to reduce damping-off.

VARIETIES. The major groups of grasses vary in susceptibility to different pathogens. Thus, under western Washington conditions the bents are most susceptible to *Fusarium nivale* and *Ophiobolus graminis*, while fescues are more affected by *Corticium fuciforme*. Varieties within these groups of grasses also vary. For instance, Penncross is much more resistant than is Colonial to Fusarium. There also seem to be strains of Seaside and *Poa annua*, some of which appear to be more resistant than others to Fusarium. The selection or hybridization of disease-resistant varieties is probably our best long-range solution to the major turf diseases.

WATER. Everyone here is familiar with the fact that we seldom see much Fusarium unless water remains for prolonged periods on grass leaves. Conversely, when grass is weakened by underwatering, it becomes more susceptible to Corticium, Fairy Ring, and Colletotrichum fungi. Too frequent watering produces turf with shallow root systems that are more susceptible to certain pathogens. Most fungi are favored by evening irrigation, since the grass remains wet for a longer period. The pH may also be important--for instance, alkaline water may favor Ophiobolus development. Water containing considerable organic matter (such as pond or lake water) should not be used for spraying, since the organic matter inactivates many mercury compounds.

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[1] Plant Pathologist, Washington State University, Western Washington Experiment Station, Puyallup, Washington.

FERTILIZERS. The effect of ratio and source of fertilizers may be one of our most important factors in increasing or decreasing disease incidence. We have found that high levels of nitrogen increase Fusarium and Ophiobolus, but decrease Corticium and Fairy Ring. The SOURCE of nitrogen is also important, i. e., organic sources of nitrogen produce more Fusarium than inorganic ones unless they are used judiciously. The cumulative effect of fertilizers may be more important than we have suspected. Let me cite an example for a different crop. In tests on gladiolus at the Western Washington Experiment Station fertilizers had no effect on disease development during the first year, but showed a marked effect in the second. High nitrogen and high magnesium significantly increased the losses from dry rot as compared with low levels. This entire problem of nutrition of turf is a very complex one. Research on it is urgently needed.

MOWING. Too short mowing may weaken grass and make it more susceptible to certain fungi--particularly when the height is too suddenly reduced. Too high a cut may produce a moist chamber effect that is conducive to the growth of many fungi, including one (a basidiomycete) in western Washington that smothers lower grass blades. Incidentally, grass mowers provide a beautiful means for fungi to "hitch-hike" from fairways and shoulders to greens, or from diseased to healthy areas in lawns. Mowers should be cleaned after each day's use, since the Fusarium fungus may quickly produce a heavy crop of spores on accumulated clippings.

AERIFICATION AND THATCH REMOVAL. Bloom and Wuest, at Pennsylvania State, recently pointed out (in the "Golf Course Reporter") that nematodes may be transferred from infested to healthy areas by aerifying procedures. It seems plausible to expect that disease-producing fungi could be spread similarly

INSECTS. Insects can weaken turf and make the grass more susceptible to many fungi. Insects may also transport certain fungi.

TOPDRESSING: Lukens and Stoddard, at Connecticut, (USGA Jour.) have reported that topdressing may be an important source of the brown patch fungus. Other fungi may also be carried by topdressing. Therefore, it is good insurance to fumigate such material.

DESIGN of COURSES can be an extremely important factor in disease development. For instance, we find Fusarium most frequently in areas of poor air and water drainage--whether such poor drainage arises from poor contouring, hillside shading, or excessive shrubbery. In some cases the elimination of a few trees, shrubs, or a hedge has reduced Fusarium by as much as 75 per cent.

WALKING. This we probably can't quite eliminate, but it should be pointed out that fungi can be transported on shoes from infested to healthy areas--which is another argument in favor of treating shoulders and even fairways on golf courses.

GENERAL. Finally, we should emphasize that the turf-pathogen interaction is a very complex one. So many factors vary that each distinct area on a golf course, park, cemetery, and even home lawn may require its own management program. We cannot say that so much nitrogen is optimum for Corticium control, nor that an alternating schedule of PMA and Cadmium chloride every two weeks is automatically best for all golf greens. Those of you having children know that each one responds differently to the same treatment.

Similarly, each turf area (as a golf green) has its own personality which is learned only by experience, accompanied by keen observation and a good green thumb.

RESEARCH PROGRESS DURING 1960/61

Fusarium

Fusarium Patch (caused by *F. nivale*) was quite common and often serious during 1960/61 on both putting green and higher-cut turf. The mild, moist weather that prevailed from September of 1960 until June of 1961 permitted the Fusarium Patch fungus to thrive in practically undiminished vigor. This resulted in considerable spotting on golf greens on which a regular treating schedule had not been used. This fungus also caused considerable thinning of hi-cut turf such as that in home lawns. However, some of the thinning of the latter turf may also have been caused by other species of Fusarium, especially in late spring.

FUNGICIDES. Our basic fungicidal recommendation for golf greens in western Washington is still the same as last year, namely a biweekly alternating schedule of PMA (as phenyl mercuric acetate @ 3/4 oz. of 10% sol. in 10 gal. water per 1000 sq. ft.) and Cadmium chloride (as Caddy @ 1 oz. of 20% sol. in 10 gal. water per 1000 sq. ft.). If a preventive program is not carried on, or if conditions become unusually favorable for Fusarium, it may be necessary to apply PMA two or three times on successive weeks and then revert to the alternating biweekly schedule with Caddy. During warm, sunny weather when turf may be burned by PMA, add 1/8 to 1/4 lb. of actual nitrogen (as nitrate type) as a safener to the spray solution. As we mentioned last year, the PMA gives the quickest kill of the Fusarium, but the cadmium produces a denser turf. The alternating schedule is aimed at getting the best traits of both. Several superintendents have reported success with it. Remember, however, that the above recommendations must be adjusted to each individual golf course and even to each green. Thus, one of our top-notch superintendents has found that a 10-day schedule is necessary on his course instead of the 14-day interval that we and certain superintendents have found adequate elsewhere. Be sure to spray shoulders as well as greens.

One or two sprays in the spring and again in the fall should usually be sufficient for home lawns. The broad-spectrum mixes containing mercury or cadmium fungicides are usually best for home owners since it is impossible for most of them to identify diseases definitely and since more than one pathogen may be present.

FERTILIZERS. Another factor that we need to know more about is that of nutrition. We already know that high amounts of nitrogen may result in more Fusarium disease than low amounts. We also know that organic sources favor more Fusarium disease development than inorganic ones. However, we still con't know the exact amounts of each type that can safely be used, or the effect of temperature on them, or the possible balancing effect of phosphorus, potash, and other compounds.

Corticium

The Red Thread fungus (Corticium fuciforme) was more prevalent than usual during 1960/61, apparently for the same causes as given for Fusarium Patch. The fungus was again found mostly on fescue, although it occasionally attacked bent and other grasses. Laboratory tests have shown that there are different strains of this fungus.

FERTILIZERS. We found several years ago that nitrogen fertilization gave us better control of Red Thread than did applications of certain fungicides. That is still the situation today, although tests of fungicides as well as fertilizers are continuing. Counts made on Dr. Goss' lawn fertilizer plots at Farm 5 showed 132 spots without nitrogen as contrasted to 55 with 4 lbs. and only 18 with 8 lbs. of actual N per year. Potash was the next most important nutrient with the lowest number of diseased spots with highest rates of the element (8 lbs. as contrasted to 4 and 0). Phosphorus was relatively ineffective, although the 4-lb. rate produced somewhat fewer spots than when it was omitted. In general, an 8-4-8 ratio was best, followed by other mixtures containing high levels of nitrogen.

The benefit from nitrogen has again shown up in fescue plots established at the home station last year in cooperation with Roy Goss. Recent counts showed that the 8 lb. rate of N had only about one-thirtieth the amount of Red Thread as the check plot, and that the 2-lb. rate had about one-ninth. The effect of phosphorus and potash was somewhat less marked in this than in the other test, but a balance appeared somewhat better, particularly at low levels of nitrogen. These studies are continuing.

FUNGICIDES. We are still trying to find a fungicide effective against the Red Thread fungus. Previous attempts have not been very encouraging, so (with Roy Goss and Vern Miller) we established a large fescue plot last year at our home farm to test several of the latest compounds. All of the compounds have reduced the disease somewhat, but none have yet appeared particularly outstanding. The fungus is just now beginning to become active, so a final rating of the materials may be available in a few weeks.

Ophiobolus Patch

Most of you have seen the dead fairy-ring-like spots in the fertilizer plots at Puyallup. Although the disease appeared dramatically in the late spring of 1960, it wasn't until November that fruiting bodies of the causal fungus appeared, thereby permitting definite identification. It proved to be the fungus we had originally suspected--Ophiobolus graminis, which was recognized as a serious problem several years ago in England. Although the fungus is common in the United States on cereals, it has seldom been reported causing trouble in turf grasses. However, it appears to be rather widespread in western Washington, and we believe it may eventually be found to rate as a serious disease. It was first found in putting turf (on bent grass), but since then it has been collected from fairways and lawns. Since the fungus does not produce fruiting bodies during the active period of growth from spring until early fall, it is difficult definitely to identify during that period. There was only one outbreak in 1960--in late spring. However, there were two active periods of spread in 1961--once in late spring and again in late summer.

FUNGICIDES. PMA appeared to suppress the fungus in 1960. In the spring of 1961 Dr. Goss ran a preliminary test on his plots using several fungicides in double the usual amount of water (20 gal. per 1,000 sq. ft.) in one application. Most of the fungicides suppressed the fungus but did not eradicate it. If time permits, we will run a larger test in cooperation with Dr. Goss in 1962.

FERTILIZERS. An excellent opportunity was available for determining the effect of nutrition on the fungus since it appeared in plots which were being used for fertilizer tests. The effect of nitrogen was particularly striking with the 20 lb. rates producing over seven times as many spots as the lower rates. The unfertilized plot had the fewest of all. Phosphorus showed little effect, while a medium level (4 lbs.) of potash appeared optimum. Lime was not tested in these plots, but experiments in England have shown that it increases the severity of the disease.

Fairy Ring

Fairy Ring is the number one problem to many homeowners in western Washington. Nitrogen partially relieves the symptoms. Mercury drenches suppress mushroom formation but do not eradicate the fungus. Methyl bromide fumigation eliminates it, but reseeding is necessary afterwards. In an effort to find a simpler solution, we obtained some mushroom-parasitic nematodes and applied them to some active rings in Tacoma last fall. Unfortunately, they didn't do the job so we're still looking for an easy control.

Anthracnose

The fungus (Colletotrichum) causing Anthracnose has usually appeared only on turf suffering from undernourishment and/or underwatering. However, it was so widespread in 1961 that perhaps we should consider it as more than a weak parasite. It appears possible that it requires drought--or heat-injured turf in order to obtain a foothold, but, once established, it may become truly parasitic, simply through the action of masses of inoculum.

In closing, may I express my deep gratitude for their assistance: to my co-workers Roy Goss, Vern Miller, and Maksis Eglitis; to many superintendents and others; and to the Northwest Turf Association, California Chemical Corporation, and the USGA Green Section for their financial aid. Such assistance has materially speeded the production of the above results to you.

PANEL DISCUSSION ON SOIL MIXTURES FOR PUTTING GREENS

Panel Members:
Dr. Roy Goss, Chairman, WSU, Puyallup, Washington
Mr. Ken Putnam, Supt., Seattle Golf and Country Club
Mr. Bill Bengeyfield, Western Director, USGA Green Section
Dr. Walter Gardner, WSU, Pullman

As a means of introducing this panel discussion, I would like to take a couple of minutes to mention why this particular problem is being handled as a panel discussion. The actual cost of a putting green on today's market will run somewhere in the neighborhood of $5,000. Of course, many corners can be cut, and this green can be constructed for somewhat less. However, this cutting of corners can result only in poor construction.

Some of the problems such as those created by mixing on site, using poor soil materials for construction, making the soil mixture too sandy, or too heavy, improper placement of drainage tiles, the use of organic materials and other additives, and other problems will be brought out in this panel discussion. Each member of this panel will devote six to eight minutes in discussing one phase of this problem, after which the floor will be invited to ask questions directed to these panel members.

The first speaker on this mornings panel will be Mr. Ken Putnam, who will discuss some of the construction problems in relation to management from the superintendents viewpoint.

Ken Putnam

From my point of view the soil mixture that goes into these putting greens is the most important aspect. If the soils are too light, we have a problem holding moisture and plant food nutrients during the growing season. If the soils are too heavy, then we have problems in getting water to drain from these soils during the winter even though play on these putting greens is continuous. If the soil is poorly mixed then the area turns out spotty, that is some areas will hold plenty of moisture, others will turn dry too quickly. In this manner then some areas necessarily must be overirrigated in order to irrigate some of the others properly. Therefore, the ideal putting green soil must be one that will hold a golf shot, drain out rapidly enough after rainfall and irrigation, hold ample water to insure the best plant growth, and hold sufficient nutrients to maintain excellent plant growth.

Thank you, Ken. The next panel speaker will be Dr. Walter Gardner, Soil Physicist, of the Soils Department here at WSU. Dr. Gardner.

Walter Gardner

The main points that I would like to make this morning on the discussion of soils for putting green construction is relating to porosity, and layering and some of the problems associated. I am not a practicing agronomist in this field and will therefore restrict my remarks to the basic or fundamental principles underlying these particular problems.

We need porosity for two reasons at least. One of the reasons is that in order for plants to grow properly there must be an adequate supply of oxygen and so there must be open pores in the soil through which gases can move from the atmosphere down on into the soil to replace carbon dioxide which is a product of metabolism in the roots. Also, these pores will serve to supply oxygen which is used in root metabolism. If this transfer of atmospheric gases into the soil is not adequate then you cannot get good plant growth. The second reason is that when soil materials are wet they tend to slide on one another. Too much water in the soil leads to too much lubrication, and when you have a lot of foot traffic on the soil the result is compaction. This compaction, of course, reduces the open porous condition which is necessary for good aeration and is deleterious to plant growth.

Pores in the soil, of course, are necessary for another reason. As everyone knows plants need water, and it takes pores in the soil to transmit water. Too little porosity leads to poor air movement and, of course, poor water movement as well. The kinds of soil material which lead to low porosity are the kinds of soil material which will be poor from the point of view of foot traffic. I am sure none of you would go out and make a golf putting green with clay. When clay is dry it is very hard and when it is wet it is soft and mushy and generally ends up in a heck of a mess. Therefore, you must have pores that are just the right size. They should be larger than the pores which would result from the construction with silts and clays If you have pores that are too large they won't retain water between irrigations, and your turf crop may suffer from lack of water.

I am not going to tell you the kind of soil mixture that is best for putting greens: I think that is the realm of some of these other folks' specialty, but I will say that whatever the porosity is, and this leads me into the next subject, this porosity needs to be fairly uniform for an appreciable depth. Otherwise, you get into a problem of water flow. I have talked about this to this group before two or three years ago when I demonstrated my talk with a movie on how water moves in the soil.

I am going very briefly to tell you in words how this happens just to remind you. When we have all the pores in the soils filled with water we call this saturated flow, and water moves in response to gravitational forces. With water pushing on water, with external forces, and with larger pores the water moves more rapidly. If you have a lot of water to evacuate and it is going to be there under saturate conditions from heavy rainfall, then you need large pores to carry away the water. After the soil drains enough so that the pores are no longer completely filled with water, then we have water and air present in the soil. At this point we go to another kind of flow which we call unsaturated flow, and here water flows along the surfaces of particles and through fine pores between particles and does not move through the large pore spaces. The large pore spaces remain filled with air. To get the best movement we need a quantity of small pores in order for rapid movement to take place under unsaturated conditions.

Under unsaturated conditions water would move very, very poorly in a gravel bed; under saturated conditions water moves rapidly in a gravel bed. Under unsaturated conditions the porosity must consist of fine, interconnecting pores where water moves not in response to gravitational forces, or external pushing forces, but in response to pulling forces which are the attraction of solid surfaces for water molecules and the attraction of water molecules for each other. Water is pulled along surfaces and through fine pores. Now as a consequence of this kind of flow, if you have porosity changes occurring in the soil, you can have great difficulties in getting rid of unwanted water. Let us postulate, for example, a proper soil mixture for producing a green that extends to a depth of six inches through the soil. Now let us put a very coarse layer of sand or gravel and see what happens. Now if we apply a relatively large quantity of water from rainfall, water will move down in the fine pores to this coarse layer, but will be retained in the fine soil and will not move into the coarse layer unless the soil is excessively wet. If the soil is so wet that we have a saturated condition, then water will move into these large pores between large particles of sand and pieces of gravel. But when these conditions exist the soil in the six inches above this layer will be too wet, and if people walk on this soil it will sink in and leave footprints. Therefore, if you have a lot of water to worry about, it would be very damaging to have a layer of coarse sand or gravel at six inches in the soil. Under dry conditions this might be an advantage because with this type of situation you do not lose a lot of water to deep percolation.

Drain tiles surrounded by gravel create large channels which will move unwanted water very rapidly. Here the important thing would be to have these tile drains or these coarse gravels at sufficient depth that when you have saturate conditions immediately above such a layer there is sufficient depth that the moisture in the soil and near the surface is not excessive. But where you have excess water to get rid of and you have saturated conditions you must have some open channels to carry the water away.

Any kind of porosity change in the soil is going to affect water movement. You may start a golf course green with the proper soil mix in order to maintain uniform porosity, but in the process of treating the surface of that green with additions of soil materials you add coarse materials which eventually work their way downward as you add new material. You are creating the kind of condition that I talked about where you have a coarse sand or gravel layer, and this can certainly work to your disadvantage. If you add a material that is too fine such as clay to the surface of your turf and allow it to work its way in, you would have a layer that is too fine. This would stop water movement because water movement through very fine materials is also slowed down. The important thing here is to have the right sizes of pores and to have them continuously for some depth.

One other little thing to mention and then I will quit. If you have problems with wetting due to the production of waxes from organic residues, sometimes you can get in trouble here because the water does not wet this kind of material and does not wet soil particles which are coated with these materials. Well here is one of those things that I am told works reasonably well, but I have not tried it, I rely on these people like Roy Goss here to tell me about such things, but if you can put a substance in the water which will make it wet things better which it contacts such as a wetting agent this often helps. However, one should in these management practices try to avoid these layers of organic material as well as layers of coarse materials. Therefore, avoid porosity stratifications in your soils. I think that is a good word to quit on.

Thank you, Walt. I am sure that there will be questions which we will return to you, after you have heard from the last two speakers. The next speaker on the panel will be Bill Bengeyfield of the US Golf Association Green Section

<u>Bill Bengeyfield</u>

It is an honor for me to be on the same panel with Dr. Gardner and these other gentlemen. For the past 10 years or so the USGA has sponsored research work on soils for putting green construction. I think last year at Seattle my little presentation discussed this, so in our five or seven minutes' time I would like to sketch it quickly and if you will allow me to fill in the blanks as we go through the questioning I think that that would be better.

The main problem in putting greens, playfields, park areas, or any other turf area is compaction and drainage. The main problem was to develop a soil that would resist compaction and would drain well. So with these two qualities in mind this is what the scientists at UCLA, Texas, and Oklahoma recommend.

We will build a cross section of the green or whatever turf area you happen to be interested in. This represents the subsoil, and this represents your drainage hole where the tiles are going in. This should be approximately six inches deep, and the bottom of the tile line should have two inches of pea gravel. The people who have done this work tell us a four-inch tile should be placed on this, and of course the tile must be tilted properly so that you have the necessary gravity to keep the water out. If it is agricultural tile, you would put a piece of asphalt paper or something over the joints to prevent the soil from filling the tile and back fill the rest of the ditch with pea gravel. Then over the entire green the recommendation is for a layer of pea gravel. This is a blanket over the entire surface. I have some reprints here of these specifications, so you don't have to write them down if you think you need them.

Over this pea-gravel layer, we say that you should add one and one-half to two inches of a concrete sand. Now you may say that Dr. Gardner and these specifications are not in agreement because we are building layers into the green and he just told us that we shouldn't have layers. But I think you will find that we probably do agree. After the sand is placed over the pea gravel there is an addition of at least 12 inches of soil that meets certain physical requirements. What are these physical requirements? Well, years ago soil scientists developed the mechanical analysis for soils. I don't know the history of it, but the analysis method has been around a long time, and the method can tell us how much sand, fine sand, silts, clays, and other materials there is in a straight mechanical analysis. This was the first approach that I think Dr. Lunt made at UCLA in his study. If you could get the right type of sand and the right type of soil and the right type of peat moss or organic matter, you could come up with a very excellent soil mixture for putting greens. It would resist compaction; it would drain well. The problem in the field, of course, is that not everybody can get just the right size of sand, soil, and peat. So the work was continued, and Dr. Howard of Texas got to the end of the problem with his work. He established certain physical requirements for soils.

In this soil mixture that we are discussing here Howard tells us that there should be 38 per cent toral porosity. In this 38 per cent total porosity or more, I suppose he wants so much capillary and so much noncapillary pore space. The noncapillary pore space should be 12 to 18 per cent, and the capillary is from 15 to 21 per cent. This is what he is after in total porosity. As far as infilteation rates go, these workers subject this to a number of laboratory procedures and then measure the infiltration rate. What they are looking for in this infiltration is a soil that will accept one-half inch of water per hour at least and no more than one and one-half inches of water per hour. These are the ranges, and you can see this a little bit further than straight mechanical analysis. And I think that you can also see that this sort of thing cannot be eyeballed. You can't pick up a hand full of sand and a hand full of soil and mix them together and say this will do it. We're not that smart. I'm not anyway. So we have taken out the eyeballing technics, and I think we have gone a step further. People who build highways subject their soils to physical analysis, and they want compaction. In the road specifications they determine exactly what the compacted level should be I think I am correct in this. We have gone the other way. In this system of eliminating compaction you cannot adopt a do-it-yourself procedure because this takes laboratory analysis. You must depend on the scientists. I am sure the college here could set up for it if they are not already. There are two laboratories that I know of that do carry out the work for golf courses in the courses in the country. There are seven steps in the specifications. If they make sense to you, you should follow all seven. Don't get properly analyzed for the proper mixture and then ignore this. Don't build your green this way, and then make your own soil mixture. It won't work or if it works, you're lucky. If you buy this procedure, you have to buy all the way, and if you don't want to buy all the way, don't do it. If you do follow all seven steps, I am sure you will be very satisfied. There are over 200 greens built according to this method in the country today. Some of them are as old as six years, and they haven't failed yet. They have been excellent, not only as regards the playability of the golfer, but also as regards the manageability of the superintendent.

Summary by Dr. Goss

The three previous speakers have covered three important phases in putting greens and handling soils. I would like to point out one of several things This is the design and the construction of the putting greens in order to avoid as many of the sharp breaks and rolls as possible. Let us make the greens architecturally interesting, but let us try to keep out all of the things that will get us into trouble. During the summer of 1961, I had more problems with golf courses that had dry spots develop whether the soils were properly mixed or not. Water was running off and not getting into the soil surface. This is a real headache which we should avoid in our construction. If we do have sharp breaks or rolls in these putting surfaces, there are only two ways you can take them out. One is by mechanical removal such as aerification, and another is by the use of chemical wetting agents.

Another thing that Bill Bengeyfield has very aptly pointed out here is the placement of drainage tile. This isn't so important in eastern Washington, Oregon, or Idaho, or for any area in the low rainfall area. However, it is exceedingly important in the areas west of the Cascade Mountains. This tile placement is extremely important because many of our tiles are not carrying any water flow today. They are dry; they are just useless costs that have added to a putting green. As a matter of variation from the techniques previously discussed, I might point out that gravel pit overburden, which is a material containing high amounts of sand and gravel and a very low amount of silt and clay, is making excellent base materials for putting greens in western Washington. All tile lines should be placed at the point where water movement is the slowest. Impervious layers are where the water builds up, and this is where the tile should be placed. After the tile has been placed, the gravel pit overburden can be built up over the tile line. This material can be used for elevating the green to any height that is desired after which you can place the 12 or 14 inches of mixed soil material. The description of this material has been adequately pointed out and will not be discussed at this time.

If enough of this gravel pit overburden material is used for raising the level of these putting greens, then perhaps no tile is needed at all, since sufficient storage area has been gained from this material so that the surface could never become wet anyway.

One other thing that I would like to point out where Bill left off is that after this soil material has been mixed off sight of the putting green and placed on the green according to best instructions, topdressings can ruin any good work previously accomplished. If you must topdress these putting greens, it is advisable that you take the time during the construction to mix a few more yards of material and stockpile it as topdressing for that putting green. This is one way of avoiding these layers and keeping continuity within your soil profile.

There are many other things that we could go into, but I am sure that time will not permit. I would like to mention one point about mechanical analysis. We have been running mechanical analyses for some of the golf courses in Washington state particularly. We have been running these samples according to the method described by Boyoucos. Washington State University does not have any program on the Pullman campus for running mechanical analyses. Here at Pullman only chemical analyses can be handled. From the results we have gotten at Puyallup, we have a very accurate picture of what should go into these putting soils.

Just remember you can't guess these soils, you have to analyze mechanically. We never guess when we get samples from some one who is building a putting green. We can look at it and come pretty close on a guess, but you never do when it comes to $5,000 worth of business. I have run mechanical analysis and sieve tests on soils which have been sent in as prospective soils for construction and found much of the sand content would pass our finest sieves, which are 1/10 millimeter in size. With soils with sand particles this fine you are definitely going to get into trouble with compaction, poor water movement, poor air movement, and generally poor plant growth.

Most golf course operators have different concepts about the coarseness of sands to use. Most of the samples submitted to me have been too coarse for putting green construction. If the materials you use are too fine and water movement is slow, you're going to end up with a sloppy surface condition with plenty of algae, no grass roots, *Poa annua*, and all other associated problems.

During the summer when we apply too much water, we run into problems of surface sealing, poor air movement, high root respiration, increase in the CO_2 content. It is no wonder that we have poor root growth.

In order to get down to your specific problems and to answer questions from the floor, I am going to terminate my portion of this program here and throw it open for general questions from the floor. Are there any questions?

Question, Manny Gueho: Do you feel that 12 inches of soil mixture is sufficient on these putting greens where heavy rainfall is predominant?

Answer: Dr. Gardner

I am not sure that I can give you a specific answer. Remember I mentioned that if you are going to have excess water there has to be a place for it to go. By building this topsoil as deep as it is economically feasible, you can provide a place for it to go. It is my judgment that, under usual rainfall conditions where you people are building these golf greens, you will have saturation only a very short distance above this gravel layer. Now where the depth of the soil should be 12, 18, 24 inches, or six inches is a matter of how much rainfall you are going to have to get rid of. I shall be very happy to accept these people's experience that 12 inches is about right for soil mixture depth. If you were in a low rainfall area you wouldn't have to worry about this.

Question: Wouldn't 18 inches be better than twelve?

Answer:

Depends upon the area. I think that the main thing here that Roy was getting at and that Bill pointed out was that this mixture does serve as a storage reservoir. The more rain you have the greater storage areas you should have. Perhaps you would be better off with 18 inches rather than 12 inches of mix.

Question: I notice that their specifications are for a rate of infiltration of one-half to one and one-half inches per hour. Some of us have problems of water standing where we have used high amounts of sand in construction. Why is this so?

Answer:

Either the mixture wasn't proper in the first place or else it has been puddled and compacted to the point where it cannot accept water.

Question: Has the USGA given up the 85 per cent sand mixture for putting greens? They were recommending 85 per cent for putting greens. Is the display in the hall, which is 65 per cent sand, the present USGA recommendation?

Answer: Bill Bengeyfield

The 85 per cent mixture was the result of Ray Lunt's work when this was first carried out. This was about five years ago. Essentially with the right type of sand, soil, and organic matter, 85 per cent sand would be just exactly what you might need to obtain this particular condition. But as I pointed out these materials are so variable from one place to another that it is dangerous to recommend specifically 85 per cent sand. We have learned this, and if we have hurt any of you by that recommendation we are sorry. But I think I would rather have an 85 per cent soil in my green than a 50 per cent sand. I will take all the drainage I can get and pour the fertilizer on to get the grass growing. (Continued by Roy Goss) This display in the hall where 65 per cent sand was used was not a USGA recommendation specifically. To explain it further, that 65 per cent was soil which contained 65 per cent sand and additional sand was added to bring the total up to 85 per cent total sand in the mixture. This soil is a Puyallup fine, sandy loam soil. Actually a considerable portion of the sand in this sample is smaller than the minimum size limit. I think that will explain the display in the hallway. We confess that 85 per cent as a flat figure is wrong.

Question: Johnny Harrison said that in 1959 the display here had a soil layer over a pure sand layer and the water didn't penetrate the sand. Is this still the proper thought?

Answer: Dr. Gardner

This was my demonstration and was the kind of thing I am talking about here. Water doesn't penetrate the sand until it becomes saturated just above it. Soil can hold a great deal of water before it becomes saturated. When it does become saturated, water does penetrate the sand, and if you will remember in the demonstration I did show later pictures where water had penetrated the sand.

There are all kinds of sand mixtures. What you people are interested in here is porosity, and you can get the same kind of porosity with a lot of different kinds of sand mixtures providing you know what you are doing. The percentages of sand which we are talking about are rules of thumb; if you use this much sand and this much silt and this much clay, etc., you will come out with something in the range of porosity that you desire. But this will range tremendously with the kinds of soil materials you use. Actually you can't afford to run a detailed analysis of your materials everytime you are going to build something. Therefore we have rules of thumb which we may use for the various types of materials.

By means of a diagram let me show you quickly how to determine this porosity in which you people are interested. (The apparatus is drawn and explained.) With this type of device you can measure the reaction of a number of kinds of soil and sand and certain mixes to produce the same kind of curve. Now this is the kind of thing we want. Maybe that is too technical.

Bill Bengeyfield: While we are discussing these mixtures I think that Boyd Gourley at the Everett Country Club in Everett, Washington, recently built two greens, and I wonder, Boyd, if you would just comment on what you did over there? "In using the recommendations from the testing laboratory we proceeded to build the green exactly as indicated. We mixed all materials off site and then transported these materials on to the green, spread them out, and laid them in place. These soils did not compact with heavy machinery run over them and I feel sure that we will have good soils in our new putting green."

Question: I would like to direct this to Bill Bengeyfield. Could you very briefly explain the importance of mixing of these soil materials and perhaps a procedure that might be satisfactory?

Answer:

Mix it thoroughly off site. This is explained in the USGA bulletin. Off-site mixing can be accomplished by a number of techniques. The best way I have seen is to have a loader and have your pile of sand, soil, and peat moss and take so many scoops of each in the proper ratio and keep moving this pile until you get a mix. And then when all ingredients are mixed, you just move this pile again with the loader on to the green site. One man in a day can mix a whale of a lot of soils. Boyd, didn't you mix yours this way? Answer: yes. To enlarge further on this mixing--Milt Bauman has mixed soil at Overlake with the angled-back-in blade on a Ford tractor. The results were a wonderful job. Here you must keep moving the soil back and forth, rolling it over continually, bunch it up, push it out again until the material is completely mixed.

Roy Goss: Other people do it with a bucket loader. In this manner it can be picked up, piled, and re-piled until you get an excellent mix. If you are going to mix your soils on site on the putting green, which is absolutely the wrong way to do it, the best instrument you can use is an ordinary disk. This instrument rolls the soils over and over and will eventually produce a reasonably good mix as compared to other machinery. The worst instrument that you can use, particularly if the soil is too dry, is a field rotovator. In this manner we get a considerable amount of sifting out of the coarse materials from the fine. When soils are mixed that are too dry we get a segregating of the fine from the coarse materials. For proper working of these soils the percentage of moisture should not be too far below field capacity. The soils should contain at least 50 per cent of field capacity to avoid this segregation.

Question: What is turface and what are the results of its use in putting-green construction?

Answer: Dr. Goss

For those of you who are not familiar with turface, I will say that it is a fused (calcined) clay. It is very porous and it is absolutely inert like pumice or other materials of that nature. It has no face exchange capacity, therefore, it cannot hold any nutrients which are not in water solution. The only thing we can say is that the material will add considerable porosity to your soils while at the same time holding considerable moisture. We have research going on this material at this time, but have no data to present. At Seattle Country Club some of our putting greens are quite old, that is, 30 to 35 years old which are in various stages of compaction. We have experimented with turface heretofore and thought that it would do the job for us, so this spring we aerified the greens with the half-inch spoons and topped them completely with turface; in fact, we used twenty tons of it. I feel that it did something good to the greens. It is kind of hard to explain because we have eighteen greens and they are all different. They are all constructed differently and it is pretty hard to put a uniform estimate on the good that it did, but I feel in my own mind that it is doing a good job for us. This fall, after the Walker Cup Tournament, we aerified with the one-half inch spoons and I added a yard and a quarter of paving sand.

When we aerified this fall, we brought up a tremendous amount of this turface and it looked like it was in the same condition as it was when we put it in there. This has only been since last spring, but we did find an abundance of grass roots in the aerifier holes. These holes were also filled with this turface material. Our program now is to go in next spring, aerify and add more turface, not as much as we did last spring. We think that if we continue this program for a period of three years we will have enough of that stuff to loosen that soil up and help us with our water condition. In addition to the turface material, the use of the newer and improved-type aerifiers is also helping to do a terrific job for us in eliminating our layers.

When I first went to the Seattle Country Club several years ago you could take a plug out of these greens with a hole cutter and you could count the top dressings. As a matter of fact, I found a layer of charcoal down along about six or six and one-half inches and I asked how it had gotten there. The previous superintendent answered that he had top dressed these greens with charcoal in 1921. You could actually count the top dressings right up to the top. I really believe we have eliminated a lot in the last four years by constant aerifying and adding the materials such as turface. They have done a real, good job for us.

THE MANAGEMENT CHALLENGE

Dr. Gene C. Nutter[1]

This is a fabulous age in which to live. Recently, a comment on the intricate and expansive traffic-ways of a large West Coast city brought about the comment that "it seems we are building wider and wider throughways on which to develop wider and wider traffic jams." Another sign of the times was the humorous prediction seen recently that for the coming winter season snow tires would be available for lawn mowers.

While in jest, such comments as the above rise out of the frame of thought provoked by this fabulous and challenging age.

Golf course operations have also progressed into an era of fabulous changes and challenges. Time will not permit detailed renumeration, but everyone close to golf is aware of the sociological, economic, and technological changes in the game and in the disciplines which service golf.

One of the greatest challenges in golf is that which faces the golf course superintendent. It is these conditions and problems surrounding the golf superintendent which have inspired the topic of today's talk, "The Management Challenge."

What Is the Management Challenge?

"The Management Challenge" is brought to light most quickly and most effectively by recent comments from Mr. Herb Graffis, Editor of Golfdom magazine and noted man-about-golf. These remarks were made at the May 1961 meeting of the Miami Valley Golf Course Superintendents Association, and published in this Association's official bulletin, Divots. The essence of the remarks are as follows: ".... The golf course superintendent is losing out because he is not more of a business man.... The consequence of this is that the golf superintendent is going to hold a position of secondary importance in the organization of the club's administration.... To move into the first echelon of administration it is necessary for the golf superintendent to have a better knowledge of business principles so that total administrative duties can become his. Presently the trend is toward a general manager to assume full control...."

Apparently education (in its presently recognized academic sense) is not the answer to this problem. Recent comments from Marion Mendenhall, outstanding superintendent at Kernwood Country Club and member of the Cincinnati Superintendents Association, sustain this opinion and pointed out several cases where young men with university training have failed to assume the status in their profession that their training should have afforded them. While generally well schooled in turfgrass technology, the college trainees Marion referred to were obviously not given proper philosophy or adequate background in business management, public relations, and personal development. This problem is recognized by many university people and I note that

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your turf-training course at WSU includes work in economics, business management, and personnel management.

In simple terms, then, "The Management Challenge" threatens that superintendents must either WAKE UP OR BE SWALLOWED UP!

Golf Course Management Requirements

To arrive at the meat of this problem, let us review the major golf course management requirements as listed in Table 1 which follows:

Table 1. Golf Course Management Requirements.

1. Turfgrass Technology

   The science of growing grass including knowledge of grasses, soils, nutrition and fertilization, irrigation, pest problems and control, etc.

2. Knowledge of Golf Course Operations

   Knowledge of the game and of player requirements and activities.

3. Labor Management (Employee Relations)

   Worker training, job motivation, work execution, worker benefits and welfare, etc.

4. Work Planning

   Problem analysis, project planning, work supervision, review of results, modification and improvement of methods.

5. Business Management

   Purchasing, recordkeeping, accounting, cost analysis, budgets, office maintenance, and activities.

6. Public Relations and Personal Improvement

   Membership relations, employer relations, press and public relations, professional development, personal advancement.

As we review these six management requirements for successful golf course operation, we note that they can be grouped into three major categories, as can the management operations of any enterprise whether it be a large corporation or a small business. These three categories are:

A. Production Activities

   1. Turfgrass Technology
   2. Knowledge of Golf Course Operations
   3. Labor Management

B. Administrative Activities

4. Work Planning
5. Business Management

C. Salesmanship (For the Superintendent--Public Relations)

6. Public Relations and Personal Improvement

It should be noted that Part C refers to selling the superintendent professionally and personally, since the operations of a golf course and the functions of the superintendent deal with services rather than a material product.

Evaluation of Superintendents' Management Ability

The objective approach in tackling any problem is first to determine the present status. Therefore, it is necessary and wise for us to review, on a countrywide basis, the current status of the superintendent's management ability. This is to cast no reflection on individuals, but is intended to evaluate the profession as a whole in order to give a more objective analysis and insight of the problem. Only through such critical professional analysis can we determine the best approach for solving "the management challenge."

Table 2 gives an estimate of the superintendent's management ability in the three major categories of golf course operation discussed above. These figures are average estimates from consulatation with turfgrass specialists who are familiar with golf course operations and superintendents' activities across North America.

Table 2. Evaluation of Current Management Ability Among Golf Course Superintendents.

Percentage estimate by various performance levels in three major management categories.

Management Category	Performance Level	Percentage Rating	Percentage of Supt's Rating Fair to Excellent
A. Production	Excellent	15%	
	Good	25%	
	Fair	40 to 50%	80 to 90%
	Poor	10 to 20%	
		100%	
B. Administration	Excellent	4 50 5%	
	Good	10%	
	Fair	20 to 30%	34 to 45%
	Poor	56 to 65%	
		100%	
C. Selling	Excellent	1%	
	Good	4 to 5%	
	Fair	15 to 20%	20 to 26%
	Poor	74 to 80%	
		100%	

This analysis would indicate that the superintendents, like the farmers, are heavy on the production side. Of course, this is not actually true, but this evaluation points up that the striking deficiency in the selling and administrative aspects has placed many golf course operations and many golf superintendents in the same marginal operations as many small farms in today's society and economy.

Fortunately, however, golf course work is in a more favorable position than small farm operations because of the growing interest in golf, and the increase in golf course facilities. Another factor is the shortage of golf course superintendents brought about by retirement of older men in the business and the relatively scarce number of young men entering the profession. Were this not the case, many golf superintendents on the job today would be out of work--at least until they accepted "the management challenge" and improved their abilities in administrative and selling aspects of golf course operation. If this analysis seems to be harsh, it is only because of the stark seriousness of the problem at hand. It should undeniably and explosively point up to all superintendents "the management challenge."

The Order of Importance

Table 1 brought out the six requirements of golf course management in order of emphasis given by today's superintendent. Now, having subjected ourselves to a severe self-analysis, and having decided that there must be "some changes made," let us decide the order of importance that should be placed on the six management requirements in Table 1, based on the professional and personal need of today's career superintendents. After careful thought, the following order seems most logical:

1. Business Management and Techniques
2. Public Relations
3. Work Planning
4. Employee Relations and Labor Management
5. Turfgrass Technology
6. Knowledge of Golf Course Operations

This certainly does not mean that turfgrass technology should be cast aside and a new order of superintendents evolved whose talents are primarily business management and public relations. Such an approach in this day and age when turfgrass technology is advancing so rapidly would be ridiculous. Superintendents cannot relax their interest, their training, or their emphasis on turfgrass technology. Rather, superintendents must continue to place increasing emphasis on the advancing technological frontier. However, they must begin additional training programs in the important aspects of administration and public relations. They must begin to "burn the night oil" to catch up in these fields of deficiency if we are to avoid the threat to our profession, emphasized by Herb Graffis in the opening remarks of this paper.

Meeting the Management Challenge

Now that we have talked about "the management challenge," what can be done about it? It would be both ridiculous and remiss to discuss this problem without offering some possible solution. Ironically, it seems easier for me to present the solution than to create concern for the problem.

The job of improving the superintendent's status in matters of business management and public relations resolves into two approaches.

The first involves SELF, or personal, improvement. The second deals with PROFESSIONAL concern and improvement.

A. Self (Personal) Improvement

The reason it is so difficult to alert and convince superintendents of "the management challenge" is that they have not been properly alert or receptive to the problem. This difficulty strikes at the heart of one of the real problems of adult training. An excellent article in the March issue of Nation's Business discusses "Eight Steps to Better Training." This excellent article points out that before adults can be successful in training programs, they must first want to learn. Children can be induced to learn or master subjects in which they have no inherent interest because they respond to external compulsion such as the desire for good grades or the dread of flunking. On the other hand, adults will learn only when they have a strong inner motivation to develop a new skill or a particular type of knowledge. Their desire can be awakened or stimulated by outside influence, but they can never be forced to learn unless they want to.

Secondly, the article points out that adults will learn only what they feel a need to learn. Children, for example, can be induced to learn a progression of more complicated subjects as they advance along normal learning stages from kindergarten through college. In many stages of this learning ladder, children have no appreciation of the relationship of a particular subject to their advanced courses or future careers. However, they do learn as they progress because they are required to learn. An adult, on the contrary, must see an immediate relationship between the training suggested and the problems at hand. Being more practical, the adult mind expects immediate results.

The other steps in the important eight-point training program make excellent reading. However, the two reviewed above indicate that we must first evaluate ourselves critically, understand the problem, then want seriously to improve enough to sacrifice time, effort, and money. The following are six steps for a designed self-improvement program for golf superintendents:

1. Educational meetings - short courses - seminars

   Fortunately, we now have available across the continent many Chapter Association meetings, state and regional turfgrass conferences, in addition to national meetings such as the Annual International Turfgrass Conference and Show sponsored by the Golf Course Superintendents Association of America. More and more of these educational meetings are beginning to offer subjects on business management and personal improvement in addition to excellent treatment of turfgrass technology.

2. Reading

   a. In order to keep abreast of the times it is essential that all superintendents subscribe and thoroughly read all magazines, newsletters, books, and periodicals in the turfgrass field. A review of these publications is presented in the Educational Mimeo "Careers in Golf Turf" published by the Golf Course Superintendents Association of America and available on request from the Headquarters Office of GCSAA at no cost.

b. Every superintendent should read more business and public relations magazines such as U. S. World News, Nation's Business, Kiplinger Letters, Harvard Business Review, Fortune, The Quarterly Review of Public Relations, etc.

c. Further self-improvement comes from reading more books on humanities, philosophy, and economics.

3. Greater effort on the job

Work harder at developing and organizing the job. Don't be satisfied with your office, your library, your shop condition, your employee-training methods, your supervision, or anything else about the job that you perform. Such self-complacency leads to a career rut and inefficient use of our human resources--America's most valued natural asset.

4. Night school courses

Almost any community in almost any section of the continent offers night school training, either from the local high school or the local college, on such subjects as bookkeeping, accounting, typing, economics, salesmanship, and many other subjects important to administrative management and personal improvement.

5. Dale Carnegie and Toastmasters

Attend either the Dale Carnegie or Toastmasters courses on speech and personal development.

These personal training courses are perhaps the most forward steps in developing articulate and effective ability to sell programs, professions, and causes--including self-advancement. An excellent article on this subject appears in the July issue of The Golf Course Reporter.

6. Winter School Courses

Take leave and attend turf-management school. More and more land-grant colleges are now offering special schools in turfgrass technology. As mentioned above, it is essential that the progressive, modern, and effective superintendent continue to master the basic aspects of turfgrass science. In addition, more and more of these schools are becoming aware of the other aspects of golf course management and are offering elective courses in business management and personal advancement. Some of the important schools include Massachusetts State University; Pennsylvania State University and Rutgers University. Every superintendent who has not enjoyed the benefit of college training in turfgrass management should consider arranging a leave of absence to attend one of these two-year winter schools.

In addition to the two-year winter turf schools, many of the land-grant colleges offer four-year courses in turfgrass management leading to the Bachelor of Science degree in Agriculture with specialization in turfgrass management.

B. The Professional Improvement Aspect

While personal improvement is the first step in career advancement, a close second in importance is the aspect of professional concern and outlook. Superintendents must recognize that their profession will advance only in proportion to their personal interest and participation. The following four elements are essential in a professional program:

1. Build stronger local or chapter association

   Men of a profession must meet periodically on a local scene to discuss problems peculiar to their area. This is certainly true among golf course superintendents because of the wide variation they encounter in climate, soils, and geography. However, to be successful, these local chapters must be built first on educational strength, and second on fellowship maintenance. Many chapter associations resort to cocktail parties, dinner, and golf as their principal activities. These groups will remain weak and uncertain until they realize that education must become the theme of such meetings. Fellowship is important and essential to group maintenance, but it must not become the primary objective of chapter meetings.

2. Support and participate in the national front

   Many aspects of career building require promotions on a national front. For example, superintendent publicity at national golf tournaments is an effective means of advancing the cause of the superintendent. This type of public relations is referred to among organizations as "image building." It means placing the picture or the image of the Association before the public on a wide scale. Certainly there is prime need for such public relations by the golf superintendents' profession.

   From another viewpoint, a national organization, with more members and larger operating fund, is in position to advance the professional front, or image, of an organization much more effectively than small groups working independently. Also the profession can advance many more membership services from a strong national front than through limited local resources and efforts. The Golf Course Superintendents Association of America is constantly striving to advance the cause of the superintendent through national public relations, education, and professional programs.

3. Respect and advancement of professional ethics

   Every vocation and profession carries with it certain obligations to which its members must subscribe if they are to work together in harmony for the individual and collective good of their profession. Such ethics emphasize the rights and importance of the individual, and the development of standards which advance the causes and benefits of membership at large. The absence of such standards and discipline may result in chaos among professional workers and the undoing of the profession.

4. Exert professional influence locally

Every superintendent has the opportunity and the obligation to exert his professional influence in community problems. He should be a member of, and frequently address, local garden clubs. He should be of assistance (to a reasonable degree) to the members of his club in matters of lawn and other turf problems. He should be a constant friend of the county agricultural agent and active in exchanging information, and he should be well known as a turfgrass authority by all local businessmen who deal with turfgrass supplied and services.

To advance the cause of his profession he should be represented in local civic clubs and should be well known to the local press. Activities of this type will advance his personal cause and build the image of his profession on the home front.

Characteristics of Management Talent

You have heard it spoken that the most important element in management involves the first three letters--M A N. No statement could be truer. Great organizations and great activities center around the talents and abilities of individual men--the leaders.

In order to accept and to advance "the management challenge" it is necessary to review and advance, in addition to professional requirements, personal characteristics. The attached exercise is designed to screen personal characteristics for management ability. It is modified for this paper from Harvard Business Review's survey on "developing management talent." I challenge you to review the two sets of characteristics in this table, complete the exercise by following directions in the table, and then compare your answers with your own personal characteristics. It might be wise to place this table where you can review it frequently--perhaps daily--in order to remind yourself that management talents and abilities involve many things above and beyond the immediate professional requirements of the job, including personal characteristics.

If you would like to compare your answers to those devised by Harvard Business Review, merely drop a note to my office requesting its summary of results. My address is:

Golf Course Superintendents Association of America
P. O. Box 1385
Jacksonville Beach, Florida

Thank you for allowing me to discuss with you "the management challenge."

SCREENING PERSONAL CHARACTERISTICS FOR MANAGEMENT ABILITY[1]

1. Below are pairs of adjectives which have been used to describe the kind of person who makes the best management specialist or organization leader. Check the adjective in each pair which you think more important in developing management ability.

a.	☐ sociability	☐ unassuming
b.	☐ polished	☐ modest
c.	☐ sincere	☐ cautious
d.	☐ determined	☐ aggressive
e.	☐ systematic	☐ assured
f.	☐ entertaining	☐ pleasant
g.	☐ calm	☐ energetic
h.	☐ courageous	☐ ambitious
i.	☐ capable	☐ dignified
j.	☐ conservative	☐ kind
k.	☐ sympathetic	☐ orderly
l.	☐ resourceful	☐ serious
m.	☐ precise	☐ reserved
n.	☐ smooth	☐ jolly
o.	☐ practical	☐ responsible
p.	☐ forceful	☐ enterprising
q.	☐ cheerful	☐ punctual
r.	☐ plain-spoken	☐ steady
s.	☐ temperate	☐ painstaking
t.	☐ intelligent	☐ considerate
u.	☐ discreet	☐ civilized
v.	☐ sharp-witted	☐ respectable
w.	☐ industrious	☐ accurate
x.	☐ independent	☐ attractive
y.	☐ tolerant	☐ careful
z.	☐ deliberate	☐ popular
aa.	☐ patient	☐ good-natured
bb.	☐ foresighted	☐ stable

2. Below are pairs of adjectives ordinarily describing undesirable characteristics of management leaders. Check the adjective in each pair which you consider least desirable.

a.	☐ dull	☐ sullen
b.	☐ cocky	☐ distant
c.	☐ disorderly	☐ anxious
d.	☐ egotistical	☐ commonplace
e.	☐ impatient	☐ meddlesome
f.	☐ excitable	☐ opinionated
g.	☐ retiring	☐ clumsy
h.	☐ unfriendly	☐ dissatisfied
i.	☐ unambitious	☐ hard
j.	☐ willful	☐ carefree
k.	☐ critical	☐ gloomy
l.	☐ apathetic	☐ intolerant
m.	☐ tense	☐ crafty
n.	☐ solemn	☐ erratic
o.	☐ argumentive	☐ careless
p.	☐ forgetful	☐ outspoken
q.	☐ reckless	☐ militant
r.	☐ slow	☐ purposeless
s.	☐ stingy	☐ bashful
t.	☐ meek	☐ irritable
u.	☐ easygoing	☐ self-satisfied
v.	☐ lazy	☐ rattlebrained
w.	☐ sentimental	☐ loud
x.	☐ rebellious	☐ daydreamer
y.	☐ cynical	☐ placid
z.	☐ pessimistic	☐ self-seeking
aa.	☐ temperamental	☐ tightfisted
bb.	☐ shallow	☐ sly

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[1] Modified for this paper from Harvard Business Review "Summary on Developing Management Talent."

RESEARCH ON TURF GRASS IN WESTERN WASHINGTON

Putting Green Fertilization Trials

Roy L. Goss[1]

This experiment was initiated in 1960 to determine the proper combination of nitrogen phosphorus and potassium for putting greens. The same scheduling and rate of fertilization has been followed for the years 1960 and 1961. Due to the high level of fertility of the soil where this experiment is being conducted, the differences in fertilizer treatment are not showing up as fast as were expected. However, some differences are apparent at this time and are indicated in the following table. The table represents an average of three ratings taken throughout 1961. Three criteria were used in evaluating these plots, namely, color, density, and the amount of Ophiobolus patch. The first figure indicates color, the second figure density, and the figure following the dash is the percentage of the total plot area affected by disease. The reason for making a disease evaluation at this time is because it is felt that nutrition plays an important role in the development of disease.

Table 1. Fertilizer Effects on Color Density - Disease[c] on Putting Green Turf.

	Treatment			Average Color[a]/Density[b]--Disease[c]
	N	P	K	
1.	20	0	0	9/10 - 3
2.	20	4	0	9/10 - 3
3.	20	4	4	9/10 - 2
4.	20	4	8	10/10 - 2
5.		Check		7/10 - 3
6.	20	0	4	8/10 - 2
7.	20	0	8	9/10 - 3
8.	12	0	0	9/10 - 1
9.	12	0	4	9/10 - 1
10.	12	0	8	10/10 - 1
11.	12	4	0	10/10 - 2
12.	12	4	4	10/10 - 1
13.	12	4	8	9/10 - 1
14.	6	0	0	8/10 - 2
15.	6	0	4	7/10 - 1
16.	6	0	8	7/10 - 1
17.	6	4	0	8/10 - 2
18.	6	4	4	7/10 - 1
19.	6	4	8	8/10 - 3

[a]Color Rated 1 - 10. Rating of 10 = best.

[b]Density Rated 1 - 10. Rating of 10 is best.

[c]Disease (estimated in per cent of plot covered) is *Ophiobolus graminis* (ophiobolus patch).

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[1]Assistant Agronomist, Western Washington Experiment Station, Puyallup, Washington.

From the table it is apparent that fertilizer treatment apparently has not affected the density of the turf. In all cases the density was rated as 10, which is the highest rating. However, the color varied from a range of 7 to 10, 7 being the poorest color and 10 being the best. From the table it is seen that plots number 4, 10, 11, and 12 have the best combination of color, density, and lack of disease. It is interesting to note that plots falling in the intermediate nitrogen range, namely 12 pounds per thousand square feet per season, had more plots in the high rating area than those with the high nitrogen (20 pounds N per thousand per season). This tends to indicate that some problems are occurring in the high nitrogen plots to keep the quality of turf down. These data tend to indicate that perhaps 12 pounds of nitrogen per thousand square feet per season may produce turf with fewer problems than when we go to considerably higher rates.

It was interesting to note that in the first part of the season (early spring) that the plots with the high nitrogen applications appeared the best. By mid-season, however, the medium range of nitrogen (12 pounds N per thousand per season) was showing the best. In September, plots receiving six pounds of nitrogen per thousand square feet for the season had as desirable an appearance as the other plots. It is not felt that this is representative of what could be expected in all cases. Perhaps the reason for this difference is that some injury was sustained by the higher nitrogen plots, due to fertilizer treatments during the hot weather.

The Effect of Fertilizer Treatment on Ophiobolus Patch

In all cases, plots receiving high nitrogen also suffered most severely from ophiobolus patch. This follows the general pattern as reported previously by Dr. C. J. Gould in other disease investigations. It does appear, however, that phosphorus or potassium is having any affect upon the development of this disease. Some of the plots have high disease incidence whether they contain phosphorus alone, potassium alone, or phosphorus and potassium in combination.

It is interesting to note that many of the plots receiving potassium during the hotter months were badly injured. The most severe injury occurred when potassium and nitrogen were in combination. High nitrogen alone caused little or no burning, hence the burning was attributed almost entirely to the potash. From the results reported here, it should become obvious that potash applications should be held to a minimum during the hottest part of the growing season. Since the potash produced only a superficial burn, the plots did recover rather quickly. Potash can be safely applied during the hotter part of the growing season if overcast or cool days are selected for application. Washing the grass blades thoroughly is also important to prevent this potash burn.

The Effect of Fertilizer Treatment on Root Yields of Putting Turf

Since the roots are equally as important as the tops of the grass, one sample 4 inches in diameter and 8 inches deep was removed from the center of each of the plots to determine this effect. In referring to the table below, several conclusions can be drawn:

Table 2.

	N	P	K	Mean Root Yield in Grams
1.	20	0	0	1. 70
2.	20	4	0	1. 62
3.	20	4	4	1. 70
4.	20	4	8	1. 55
5.		Check		*2. 54
6.	20	0	4	1. 87
7.	20	0	8	*2. 36 (highest yield in High N Plots)
8.	12	0	0	2. 38
9.	12	0	4	2. 08
10.	12	0	8	*3. 12
11.	12	4	0	1. 55
12.	12	4	4	2. 11
13.	12	4	8	2. 37
14.	6	0	0	1. 94
15.	6	0	4	*2. 82
16.	6	0	8	*2. 76
17.	6	4	0	1. 78
18.	6	4	4	2. 14
19.	6	4	8	2. 31

Grand Mean = 2. 14

Note from the table that the highest root yields from the plots receiving high nitrogen were from plots receiving potassium. By observing the remainder of the plots it can be found that the highest root yields were from plots receiving potassium. Further, it can be found that the lowest root yields were from plots receiving phosphorus and no potassium.

These experiments will be continued and other data will be collected in 1962.

Poa Annual Control Investigations

With the exception of crab grass, Poa annua has probably been investigated just about as much as any other turfgrass weed. Because of the many problems associated with this plant, it is a very poor turf where extensive traffic occurs.

A plastic air-supported greenhouse, which is being called the bubble house, was constructed at the Western Washington Experiment Station in February 1961. This house is approximately 20 feet wide by 100 feet long. The house was designed by the Agricultural Engineering Department of WSU, by Mr. Walter Matson. The funds for construction of this house were provided in the most part by the Diamond Alkali Company and further supported by the Northwest Turf Association. The research which brought about the design and construction of this house was sponsored by grants from the Washington Farm Electrification Committee. This house was built specifically for turfgrass research and primarily at this time for investigation of Poa annua control. Fourteen different treatments were applied to bare soil in March 1961 in an effort pre-emergently to control annual blue grass. After the chemicals were applied to the soil, periodic small plot seedings were made into each of the treated plots to determine the length of time these materials were effective in keeping down germination.

Of the materials tested, six of these appeared to be worthy of further testing. Of these six materials, both Dacthal and Zytron, which are good crab grass pre-emergent herbicides, showed up very good for the purpose of pre-emergence control of Poa annua.

These trials will be continued again this fall and winter, and the best of the materials will be tested for phytoxicity under field conditions in the spring of 1962. If these materials prove to be effective in pre-emergence control and have a low order of phytoxicity, a program or schedule will be worked out for the application of these materials to old existing Poa annua-infested turf and also for applications to clean bent grass turf.

Root Growth Investigations

In an effort to determine if certain materials would increase the root growth of turfgrasses, especially during the season when the roots are needed the most (during warm summer months), an experiment was designed and initiated at the Overlake Golf and Country Club. A grant of $500 was provided by the Golf Course Superintendents Assocation of America Research and Scholarship Fund for these investigations. Jim, Bauman, currently attending Washington State University as the first turfgrass management major, assisted in conducting this experiment. Twelve different materials at differing concentrations were randomized and replicated four times on a practice putting green at the Overlake Country Club. These materials included two wetting agents, namely, Aquagro, Propen, and several of the vitamins, as follows: Vitamin B^{12}, thiamin, pyridoxin, niacin, and a combination of the four. Urease, Indoleacetic acid, a hormone solution called Hormex, and a treated ammonium sulphate fertilizer were used in these tests.

The reason for testing these various vitamins, hormones, and sugar compounds is that if a greater root system can be developed, more of the soil profile can be used for obtaining nutrients and water during summer stress periods. Also, during the hottest part of the summer, respiration rates go up quite high. It is conceivalble that insufficient food reserves can be produced to maintain healthy, active growth within the plant; hence, the reason for applications of sugar.

Briefly, the four materials applied apparently produced turf having longer-than-average roots. The average root length at the time the test was made was 4. 15 inches deep for all treatments. Sugar increased the root length by almost 1 inch. Vitamin B^{12} increased root length slightly more than the average. Pyridoxin (Vitamin B^{6}) increased root length by about 3/4 of an inch. And, finally, a four-way mix of all vitamins increased root length by approximately 3/10 of an inch.

From these conclusions, it is obvious there are no dramatic increases in root length from any of these materials; however, even this much increase could be extremely important under certain stress conditions. From the information gained from this investigation, further trials will be initiated on different soil types to determine if such treatments are practical.

Lawn Turfgrass Investigations

Two levels of nitrogen (4 and 8 pounds per thousand square feet per season, 0 and 4 pounds of phosphorus, and 4 and 8 pounds of potassium per thousand square feet per season) have been used ain all combinations to yield fertilizer plots on these lawn grasses. The main fertilizer plot being 7 feet by 20 feet, it was divided in half and each half of the plot is being cut at two different heighths. The high cut is $1\frac{1}{2}$ inches and the low cut is 3/4 inch. By dividing the plots thus, determinations can be made as to the effect of fertility treatment on these grasses and the interaction of cutting height and fertility level.

Even though this terminates the second year of fertilizer applications, only minor differences appear between the plots in the 4- and 8-pound nitrogen level. The higher nitrogen level is definitely better than the low level, but no apparent differences exist between the phosphate and potash treatments. Perhaps the reason for this is that the native soils, where this experiment is established, are fertile and have good productive capacities.

The Effect of Fertility on Weed Invasion

In recording data from the plots, it was interesting to note that plots receiving the low level of nitrogen contained on an average 18 more weeds per plot than the plots receiving high nitrogen without regard to the level of phosphate and potash. This was so for the plots receiving the high cut. For plots receiving low cutting the average number of weeds present for the high-nitrogen treatment was five weeds per plot. The average number of weeds present on plots receiving low nitrogen for the low-cutting treatment was 14 weeds per plot. The conclusion can obviously be made then that at this stage of growth weeds can be controlled, at least in part, with a good nitrogen fertilization program. It is significant also to point out that the check plots receiving no nitrogen phosphorus nor potassium had an average of 30 weeds per plot. This leaves little doubt then as to the effect of a good fertilization program on weed establishment.

The Effect of Cutting Height on Weed Invasion

Various investigators have reported in the literature for some time on the effects of cutting heights on weed development and invasion. Most of the investigators previously have reported that low cutting heights usually result in higher weed populations. At this time these results have not occurred at this location. By comparing the high cut with the low cut, when both received high nitrogen levels, it can be seen that the high-cut plots have an average of about nine weeds per plot as compared to about six weeds per plot for the low-cut treatment. Almost identical proportions were maintained in the plots receiving low-nitrogen treatment when comparing high with low cutting, the only difference here being that low-nitrogen treatment allowed a greater weed invasion.

The measurement of thatch was not attempted this year, but will be an important phase of the study in the following year. At the present time, important differences exist between the amount of thatch formation in comparing 3/4 with $1\frac{1}{2}$ inch cutting heighths. The high cutting is producing a serious thatch problem which will require vert-cutting, power raking, or some means of thatch removal in the near future. The low-cut (3/4 inch) plots are in excellent condition insofar as thatch formation is concerned. A technique will be developed for accurately measuring and reporting this thatch in the following year.

From the table following, it can be observed that treatment No. 6, 8 pounds of nitrogen, no phosphorus, and 8 pounds of potash, produced turf with fewest numbers of weeds.

Table 3. Fertilizer and Cutting Effects on Weed Invasion in Lawn Turf

	Treatment			Average No. Weeds/Plot	
				High Cut (1½")	Low Cut (3/4")
	N.	P.	K.		
1.	8	0	0	11	8
2.	8	4	0	10	7
3.	8	4	4	9	6
4.	8	4	8	8	7
5.	8	0	4	8	9
6.	8	0	8	6	4
7.	4	0	0	13	11
8.	4	4	0	13	10
9.	4	4	4	13	9
10.	4	4	8	15	11
11.	4	0	4	12	13
12.	4	0	8	15	15
13.	0	0	0	32	32

Note: Numbers under Treatment refer to lbs. of available nitrogen, phosphorus and potassium applied per 1, 000 sq. ft. per season divided into monthly applications.

Fumigation Investigations

Many of the problems associated with turfgrass management are directly related to weedy or trashy soil at the time that the turfgrasses are established. Some weeds, due to their highly specialized nature, will not only compete with our desirable turfgrasses, but in many instances will completely over-ride them and eventually dominate the stand. The number one enemy today, of course, is Poa annua. Other weeds, such as mouse ear chickweed, dandelion, plantion, pearlwort, velvetgrass, watergrass, dog fennel, pineapple weed, and many others, can be serious when grasses are in the seedling stage. These weeds all grow just as fast or faster than the turfgrasses.

In order to start a turf planting and maintain its pure botanical composition, it is necessary to eliminate as many of these weeds as possible before trying to establish a turfgrass. I feel that one of the greatest problems facing us in the control of Poa annua today is the fact that this grass becomes established at the time that the desirable bentgrasses are getting their start. Whenever desirable grasses are lost by disease, then we also have good avenues of establishment of Poa annua.

One thing is certain and that is, if we have a clean seedbed in the beginning, we will give our desirable turfgrasses the best possible chance for survival and performing properly. Since I have previously reported on fumigants and their use, this report will be limited to reporting on the use of new fumigants and a brief summary of the old ones.

Table 4.

Material	Pounds per 1000 Sq. ft.	Per cent weed control Average of 4 replications
Vorlex	3 qts.	10%
Vorlex	4 qts.	90%
Vapam	10 qts	75%
Telone	200 pounds per A.	76%
Cyanamid	70 pounds per 1000	98%
Trizone	200 pounds per acre	100%

The soil moisture at the time of application of these fumigants was at field capacity. The Trizone, being a gas, was injected into the ground and the plots were simultaneously covered with a polyethelyne tarp by means of a mechanical tarp layer. Vorlex and Vapam, both being liquids, were applied to the soil, Vorlex by way of chiseled injector, and Vapam by means of sprinkler can. A water seal of $\frac{1}{2}$ to 1 inch of water should be applied to both of these materials following their soil application. In the early test in May irrigation water was not available, therefore, plots were re-established in August and were sealed with water. The percentage weed control in the retest with water seal was significant. The Vorlex treated plots increased their weed control to 95 per cent and Vapam increased up to 98 per cent control. It is obvious then that water sealing with these two materials is extremely important.

The conclusions can be drawn from this series of tests that Trizone, Vorlex, Vapam, and Cyanamid will give excellent weed control if used according to manufacturers' specifications. In using fumigants prior to turfgrass planting two simple precautions must be taken. The soil temperature must be high enough (50 degrees or more) for normal plant growth. The soil moisture should be at field capacity and should be maintained at field capacity during the fumigation period. And finally most of the fumigants should be allowed 10 days to three weeks to finish their fumigation action with the exception of the gases such as Trizone and Methyl Bromide. In the latter part of the fumigation period the soil should be restirred and allowed a short aeration period before planting. Just remember that until better control for some of the weed tests in turfgrass plantings comes along, the fumigants will aid greatly in maintaining clean conditions.

Compaction Studies

As every turf manager knows, compaction is a deadly enemy to turfgrasses. With the average soil, the greater the amount of traffic the greater the compaction imparted to the soil. Due to the ever-increasing demand for play areas such as play fields, athletic fields, and golf courses, the problem of compaction is becoming more severe. The effects of compaction are more noticeable even in areas where rainfall is the highest during the use season.

In most areas golf course putting greens, particularly, get some respite from compaction during the late fall, winter, and very early spring months.

During the winter months, on golf courses west of the Cascade Mountains, play continues normally unless unusual cold conditions force discontinuance of play. This ordinarily does not occur, but if so, for only brief periods.

Even though soils are compacted at all times of the year, coastal golf courses receive the additional three or four months compaction that other golf courses do not experience. Compaction can occur at any time when the soil moisture is sufficient so that the soils are plastic. This condition exists at all times during the playing season when irrigation and/or rainfall is sufficient for normal growth of turfgrasses.

Soil compaction can be blamed on several factors. Among them are the following: (1) excessive clay content, (2) excessive silt content, (3) excessive very fine sand particles, (4) any combination of the three, (5) excessive moisture, and (6) extensive use of turfgrass areas while the moisture content of the soil is above field capacity.

Surely, if all of these above factors existed in any one soil area, trouble would certainly ensue. Even so, many of these factors do occur in the same area and certainly all of them occur over a wide area.

In order to determine the amount of traffic necessary to induce certain degrees of compaction and also to determine the best way of eliminating this compaction, an experiment was designed at the Western Washington Experiment Station for this study. A compaction machine was built to simulate compaction induced by foot traffic. This machine has 16 feet which actually walk on the turfgrass, and a desired amount of traffic can be imposed on the turf area with little expenditure of time and labor. This machine was built by Mr. Ed Jennings, a mechanic at the Overlake Golf and Country Club. The funds for purchasing the basic machine and for construction of the compaction machine were furnished as a grant from the Aero-thatch Company of Rahway, New Jersey.

After the machine was tested on site and determined to be satisfactory in operation, it was turned over to Mr. J. Roberts and Mr. J. B. Simpson of the Agricultural Engineering Department of WSU to determine the actual compacting force. Their findings were as follows: The unit pressure of a 180-pound man walking was approximately eight pounds per square inch. The unit pressure of the compaction machine, when operating, was 11. 1 pounds per square inch. This indicates, then, that the compaction machine was exerting a force a little in excess of a man 180 pounds of weight. This difference could be made up by using a shoe with approximately three square inches more of surface.

The experimental putting green at the Experiment Station was divided into four strips of ten feet each. The compaction machine was run the length of the putting green over three of these strips. Strip number 1 received 100 rounds of traffic daily, strip number two, 200 rounds daily, strip number three, 300 rounds daily, and strip number 4 received no traffic. Since the green is approximately 48 feet long, it was divided into four replications of 12 feet each. Each replication was further subdivided into three strips of four feet each. Vertical to the direction of the compaction, these four foot strips were treated as follows: Strip number 1 was treated to the maximum depth with the Aero-thatch machine. Strip number 2 was aerofied with a Ryan Greens Aerofier, and strip number 3 received no aerofication. The aerofication treatment was practiced three times throughout the year with the compaction being induced daily, with the exception of a brief period when excessive rainfall made the surface too wet.

In order to determine the degree of compaction, water infiltration tests were run in an effort to secure accurate measurements. Due to problems existing which cannot be easily controlled, this system is difficult to adapt to field conditions. Minor variations in soils will produce serious differences in results of infiltration. However, some useful data were gained from these infiltration studies. The area receiving 100 rounds of traffic daily, regardless of the mechanical treatment, accepted five centimeters of water from the $1\frac{1}{2}$ inch glass tube per minute on the average. The strip receiving 200 rounds of traffic daily accepted an average of four centimeters of water per minute. The strip receiving 300 rounds of traffic daily accepted less than 2. 5 centimeters of water per minute, and the strip receiving no compaction accepted approximately 4. 5 centimeters of water per minute.

The average infiltration rate of water assessed to the effect of the machines which are designed to relieve compaction was approximately the same in the case of the Aero-thatch and the Greens Air Aerofier. Both machines, however, increased the infiltration rate considerably over the checked area where no relief from compaction was given.

From the data indicated, it is obvious, of course, that the more traffic over a given area, the slower will be the infiltration rate of the water. There is one confusing factor here, however, and that is that the area receiving no compaction accepted water at approximately the same rate as the area receiving 100 rounds of traffic daily. Upon close examination of the areas, it was found that the area not being compacted had extensive thatch formation, as compared to little or no thatch formation on the other plots. This is an extremely important factor and serves as a partial explanation as to why golf courses in western Washington cannot get sufficient thatch to produce a good playing mat.

Further conclusions from this experiment may be drawn that the more the winter traffic on play areas, the more damaging it is to both the grass and the soil. This traffic should be routed to other areas, or eliminated during the period of the year when the growth is the slowest and the soil is the wettest.

Further studies are being conducted along this line with different soil mixtures.

Surfactant Investigations

According to Webster's dictionary, surface tension can be defined as "that property, due to molecular forces, by which the surface film of all liquids tends to take a form having the least superficial area." When water is subjected to considerable tension, the angle of contact between the water droplet and the surface becomes very steep, or in other words, has very little contact with the surface. When the tension is relieved at the interface between the water droplet and the material on which it is resting, the droplet becomes flattened and has considerably more area in contact with the contacting media. Any method by which this tension can be reduced can be termed a surfactant.

The surfactants that will be discussed at this time are chemical wetting agents that due to their action upon these water droplets reduce the surface tension and cause a flattening of the water droplet, ultimately making better contact between the water droplet and the surface.

The need for surfactants or wetting agents has been constantly with us, particularly during the summer period. In prolonged periods of hot, dry weather, surface tension builds up quite high on grassy surfaces and on soil surfaces. Because of this high tension, water tends to run off of the surface or remain as individual droplets rather than trying to seek entrance into the soil or grass. The steeper the slopes, the more pronounced the run-off effect. Even in areas which appear flat, minor variations in elevation on the surface will occur. Small isolated areas that are only slightly higher than the surrounding area may not receive any water at all even though ample irrigations are being practiced. This has been one of the most common problems in the Pacific Northwest during the summer months on both home lawns and putting greens. Fairways, of course, are constantly bothered with this problem, particularly where a number of rolls and mounds occur.

Many wetting agents have been available for several years to help combat this problem of dry spots. Most of the best wetting agents are all of the chemical composition of non-ionic organic. This means that not being ionic, they will enter into no chemical reaction with the soil and will produce no chemical or physical structural changes. And being organic, they will break down or be converted to harmless products in the soil. These are the desirable wetting agents, and those which contain ionic fractions, such as sodium salts, should be avoided if at all possible. In an effort to determine how practical and profitable it would be to use wetting for the relief of dry spots and better infiltration and penetration of water, two identical experiments were established on the Olympia Country Club and the Tacoma Country Club. Olympia Country Club has experienced considerable trouble with water penetration on putting greens that were only two years old. Even though thatch formations were of no significance, water was entering the surface very unevenly over the entire putting green, leaving a great many dry spots. At the Tacoma Country Club, the conditions was similar, but not nearly so severe. The major difference in the management practices between these two experiments was that the putting green at Olympia had not been aerified, and the putting green at Tacoma had been aerified with a Greensaire aerifier. In this manner, we were able to get information on the effects of wetting agents on both aerified and non-aerified putting greens. Only two materials were tried in both of these experiments, however, different dates of application were tested. Propen, a surfactant produced by the Process Chemical Company, was applied at three ounces per 1000 square feet, and Aqua-grow, manufactured by the Aquatrols Corporation of America, was applied at eight ounces per 1000 square feet. Both of these rates were recommended by the manufacturers. Both materials were applied at the concentration indicated above once per season, twice per season, and every three weeks. Check plots were maintained for comparison.

In order to evaluate the effectiveness of these wetting agents in reducing dry spots or increasing the infiltration of water, the numbers of dry spots found in the plots at the time of the third application were used to evaluate this effectiveness. These dry spots varied in size from six inches in diameter up to eighteen inches. Visual examination was all that was necessary to make this determination. However, several spots were plugged to verify visual examination. The table below will indicate the effectiveness produced by these wetting agents.

Table 5. Wetting Agents - Olympia.

	Numbers of Dry Spots				
	Rep. I	Rep. II	Rep. III	Rep. IV	Avg. No. Dry Spots
Propen - 1	6	1	10	10	7
Propen - 2	1	9	5	8	6
Propen - 3 wks	2	8	3	5	4
Aqua Gro - 2	0	1	0	2	1
Aqua Gro - 3	0	0	0	0	0
Check - -	6	5	6	10	7

Since very few dry spots developed on the putting green at Tacoma due to thorough aerification, no individual plot data were taken. From the data obtained above at Olympia, it is obvious that dry spots can be eliminated by the use of these wetting agents. They are easy to apply and, from what is known today, are harmless additives to the soil.

One important factor which should be considered in the use of surfactants is that the total water application for the summer may be considerably reduced. The important thing here is that we quite often irrigate the total surface only to accommodate a half-dozen dry spots over the area. If we can induce these dry spots to take water, then we may be able to extend the irrigation period unless other serious soil restrictions occur in these dry spots. Not only will we save in application of water, but in hand labor which is involved sometimes in hand watering these dry spots. We will also be able to save in fertilization, particularly nitrogen. By attempting to irrigate these greens or other turf areas uniformly, we will not be leaching so much nitrogen out of the surface.

More investigations will be made on these surfactants in the near future to determine if prolonged use will cause hydrophobic effects or any other detrimental effects to turfgrasses.

MANAGEMENT OF ATHLETIC AND PLAYING FIELDS

Norman Goetze[1]

The production of high-quality turf for playgrounds and athletic areas involves the same principles used in all other turf areas. Many times these principles must be used in practices differently because of the unique demands of this type of turf. This discussion will outline some of the alterations in management practices adopted for athletic turf production.

At many institutions, the supervision responsibilities have not been clearly delineated. Management decisions under these conditions are far too often based on personalities and politics. High-quality turf rarely results from disorganized supervision. Generally, when management is clearly in the hands of one individual, the quality of turf is much higher. There is little need for the agronomic phases of athletic turf management until the supervision has been delegated to one individual.

Mowing

Height of mowing is not too important, but is determined by the type of grass and its use. Frequency of mowing should be fairly constant throughout the year, whether the turf is being used or not. Allowing tall growth of football turf during summer and returning to a short mowing height in the fall weakens the root system and the stand is more easily injured by heavy traffic. Bentgrass should be mowed at 3/4 inches, bluegrasses and fine fescues at $1\frac{1}{2}$ inches, and tall fescue at 2 inches or more.

Watering

Since grass roots are ultimately distributed in the soil where moisture is available, deeper root penetration can be obtained by thorough irrigation to a depth of eight inches or more. This will reduce the number of irrigations required, prevent surface compaction, and improve water efficiency while producing a stronger-rooted turf. Irrigation should be completed at least six hours before use on sandy soils and at least two days before use on heavy clay soils to allow the surface to dry to prevent compaction.

Fertilization

Heavy use of nitrogen fertilizers should be avoided just prior to and during periods of heavy use, since nitrogen causes a succulent top growth more susceptible to mechanical damage and restricts root growth. Athletic areas used for summer sports should be fertilized in fall and spring. Football fields should be fertilized in late spring and mid-summer. The role of phosphorus, potash, sulfur, and other nutrients for athletic turf has not been studied in research. Consequently they should be used as in other turf growing on similar soil conditions.

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[1]Extension Farm Crops Specialist, Oregon State University, Corvallis, Oregon.

Soil Compaction

Since most athletic events are conducted on a calendar basis irrespective of weather conditions, heavy use is often experienced during rainy weather. Saturation of the surface layers by light rainfall during an athletic even results in soil compaction near the surface.

Compaction cannot be prevented by altering the soil mix under these conditions, but instead must be relieved by mechanical treatment during seasons of non-use or during periods when the soil can be kept in a non-saturated condition. Field aerifiers or any other type of equipment which removes a core from the compacted zone are recommended. Spikers actually create additional compaction at the bottom of the hole and along the sides while giving temporary relief to compaction by allowing for better air circulation.

Establishment and Overseeding

Following seasons of heavy use and partial loss of stand, interest is often expressed in complete reconstruction of the facility. This is unnecessary and usually unsatisfactory unless a soil or drainage condition is to be corrected. Overseeding prior to the last athletic event of the season usually will repair the heavy-trafficked areas. A light harrowing will assist in covering the seeds if the last activity did not involve cleated shoes. Yearly or biyearly overseeding is far less expensive and easier than complete renovation jobs.

If complete renovation is necessary because of improper drainage or soil conditions, a complete year is required for best establishment of a tough wear-resistant turf. The development of a temporary facility using annual ryegrass will provide a longer period for development of the more slowly established turf species on the permanent facility. Many renovation jobs have failed because the turf has been used heavily too soon after planting.

Grasses

Heavily used athletic areas in western areas are being planted with Alta fescue at 200 to 400 pounds per acre. Heavy amounts of seed are required because it is noncreeping and because the seed size is large. Similar turf in eastern and central regions is mostly devoted to Kentucky bluegrass or Merion bluegrass. Unless heavier fertility and excellent watering schedules are planned, the Kentucky bluegrass is preferred because of its better drought tolerance. Alta fescue has been successfully used on highly alkaline soils in these regions.

Athletic turf not receiving heavy cleated traffic can contain bentgrasses in western regions and the fine-leaved fescues throughout the Pacific Northwest. Bentgrasses are not adapted to the inland areas and the bluegrasses do not persist in the western regions. Bentgrasses should not be mixed with Alta fescue or any of the bluegrasses.

TURF RESEARCH IN EASTERN WASHINGTON

A. G. Law, J. K. Patterson, T. J. Muzik, and Roy Goss[1]

Data were obtained on the effect of various chemicals on the survival of crabgrass during the 1960-61 season.

Collections of crabgrass seed were obtained from four states and planted in the greenhouse in March, 1961. Dacthal at 1, 2, and 6 lbs. per acre and Zytron at 5 and 10 lbs. per acre were applied to the surface of the soil at planting time. Results of these trials are shown in Table 1.

Table 1. Effect of Chemicals on Survival of Seedlings of Six Collections of Crabgrass Planted in the Greenhouse.

Collection Number	Number of Seedlings After 60 Days					
		Dacthal			Zytron	
	Check	1#/A	2#/A	6#/A	5#/A	10#/A
1-Lewiston, Ida.	67. 5	37. 7	8. 5	0. 0	1. 2	0
2-Calif. (Hairy)	57. 5	25. 5	4. 7	0. 0	0. 5	0
3-Calif. (Smooth)	67. 7	19. 7	4. 1	1. 2	1. 0	0
4-Arizona	81. 0	40. 0	5. 0	0. 0	0. 5	0
5-Oregon	33. 7	16. 5	4. 0	0. 0	0. 5	0
6-Prosser, Wn.	84. 5	38. 5	8. 0	1. 7	1. 7	0

It can be seen that there were wide differences in germinability of the crabgrass collections, ranging from 84 per cent to 33 per cent. Essentially complete kill of seedlings resulted from the use of Dacthal at 6 lbs. per acre, or Zytron at 10 lbs. per acre. applied to the soil surface at seeding time. Approximately 90 per cent control was obtained with Dacthal at 2 lbs. per acre under greehouse conditions.

As a part of this trial, six turf and field grasses were planted the the same time and subjected to the same treatments. It was hoped to find if there were higher tolerances to these chemicals among the perennial turf and field grasses than with crabgrass. These data are recorded in Table 2.

[1] Washington State University, Research Project No. 1571.

Table 2. Effect of Chemicals on Survival of Seedlings of Six Field and Turf Grasses Planted in the Greenhouse.

			Dacthal						Zytron			
	Check		1#/A		2#/A		6#/A		5#/A		10#/A	
Variety	Verm	Peat	Verm	Peat	Verm	Peat	Verm	Peat	Verm	Peat	Verm	Peat
Pennlawn	48	34	40	26	39	31	13	45	0	24	0	28
Ranier	47	41	36	40	27	38	20	42	0	32	0	21
Merion	29	26	0	22	2	24	0	9	0	11	0	14
PNW	78	49	12	47	8	38	5	30	0	24	0	28
Newport	47	27	5	28	17	30	2	30	0	7	0	14
S. Brome	23	27	26	17	34	16	15	21	5	10	2	17
Average---	45	34	19	30	21	29	9	29	.8	18.0	0	20

At the low rates of Dacthal, namely 1 and 2 lbs. per acre, the creeping red fescue varieties and smooth bromegrass showed very little seedling mortality compared with the check. The bluegrasses showed considerable more susceptibility to both chemicals with Merion bluegrass showing the greatest injury.

As an exploratory part of this experiment, half of each greenhouse flat was mulched with vermiculite and half with peat moss. When treated with Zytron at either 5 or 10 lbs. per acre, the vermiculite-mulched areas showed essentially no seedling survival of any of the grasses in contrast to very good survival with the peat moss mulch. A similar trend was observed for the Dacthal treatment at 6 lbs. per acre, particularly for the bluegrass varieties. This differential result from the use of the two mulch materials possible could explain some differences between experiments in the greenhouse as reported in the literature. It is thought the difference in survival may be due to the tie-up of the chemical by the organic matter of the peat mulch. We have no data on this point, however.

Field trials were conducted in cooperation with the Clarkston Golf and Country Club at Clarkston, Washington, to determine the effectiveness of various chemicals in the control of crabgrass. These data are reported in Table 3.

Table 3. Effect of Pre-emerge Chemicals on Crabgrass Control at the Clarkston Golf and Country Club, 1961

		Average Control Rating[1]			Number
		1961	1960 - 1961		Reps with
Rate/Acre			Retreated	Not Retreated	Observable Burn
Dacthal	4 lbs.	4.25	2.75	8.25	0
	8 lbs.	1.50	2.75	7.75	2
	12 lbs.	1.25	1.00	7.00	2
Zytron E.	10 lbs.	1.50	2.75	8.25	0
	15 lbs.	1.00	1.00	8.25	2
	20 lbs.	1.25	1.25	8.25	3
T. B. A.	2 lbs.	8.00			0
	3 lbs.	7.75			2
	4 lbs.	8.25			3
"A"	86 lbs.	6.50			
"B"	4 lbs.	6.25			
"C"	4 lbs.	7.75			
"D"	860 lbs.	1.00			3
"E"	430 lbs.	1.50			2
NIA 6370	6 lbs.	8.00			
Check		9.00			

1 = Complete control
10 = No control

Examination of the data for 1961 shows that Dacthal and Zytron were extremely effective in the control of crabgrass. There were no important differences between the 8- and 12-lb. rates of Dacthal and the 10-, 15-, or 20-lb. rates of Zytron. Two commercial preparations labelled "D" and "E" were effective at the rates used. Other materials tested were essentially ineffective. Some burn or discoloration of the perennial turf was observed with the higher rates of both Dacthal and Zytron, but this discoloration had disappeared by three months after treatment.

The 1960 plots were split in half, and half of each of the Dacthal and Zytron plots retreated in 1961. These data are reported in columns 2 and 3 of Table 3. On the plots not retreated, it can be seen that there was essentially no control of crabgrass from the 1960 treatments. On the retreated half of the plots, control percentages followed very closely those obtained on the 1961 plots. Hence, we would conclude from this that there is very little, if any, carryover effect of either of these two chemicals insofar as crabgrass control is concerned.

Various postemergence chemicals were tried in 1961 and the data reported in Table 4. Of the materials used in 1961, Dricryl showed considerable

Table 4. Effect of Postemerge Chemicals on Control of Crabgrass at Clarkston Golf and Country Club, 1961.

Treatment & Rate		Dates Applied	Average Control Rating[1]	No. Reps with Observable Burn
Shell 6623	2#	6/21 & 7/7 1961	7.00	
	4#		5.25	1
	6#		4.25	3
RR-Stam	2#		9.00	
	4#		8.75	1
	6#		4.75	3
Dricryl	3#		3.50	2
	5#		2.00	2
	7#		1.25	2
Casoron	3#		10.00	4
	5#		8.25	4
	7#		8.00	4
Check	--		8.50	-

[1] 1 = Complete control
10 = No control

effectiveness at the 5-lb. rate and was quite satisfactory at the 7-lb. rate. Two treatments were applied, one on June 21 and one on July 7. Data taken on September 1 showed a very high rating for the Dricryl treatments without excessive discoloration or burn of the perennial grasses. Some reduction of crabgrass was observed in the plots receiving 4 and 6 lbs. of Shell 6623 and Stam. However, in these plots, quite serious discoloration or burn occurred that was still observable in September.

The variety turf nursery was maintained this year with observations being taken on the relative desirability of different varieties of fescues and bluegrasses to simulate lawn conditions. Differential fertilizer trials were not attempted this year. Of the various fescues tested, Pennlaws creeping red fescue continues to have the best general rating for lawn use. Of the bluegrass varieties under trial, Merion continues to have the highest general rating with very little difference among Merion and Scott-2 and P. N. W. Rust has not been a factor in this nursery, hence the high rating of Merion. Eight new accessions and varieties of bluegrass were established for trials in 1962 and data will be taken on rate of establishment and turf desirability.

CRABGRASS CONTROL WITH DACTHAL

Dr. R. J. Marrese

Introduction

At a meeting of this nature, and after many of you have spent a summer fighting against or living with crabgrass, the speaker will refrain from a discussion of this pest and what it can do to an established sod. This paper will, however, attempt to cover the nature, use, and effectiveness of a very interesting and unique crabgrass herbicide. There are many factors to consider. Comparatively speaking, each chemical has its advantages and disadvantages. However, as regards crabgrass control in turf, on chemical is currently available which combines so many advantages as almost to put it in a class by itself. This material is Dacthal, a product of the Diamond Alkali Company. In order to present this point of view in a thorough manner, some basic principles may be touched on, and of necessity, Dacthal will be compared to other crabgrass herbicides.

If we were to list the most desirable features wanted in any crabgrass herbicide, they might read something like the following:

1. Effective and dependable
2. Reasonably safe (to the applicator, other humans, animals, ornamental plants, and established lawn grasses)
3. Economical as possible
4. A minimum of applications
5. Without excessive residue
6. Ease of use and reasonably fool-proof

Dacthal, the dimethyl ester of 2, 3, 5, 6-tetrachloroterephthalic acid, in the past four years has proven to be, pound for pound, the most effective and dependable pre-emergence crabgrass herbicide on the market. Only Zytron has looked as effective and dependable, but at one-half again to twice the rates of application as Dacthal. Tables 2-5 show this fact very clearly. The arsenicals are conspicuous by their inconsistency. They are not predictable from location to location or year to year. Chlordane, on the other hand, shows more consistency; it is consistently of little effectiveness. Another material, calcium propyl arsonate, has not given good results at many locations. Little emphasis has been given to its failures; more often, such factors as the problem of reseeding have predominated. Reseeding in an area treated with inerts would also be safe, but this application, like calcium propyl arsonate, would not inhibit the development of crabgrass to any worthwhile degree. More about this later on. Diphenatrile, too, has not shown any degree of consistent and effective crabgrass control in many locations.

In the pure form, Dacthal is a white crystalline solid. It possesses a low vapor pressure and is only very slightly soluble in water. It is odorless with a fairly high melting point. Practically, this means the technical material, as well as the wettable powder formulations, is stable. It is this basic

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[1] Technical Service Representative, Agricultural Chemicals Division, Diamond Alkali Company.

stability and "inert" qualities which make Dacthal so safe. The acute oral LD_{50}on rats is greater than 3, 000 mg. /Kg. of body weight. The acute dermal toxicity on rabbits is greater than 10, 000 mg. /Kg. body weight. Dacthal, included at a rate of 1 per cent of the diet, caused no harmful effect on rats when fed this diet for 30 days. Dacthal is also not irritating to the skin or eyes. Dr. H. J. Amling of Auburn University says Dacthal is one of the safest materials he has ever worked with. Though turf is not an edible product, this is an extremely important factor when considering a herbicide's use near children and household pets. This mammalian safety is, of course, in contrast with the arsenicals. This issue should not be used in a "scare-type" program, but it chould be mentioned. The arcenicals are, in fact, poisons. By far, most ornamental plants tested to date are completely tolerant to Dacthal, even at excessively high rates, and when sprayed directly on the plant itself. However, there has been an occasional report of thinning of fescues, all of which do thicken up readily, though.

Dacthal will be available for the current season under many labels. Those containing this herbicide may be recognized by the registered Dacthal trademark and the sunburst emblem containing the word Dacthal. Various formulations will be available, but basically Dacthal should still be one of the most economical pre-emergence crabgrass herbicides on the market.

The residual of Dacthal strikes what we feel is the happy medium. It is long enough so that one application will do the job for one growing season, but not excessive where it might damage the lawn grasses. It should be noted, as far as reseeding is concerned, that there is a strong correlation between detriment to turfgrass seed and effective crabgrass control. Calcium propyl arsonate, diphenatrile, and chlordane are three of the supposedly "safe-to-seed-after" chemicals. They are also chemicals which do not do a good job for long enough, lacking full season control. Dacthal and Zytron are more toxic to developing seedlings but are also outstanding in their crabgrass control. Table 1 shows that this feature of Dacthal may be overplayed. There are also many species and varietal differences which need further clarification. For example, at Boyce Thompson Institute they have found the seedlings of Seaside, Penncross, and Colonial bentgrasses to be more tolerant than those of Highland. Creeping red fescue is more tolerant of Dacthal in the seedling stage than Chewing's. Pennlawn, and Illahee. The arsenicals show long residual effects. It should be remembered, though, that arsenic behaves in the soil much like phosphorus. It may be that it would also replace phosphorus in plant absorption. Arsenic, however, cannot be used by plants in their metabolism. This might easily lead to physiologic imbalance. This is what is meant by nonselectivity. Many long-lasting chemicals are those which will not distinguish between weed and crop species. Chlordane as a compound shows fairly good residue. That is as concerns its breadkown. Yet, it is not an effective crabgrass herbicide. The reason for this is simple enough. Chlordane is basically an insecticide and not a herbicide.

Dacthal is strictly a pre-emergence herbicide. For optimum results it must be applied in early spring before crabgrass has germinated. In most areas, this coincides with blossom fall of Forsythis. Application rates are 10-12 pounds of technical Dacthal per acre. These rates will also control the following other weeds in turf and ornamental plantings:

Carpetweed	Green Foxtail	Purslane
Common Chickweed	Johnson Grass	Texas Millet
Fall Panicum	Lambsquarter	Witchgrass
Florida Pussley	Lovegrass	Yellow Foxtail

Application of the dry material may be made with any suitable spreader. For best results, the area should be gone over twice, the second application crossways to the first.

Rates up to 24 pounds of active material per acre have shown no damage to established tolerant lawn species such as bluegrass. There is no fine line between control on the one hand and grass damage on the other.

In conclusion, Dacthal has consistently given excellent control of crabgrass at rates of 10-12 pounds per acre. This has been so both as the 50 per cent wettable powder and in commercial granular formulation. Excellent results (greater than 95 per cent control) have been obtained in most tests all years and in all locations. This is important! If crabgrass control is to become an annual feature of lawn care, then the consumer must be supplied with a product which is effective and consistently so.

What Some of The Experts Say

1. Dr. J. F. Ahrens--Connecticut Agricultural Experiment Station published in The Connecticut Arborist, January 1961, pp. 2-5 (see Table 2).

> "With some of the pre-emergence herbicides on established turf excellent results were obtained. Three compounds--dacthal, zytron, and calcium arsenate--all applied in late April or early May in dry powder formulations, controlled better than 95 percent of the crab grass for the season. Zytron and dacthal also performed satisfactorily at lower dosages. Both of these materials are promising also because of their relatively low toxicity to humans."

> "Compared to Zytron, Dacthal, or Tricalcium arsenate, however, 'Halts' does a relatively poor job of controlling crabgrass."

2. Dr. R. R. Davis--Ohio Agricultural Experiment Station Published in The Pesticide Institute News, Winter 1961, pp. 16-20 (see Table 3).

> "In those early studies, it was found that results with arsenicals were inconsistent from location to location due to several soil factors. This limitation to the use of arsenicals for crabgrass control remains. A wide range of results has been experienced on the Experiment Station campus and the spots where arsenicals will give good or poor control cannot be predicted."

> "Dacthal has been tested for two seasons at the Ohio Agricultural Experiment Station. Ten pounds of active ingredient per acre has given good control both years."

> "Zytron has been tested for two seasons. Twenty pounds of active ingredient per acre has given good control both years."

3. Dr. R. L. Goss--Western Washington Experiment Station published in Agrichemical West, June 1961, pp. 13-14 (see Table 4).

"It can be readily observed that treatments with Dacthal at 10 lb. active ingredient per acre and Zytron at 15 lb. per acre gave excellent control of crabgrass.... These observations were the same in 1959 when conducted under duplicate conditions."

4. Dr. E. C. Roberts--Iowa State University published in Iowa Farm Science, April 1961. vol. 15, pp. 5-7 (see Table 5).

"Dacthal and Zytron (granular formulations) resulted in better crabgrass control than chlordane or the materials containing arsenic. Dacthal and Zytron were equally effective in this regard. Results from the use of these two new chemicals were more consistent at different locations than the results from other materials."

Table 1. Tolerance of Three Lawngrass Species to Three Dacthal Formulations. 1961 Trials Conducted at the University of Rhode Island. (Personal Observations).

I. Chewings Fescue			
Seeded; then treated	at same time	2 weeks later	4 weeks later
Formulation		% Grass Stand	
1. DACTHAL 1.5G	20	50	75
2. Rid	20-25	50	80
3. DACTHAL SY 1.5G	100	70	90
II. Merion Bluegrass			
Seeded; then treated	at same time	2 weeks later	4 weeks later
Formulation		% Grass Stand	
1. DACTHAL 1.5G	15	95+	95+
2. Rid	15	95+	95+
3. DACTHAL SY 1.5G	95	95	95
III. Astoria Bentgrass			
Seeded; then treated	at same time	2 weeks later	4 weeks later
Formulation		% Grass Stand	
1. DACTHAL 1.5G	70	60	80
2. Rid	85	80	90
3. DACTHAL SY 1.5G	100	100	100

Table 2. Pre-emergence Crabgrass Control. Results of April 29 Applications and Observations Recorded September 1960.

Material	Trade Name	Dosage[1]	% Control in September	Approximate Cost per 2,500 sq. ft.
Zytron	Dow M-1329	10#/A.	86	$9.95
	(Not on market)	20#/A.	99	
Dacthal	Rid	7.5#/A.	95	$6-7
		10#/A.	97	
Lead Arsenate	Pax	18#/1000 sq. ft.*	45	$10-12
Chlordane	Halts	60#/A.**	60	$9.95
Calcium Arsenate	No Crab	370#/A.	95	$6-10

[1] Amount actual ingredient

*Recommend 20#/1000 sq. ft.

**Water after application.

Table 3. The Per Cent Crabgrass in a Kentucky Bluegrass Sod, October 5, 1960. The Pre-emergence Chemicals Were Applied April 7, 1960.

Chemical	Rate Per 1000 sq. ft.	% Crabgrass 10-5-60 *
Dacthal	10.0 lb. of 2.3%	1
Zytron	6.0 lb. of 8%	1
Lilly 31864	3.7 lb. of 12.5%	1
Chlordane	40.0 lb. of 5%	20
Calcium Arsenate	15/0 lb. of 73%	26
None	-	49

*Numbers enclosed by a common line are not considered to be different.

Table 4. Summary of Chemicals Tested at the Western Washington Experiment Station in 1960.

Treatment	Mean Control in %	(Aver. of 4 replications)
Dacthal W-50	@ 5# A. I. /ac.	68%
Dacthal W-50	@ 10# A. I. /ac.	100%
Zytron Emul.	@ 15# A. I. /ac.	100%
Zytron Granular	@ 15# A. I. /ac.	95%
Pax	@ 25#/1000 sq. ft.	90%
Calcium Arsenate	@ 20#/1000 sq. ft.	60%
Falone	@ 3 gal. /ac.	40%

Table 5. Crabgrass Control From Chemical Crabgrass Preventers Applied Before Seedling Establishment, 1960.

Material	Rate of Application*	Av. No. Crabgrass Plants per sq. ft.	
		Location 1	Location 2
No Treatment	-	17.8	7.8
Pax	20#/1000 sq. ft.	6.0	0.7
No Crab	18#/1000 sq. ft.	6.0	0.5
Calcium Arsenate	16#/1000 sq. ft.	4.0	0.7
Chlordane	6#/1000 sq. ft.	2.2	3.7
Dacthal	10#/A.	0.5	0.9
Zytron	22#/A.	0.0	0.5

*Figures obtained from another set of data.

THATCH--ITS CAUSES AND REMOVAL

John Carper[1]

After that bang-up social hour sponsored by the dealers and distributors of turf supplies and equipment, and the banquet last night, I'm in no condition to come up with those witty sayings attributed to morning-after speakers. If Professor Law will take care of this little pink paper from the local constabulary, I'll get down to business.

Thatch--Its Causes and Removal

A year ago, I would have given you the answers, but in preparing my talk I probed farther into this subject and found out how little I know, and as Dr. Gould said yesterday about diseases, I should have quit while I was ahead.

There are so many conditions that enter into the picture of thatch causes, such as fertility, moisture, aeration, the porosity of soils, and many others. The preventatives and cures come under good turf management.

We could discuss these causes and cures all day and still not have the answers. There are but few tried-and-set rules for turf management. Removal of thatch has developed into a complicated subject. These subjects will be covered by Mr. Bob Wiley of the Aero-Thatch Corp., Rahway, N. J. He has traveled extensively, and can give you and over-all picture in the U. S., so I will limit my talk to the machinery and a few pictures.

I was unable to obtain pictures of most of the equipment, so I took some myself, but most of them are riding around lost in the U. S. mails. However, here are a few.

This shown the Westpoint, a spoon type that perforates and tears at the earth and thatch, removing plugs.

This is the same type in a fairway aerifier.

This is a Ryan, a hollow-tined type of aerifier that removes a core, or plug, of earth and thatch.

This is a Verticut, a vertical type of mower, and these are the Henderson and Jacobsen vertical mowers. They remove the thatch by a slight penetration of knives.

This is a hammer knife mower, with straight knives that remove thatch similar to the vertical mowers, but the knives are free swining and use centrifugal force to penetrate and remove the the thatch.

Then there are numerous power rakes that use wire tines to remove the loose thatch and comb the turf.

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[1] Ed Short Company, Seattle, Washington.

This is an Aero-Thatch with knives that penetrate deep in the turf and soil and remove a narrow cut, cultivating the soil, while aerifying, renovating, removing thatch, and preparing a seed bed.

This is the four-foot Aero-Thatch on the power take-off of a tractor. It will penetrate to three inches. It is also used to prepare seed beds.

Nature has one of the greatest aerifiers--weather--the action of freezing and thawing. This picture is of the drying and cracking of the earth's surface in soils.

This is a herd of hogs aerifying with their snouts.

Then there are tools of torture, known as hand rakes, idiot sticks, and what have you.

And now to give you a presentation of aerification and thatch control in this United States. Here is Bob Wiley of the Aero-Thatch Corporation and of Fertile Soil Incorporated, Rahway, New Jersey. Bob Wiley----

THATCH CONTROL

Bob Wiley[1]

It is indeed a gratifying experience to be invited to participate in this educational meeting and to appear before you to discuss mutual ideas and problems. My interest and my subject concern damage to and deterioration of the growth zone of turf and practices to prevent and correct the damage and deterioration. By growth zone I refer to the place occupied by the upper few inches of the soil. This zone of the turf consists of roots, soil, lower stems, and other more-or-less related materials found in intimate association with these roots and stems.

As a nontechnical observer of the many practices designed and intended to provide conditions to sustain healthy turf in this growth zone, I must in talking with you point out that I reflect not only my own but also the views, opinions, observations, and findings of others digested and reviewed by me in the light of the broad and varied contacts which I have the good fortune to enjoy in my travels throughout the United States and Canada. Should I be guilty of any inaccuracies, excuse them, please, as something to be expected from the practical rather than the technical man.

As a commercial man representing a company vitally concerned with the practices pertaining to the growth zone, I shall quite unintentionally and unconsciously color my comments with a seller's philosophy. For this I don't apologize.

In moving about this fair land of ours I find myself in first-hand contact with the many conditions of soils, temperatures, rainfall, economics, and local ideas which I had formerly only read or heard about.

I am about to mention certain terms which are constantly used in discussions of turf in all parts of the country particularly when the growth zone in the topic of conversation. They are: thatch, layers, compaction, top-dressing, wilting, root culture, porosity, aerating, cultivation, vertical mowing, renovation, and many others. In general they mean the same to everyone concerned with them, but there are variations which occasionally produce misunderstandings. If you do not understand my use of any of these terms or it you disagree with my interpretation, I shall be pleased to discuss the differences either at the end of this talk or later on. The growth zone is that partion or cross-section in turf where all extensive activities of turf management, mainly watering, fertilizing, top-dressing, mowing, and other similar operations, ultimately combine into the intensive activities, meaning the natural functioning of the soil by which plant life is sustained. This vital zone is the beginning and the end where anything which affects this zone or buries its function, either favorably or unfavorably with respect to plant growth, determines good or bad turf.

Within the upper and lower limits of this rather meager growth zone are carried on the many soil functions such as conversion of fertilizer materials from unavailable to availables, the various movements and functions of water,

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[1] Aero-Thatch Company, Rahway, New Jersey.

the transfer of gases including the all-essential oxygen, the highly complex activities of the microbiological population, and the responses of the plants to these various soil functions.

Every conscious effort of the turf man is directed to the ideal and optimum functioning and conditioning of the growth zone. Watering, draining, mowing, grooming, aerating, cultivating, fertilizing, liming, soil conditioning, top-dressing, and protecting from compacting, burning, and other injurious factors are directed toward the ultimate in growing conditions.

However, the use to which our golf course turf and that of certain other related fields of recreation is put results in a very serious deterioration of the growth zone. The traffic produces compaction, the practices followed to provide good playing conditions frequently impose harmful influences on the plants, the soil, and the microflora and fauna. The economics of an operation, however, often limit desirable, beneficial activities and force the adopting of harmful ones. Mechanization has introduced many such activities which have frequently harmed the growing zone but which, of economic necessity, had to be expected.

Since damage to and deterioration of the growth zone is inevitable and accepted as a necessary evil in turf maintenance, it follows that many devices, products, and methods, ranging from extremely effective to seriously harmful, will be developed to attempt to prevent or correct the damage and restore deteriorated conditions. However, great care and much good common sense must be exercised to make certain that undesirable conditions are recognized, sound practices are followed to correct these conditions, and that self-styled experts selling a multitude of useless and sometimes harmful nostrums don't complicate the already difficult situation.

The three most pressing physical conditions found in the growth zone which prevent the maintenance of good healthy turf are thatch, layers, and compaction. These three conditions, either singly or in combination produce, contribute to, or aggravate nearly all troubles found on golf greens. This may sound rather exaggerated, but even a hurried analysis of turf problems occurring from day to day will prove the statement correct.

Thatch, as we all know, is that heterogeneous accumulation of both organic, and to a lesser degree inorganic, materials which is necessary to give turf the resilience or cushion which good turf is expected to have but which, as it continues to develop beyond a desirable degree, interferes with watering, fertilizing, insect and disease control, precision mowing, and plant health. Like fire, thatch is a good servant but a bad master.

The limits of thatch in the growth zone are about the same. The lower limit is where roots accumulate rather than decompose, and the upper limit is where stems, leaves, and foreign matter start to mat into the first stage of thatch production. Between these limits we find a curious relationship existing between both living and dead plant materials, with some of the living plants surviving almost hydroponically in the thatch. No wonder that wilting is so prevalent and hard to combat on a heavily thatch green.

We may liken excessive thatch to a poorly managed compost pile, and in so soing see more clearly the procedures for maintaining the delicate balance between a necessary volume of thatch and a harmful over-accumulation. When we make a compost pile the object is to convert organic material into a healthy humus or humus soil by encouraging the microbial activities by which the conversion is brought about.

Fast, healthy compost production calls for moisture in either too great or too little supply and free passage of air and other gases as a result of cultivation and separation of organics, by introduction of inorganics such as sand and soil, correction of pH, and by not adding anything to the pile to stop or retard the action of the micropopulation.

Good thatch management calls for an adequate supply of moisture through the thatch, not just in widely spread holes but uniformly distributed, and preventing excess moisture by maintaining good surface drainage, with respect to both runoff and penetration or percolation. Layers and compaction interfere with good moisture movements so they can actually contribute to thatch build-up.

Further good turf management maintains ready movement of air and gases through cultivation, aeration, grooming, and the use of correctly designed top-dressing. Effective cultivation and aeration, accomplished by heavy-duty, highly specialized machines, provide tremendous volume of void either left open or automatically filled with loosened soil. Grooming and vertical mowing devices open up and remove from the upper level of the thatch considerable loose material to allow for connection between the activities above this layer and penetration to the lower level of the thatch.

From the beginning of time--that is, fine turf time--the need for top-dressing was recognized. Of course the obvious but not the most important need for top-dressing is for trueing the surface. But the really important use for top dressing is, as in a compost pile, the separation of young organic material with mature materials. By this I mean that when the turf materials such as leaves and stems are kept separate by the application of fully decomposed organic material and soil as found in a good top-dressing, decomposition takes place readily. If regular periodic top-dressing with the material that will maintain an open structure in the upper thatch level and eventually evolve into a sandy loam is practiced thatch will not be a serious problem.

The application of materials, both chemical and other, to greens for a number of reasons is necessary. We can hardly question the use of fungicides even though they do not generally aid microbial function. We cannot question the use of insecticides nor some herbicides. But we can and do question the use of material with an immediate or a residual toxicity, a permanent harmful effect on the soil structure or microbial population, or any physical, chemical, or chemical soil conditioner which will prevent or at least fail to contribute to the development of a good sandy loam soil body in the growth zone.

Be from Missouri in all such matters. Don't waste your club's money, jeopardize your club's property, and risk your job and reputation by using anything that does not have the unqualified approval of the turf research men in the advisory serviced or in the experimental stations turf department.

To recap these remarks on thatch let me say that the principles of good compost production are the principles of thatch control. Layers constitute a very serious hindrance to good growth zone conditions. They produce lateral paths for the movement of water and soil solutions rather than the desirable continuous vertical paths which allow passage both up and down. They act as root barriers with the result that shallow rooting frequently occurs; they produce conditions of poor drainage; and they provide zones for accumulation of chemicals which can have an extremely harmful effect on root development.

The most prominent layers are those at or below the lower limits of the growth zone. These have usually been caused by poor construction or by abnormally heavy application of top-dressing. However, less prominent but just as serious are those in the growth zone itself caused by application of poorly made top-dressings from which light-weight, water-repelling humus materials have floated out. The sand and silt settle into these layers or top-dressing applied at such long intervals, and they bury layers of vegetation which, in the absence of air could not decompose. Other layers have been caused by application of sand, organics such as peat moss, or a very clayey soil. How much harm will come with respect to layers from the recently advertised soil improvers or conditioners remains to be seen. However, layers never improve no matter from what source they have derived except by actual cultivation.

Compaction is a most frustrating problem since nearly everything that happens on turf leads to greater compaction and nearly everything used to reduce compaction interferes with the turf. It in indeed unnecessary to enumerate the causes of compaction as they are so common and obvious.

However, since compaction of the growth zone leads to more thatch, aggravation of the effects of layers, and generally poorer growing conditions it is most important that it be constantly combatted.

For a long-range effect, top-dressing with a high organic sandy loam material, lightly but frequently, is the best practice. <u>But be sure of what this top-dressing will ultimately produce in the way of soil texture and structure.</u>

Make the use of flocculating agents such as gypsum and lime a regular part of your turf program except of course, in those parts of the country where such a practice is not recommended.

Plan your maintainance to reduce traffic on your turf and lighten all equipment where possible. Use much wider wheels, in fact, roller type and wherever possible the wide, soft rubber models.

Cultivate frequently--this is not to be confused with aerifying. Spiking, discing, and aero-thatching are cultivating operations whereby more or less continuous lines of breakage are cut into the compacted soil rather than mere perforations whose walls are themselves glazed and compacted even more than the surrounding soil.

By constant attention to thatch control, layer grooving, or slicing and compaction cultivation, the growth zone can be maintained in a far better condition for the production of good turf.

At this point I wish to mention that although my talk has been directed toward turf on greens, nevertheless, there is growing emphasis on the handling of tee and fairway turfs in all parts of the country as only greens turf had been until quite recently.

In the eastern part of the United States the demand for short-cut fairways has forced out of these areas nearly all desirable grasses. Poa annua and weeds have taken over to the extent that now hundreds of fairways are being or need to be renovated, and then are being treated with fungicides, frequently PMAS and iron. Of course, this creates a thatch problem on fairways. Fortunately for the company I represent, this need for renovation, cultivation, and thatch control has created a tremendous market for our equipment. In warm-weather grass areas the Bermudas, especially highbreds, under modern cultivation methods have become rank thatch producers both with respect to above-ground vegetation and below-ground rhizomes. Mechanical thatch control is an absolute must. Nitrogen cost savings alone justify this control.

Further, the recent serious inroads of disease in Bermuda point to two conditions which exist when diseases are active. Mechanical thatch control has a corrective bearing on both. The density of the thatch seems to contribute to the intensity of the diseases, and the older portions of the Bermuda turf seem to be more susceptible than the newer growth.

Having expressed by views quite thoroughly I now invite questions either at this point or after the meeting.

WEED CONTROL FOR ORNAMENTAL PLANTINGS

Arthur S. Myhre[1]

Research investigations were started in 1957 at the Western Washington Experiment Station for the purpose of finding safe, dependable, and economical chemical herbicides for killing weeds in ornamental nursery stock. Hand-weeding, hoeing, and cultivation have been costly and time consuming in the maintenance of nurseries, as well as for ornamental plantings in parks, arboretums, golf courses, etc.

Nurserymen, with whom we are working closely, are particularly interested in weed-killing herbicides that are reasonably safe to use and are effective for long periods. In order to obtain this type of control, we have tested some of the more potent chemicals at varying rates. Increased potency of chemical, however, lessens the margin of safety so that utmost care and precaution must be taken in their application. It is extremely important that there be good agitation of materials as they are being applied, accurate calibration of sprayer so rate of output is according to direction, and materials applied at low pressure in sufficient amounts of water to give uniform coverage. Many herbicides are effective only on germinating weeds. It is necessary, therefore, that application of such herbicides as simazine, neburon, diuron, propazine, sesone, etc. be made onto weed-free, freshly worked top soil. Best results are obtained when rainfall or supplemental irrigation follows application. Time of application will vary with locale. Early spring and fall are convenient times to apply these chemicals.

Ornamental shrubs and herbaceous perennials vary considerably in their tolerance to chemical herbicides. Extensive tests conducted at the Western Washington Experiment Station indicate it cannot be assumed that when a certain shrub variety shows tolerance, then all varieties within the same group or family will likewise be tolerant. An excellent example of this can be cited from results obtained with the use of chemical herbicides on holly. *Ilex Aquifolium*, English holly, planted as rooted cuttings in 1957, received yearly spray applications at low to high rates for a period of five years. To date, no damage to these plants has occurred. *Ilex crenata*, Japanese holly, however, given the same treatments has shown considerable foliage discoloration and decreased growth. Rhododendrons and azaleas are other shrubs that also show varying degrees of tolerance.

Of 35 chemicals tested, simazine has shown most promise on coniferous evergreen shrubs and many kinds of broadleaved evergreen shrubs, both from the standpoint of good control of annual weeds and least damage to shrubs. Rates of two pounds actual per acre for broadleaved evergreens and four pounds actual for confierous evergreens applied in May on medium-heavy soils have given excellent summer weed control. Rates applied at half these amounts on lighter soils likewise gave good weed control.

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[1]Assistant Horticulturist, Western Washington Experiment Station, Puyallup, Washington.

The following conifers have shown tolerance: Chamaecyparis cyano-viridis (Blue-green cypress), C. Ellwoodii (Ellwood cypress), Juniperus Pfitzeriana (Pfitzer juniper), Taxus spp. (Yew), Thuja Spp. (Arborvitae). Broadleaved evergreens that showed little or no damage at two pounds were: Arctostaphylos Uva-Ursi (Kinnikinnick), Cottoneaster horizontalis, Erica carnea, Erica darlyensis (Heather), Euonymus radicans (Wintercreeper), Ilex Aquifolium (English holly), Laurocerasus zabeliana (Zabel's laurel), Potentilla fruticosa (Shrubby Cinquefoil), Pernettya mucronata (Pernettya), Pieris japonica (Japanese pieris), Rhododendron var. Cynthis, R. Jock, Viburnum tinus (Laurestinus), Viburnum Davidii, Osmanthus Delavayi. Rooted cuttings of Ilex Crenata (Japanese holly), Buxus (Boxwood), Azalea mollis, and certain evergreen azaleas have shown foliage damage. Established plants of these, however, show little or no damage at lower rates.

Other chemical herbicides that have shown promise are: diuron (gran), neburon, atrazine, propazine, amiben, and trietazine.

Studies are also underway with perennial flowers which to date have been sensitive to the majority of herbicides tested.

AN APPRAISAL OF STRAINS, VARIETIES AND KINDS OF KENTUCKY BLUEGRASSES

Arden W. Jacklin[1]

In analyzing various strains, varieties, and kinds of Kentucky bluegrasses, fifteen varieties underwent testing in a series of trials on the Jacklin Farm in Idaho on irrigated land. These included: Blue Mountain, NK 95, OP 23, Delta, Geary, S-21, Arboretum, Park, Troy, Iowa Common, two Poa ampla x Poa pratensis hybrids, Merion and Newport.

The majority of the plots were planted in the spring of 1958. The 1958 growing season was poor for seedlings, consequently the first crop harvested in 1959 was considerably below normal on all plots. The 1959 and 1960 seasons were more nearly normal so the yield figures from the 1960 harvest are quite representative.

A portion of the observations made were: Blue Mountain was rather average. OP 23 rusted and mildewed. Delta harvested early and yielded well. It is not a fast sodder--its rhizomes are sparse. Geary is a good, vigorous "common"type. S-21 is a vigorous common type with good color and uniformity. Arboretum is a somewhat tall and irregular common type. Park starts good and is a vigorous, open, common type. Troy doesn't form a dense sod. It is tall and coars--a hay type. Iowa common performed as expected. The Poa hybrids showed sterility. Pacific Northwest was slow starting. Merion yielded well and demonstrated its characteristics. Newport yielded the most seed.

The "Leaf spot" and Stem rust" evaluations in the chart are from the literature and observations in the Central and Eastern U. S., as these two diseases do not occur in the Spokane area.

There has been no problem with striped smut in the Spokane area. Neither has Poa annua or bent survived.

In a new series of Kentucky bluegrass plots Jacklins have 35 strains and varieties under test. Production for regional adaptation can be accomplished.

A series of five sets of slides from the spring start to fall harvest were shown of each variety in the plots which were 30 ft. wide by 300 ft. long.

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[1]Jacklin Seed Company, Inc., Dishman, Washington.

KENTUCKY BLUEGRASS VARIETY

Plant Comparatively 1 to 10--Not rated or judged

Variety or Strain	Origin or Ownership	Sodding 1=vigorous to 10=slow	Plant Height 1=short to 10=tall	Plant Weight 1=heavy to 10=light	Root and Rhizome 1=heavy to 10=light	Seedling Vigor 1=high to 10=low	Turf Density 1=high to 10=low	Turf Color 1=dark to 10= light	Vegetative Character (appeal) 1=high to 10=low
Blue Mt.	High altitude Volunteer	5	5	5	5	4	6	5	7
NK 95	Northrup King	8	4	4	7	2	6	5	5
OP 23	JSCO Selection	4	7	4	4	4	5	4	6
Delta	Canadian Selection	8	4	4	7	2	6	5	5
Geary	Re-volunteer Common	5	5	5	5	4	5	5	5
S-21	JSCO Selection	5	6	4	3	4	4	4	4
Arbo-retum	St. Louis Arboretum	5	7	4	4	4	5	5	7
Park	Minnesota Synthetic	5	6	4	4	2	5	5	3
Troy	Montana Release	7	10	1	?	?	10	4	10
Iowa Common	Com-mercial	5	5	5	7	4	5	5	8
Ampla x Pra-tensis	Carnegie Institute BR L	9	1	10	7	10	3	1	2
Ampla x Pra-tensis	Carnegie Institute N L	10	2	8	9	9	8	10	9
Delta	Canadian Selection	8	4	4	7	2	6	5	5
P. N. W.	Wash. State notreleased	2	1	9	4	7	1	2	2
Merion	U. S. D. A. U. S. G. A.	2	2	5	1	7	1	1	1
Newport	Carnegie Institute	1	3	4	1	3	4	6	6

Disease Resistance 1=most 10=most Leaf Spot	Leaf Rust	Stem Rust	Maturity 1=early to 10=late	Seed Bu. Wt. 1=heavy to 10=light	Size 1=large to 10=small	Year Planted	SEED YIELDS lbs. Per Acre 1959	1960	1961	Variety or Strain (repeated)
?	5	5	4	5	3	1959	Seedling	987	561	Blue Mt.
4	4	5	1	7	5	1959	Seedling	1043	621	NK 95
?	8	?	5	4	5	1959	Seedling	714	381	OP 23
4	4	5	1	7	10	1958	564	854	629	Delta
5	5	5	4	5	3	1958	293	973	476	Geary
3	4	4	4	4	3	1958	228	896	472	S-21
5	5	5	4	5	5	1958	143	973	596	Arboretum
4	5	4	4	4	5	1958	221	938	694	Park
?	4	?	6	3	1	1958	136	903	441	Troy
5	5	5	4	5	8	1958	257	1008	557	Iowa Common
?	4	?	10	5	4	1958	none	112	111	Ampla x Pratensis
?	4	?	10	6	4	1958	none	259	270	Ampla x Pratensis
4	4	5	1	7	10	1958	550	854	592	Delta
3	4	4	10	3	5	1958	107	819	459	P. N. W.
1	6	7	6	10	10	1958	143	665	349	Merion
7	7	2	6	1	1	1958	386	1218	971	Newport

TURF GRASS RECOMMENDATIONS

Revised November 1961

The Turf Committee of the Washington Seed Council, in response to requests from schools and other public agencies, has prepared these basic recommendations for turf management.

The recommendations are necessarily general in nature. The fertility, texture, and drainage characteristics of the soil, the irrigation practices, and the intensity of traffic (wear) on the turf are factors which must be considered for each specific site.

Therefore, we urge that these recommendations be interpreted and amplified for each specific location by the local seedsman and turf authority, both for new seedings and for correcting management practices on existing turf.

I. SEED MIXTURES

A. East of Cascades

	Suggested Percent in mixture
1. Type of areas	
a. School lawns - (no play area)	
Kentucky bluegrass	50
Creeping red fescue	50
b. Playfields	
Kentucky bluegrass	70
Creeping red fescue	15
Chewings fescue	15
c. Waste or infrequent use areas	
Chewings or Hard fescue	100

2. Varieties of grasses adapted to Eastern Washington
   Merion, Newport, Delta, Park, Common Kentucky bluegrass
   Pennlawn, Olds, Creeping red fescue
   Chewings fescue

B. West of Cascades

1. Type of areas	
a. School lawns - (no play area)	
Bentgrass (Colonial types)	30
Creeping red fescue	70
b. Playfields	
Creeping red fescue	50
Chewings fescue	20
Bentgrasses	30
On wet sites, tall fescue may be substituted for bentgrass and chewings fescue.	

Suggested Percent in mixture

c. Waste or infrequent use areas
Chewings fescue 100

2. Varieties of grasses adapted to Western Washington
   Astoria, Highland, Colonial bentgrass
   Seaside, Penncross, Creeping bentgrass
   Pennlawn, Rainier, Illahee, Creeping red fescue
   Chewings fescue

C. The Turf Committee recognizes that bentgrass cannot be expected to provide an adequate turf for playground use in Eastern Washington. They further recognize that Kentucky bluegrasses have only a minor place in turf in Western Washington. In this area, the bluegrasses have been only moderately persistent through careful management on well-drained, deep loam to sandy loam soils.

Ryegrasses can be mixed with the above turf grasses in either area when there is a need for rapid establishment of ground cover. However, use low rates since the ryegrasses are strong competitors and will delay establishment of the long-lived, fine-leaved turf grasses.

II. General management considerations for both Eastern and Western Washington.

A. Fertilization

1. Apply nitrogen fertilizers at least three times during the season, Use one and one-half pounds actual nitrogen per 1000 square feet per application.

2. Lime may be needed on acid soils.

3. Use fertilizers with potassium and phosphorus when soil test results show the need.

4. Apply fertilizer only when the grass leaves are dry. Apply water immediately after application.

B. Mowing

1. Fescues and Kentucky bluegrass — one and one-half inches

2. Merion type Kentucky bluegrass — three-quarters inch

3. Bentgrass — one-half to one inch

4. Turf areas should be mowed often enough so that not more than one-half the total leaf length is removed at any one time.

Conference Attendance 1961

Adams, Fred	Seattle, Washington	Nat'l Irrigation Consultants
Anderson, Milton	Tacoma, Washington	Metro Park District
Banks, Harvey	Bremerton, Washington	Kitsay GC
Barclay, Earl	Oswego, Oregon	Oswego CC
Bauman, Clayton	2036 9th Street, West Kirkland, Washington	Glendale G & CC
Bauman, Milton	235 10th Avenue, West Kirkland, Washington	Overlake G & CC
Beardsley, Norris	Route 5 Spokane, Washington	Spokane G & CC
Bengeyfield, Wm.	P. O. Box 567 Garden Grove, California	USGA
Blaskowsky, Aaron	Baumclaw, Washington	Enumclaw GC
Borst, Fred	2400 Sixth Avenue, South Seattle, Washington	Ed Short Co.
Brinkworth, Babe	Minneapolis, Minnesota	Toro Manufacturing Co.
Brusseau, W. C.	2707 West Kiernan Ave. Spokane 13, Washington	Downriver GC
Burkette, Art	Seattle, Washington	Charles Lilly Co.
Canode, C. L.	Washington State University Pullman, Washington	Dept. of Agronomy
Carper, John	2400 Sixth Avenue, South Seattle 4, Washington	Ed Short Co.
Chonle, H. C.	Yakima, Washington	Wash. Turf & Irrigation Company
Clark, Dave	Vancouver, B. C. Canada	Point Grey GC
Deshler, Melvin F.	Spokane, Washington	
Dustin, John	Seattle, Washington	Dow Chemical Company
Dye, Robert	Pomeroy, Washington	Robert Dye Seed Ranch
Eastern Washington State College	Cheney, Washington	

Everhart, Cliff	P. O. Box 8025, Manito Sta. Spokane 36, Washington	Manito G & CC
Fairburn, Don	Seattle, Washington	Wash. Turf & Toro
Federspiel, Fred	Lake Oswego, Oregon	Oswego Lake G & CC
Feinberg, Chester	Portland, Oregon	Diamond Alkali Co.
Filer, Theodore	Washington State University Pullman, Washington	Dept. of Plant Pathology
Fluter, Ed	14015 N. Glisan Street Portland, Oregon	Glendoover GC
Gabel, Bill	Walla Walla, Washington	Memorial GC
Garletts, Hank	Oak Harbor, Washington	Gallery GC
Gavan, Frank	Victoria, B. C., Canada	Uplands GC
Gettle, Richard	1425 Pacific Highway Bellingham, Washington	Bellingham GC
Goetze, Norman	Oregon State University Corvallis, Oregon	Farm Crops Dept.
Goddard, Murl	Selah, Washington	Yakima Elks GC
Goss, Roy	Western Wash. Experiment Sta. Puyallup, Washington	Research Agronomist
Gould, Charles	Western Wash. Experiment Sta. Puyallup, Washington	Plant Pathology
Gourley, Boyd	Pinehurst, Washington	Everett GC
Gueho, Manny	771 Austin Road New Westminster, B. C. Canada	Vancouver GC
Hale, Martin	Whitefish, Montana	Whitefish GC
Hall, John	Everett, Washington	Everett Memorial GC
Harris, Marion	Ag. Extension Service Washington State University Pullman, Washington	Dept. of Plant Pathology
Harrison, George	Box 883 Tacoma, Washington	Nu-Life Fertilizers
Harrison, John	Hayden Lake, Idaho	Hayden Lake CC
Harshaw, Wm.	Coeur d'Alene, Idaho	Coeur d'Alene Public GC
Hart, J. C.	Wenatchee, Washington	Three Lakes GC

Haskell, Dick	10132 Rainier Avenue Seattle 88, Washington	Seattle Park Dept.
Hogan, Don	1910 Minor Avenue Seattle, Washington	Professional Engineer
Hogatt, George	P. O. Box 1479 Wenatchee, Washington	Wenatchee G & CC
Ingram, Ed	1819 East 14th Avenue Vancouver, British Columbia	Seymour GC
Jacklin, Arden	Dishman, Washington	Jacklin Seed Co.
Jaslowski, John	2906 12th Avenue N. Renton, Washington	Broadmoor GC
Junor, Harvey	6585 S. W. Scholls Ferry Rd Portland, Oregon	Portland GC
Krumbholz, Walter	Spokane, Washington	Leo Cook Co.
Kuhn, Carl	901 Lane Street Seattle, Washington	H. D. Fowler Co., Inc.
Lambert, Margareta	Woodstock, Illinois	Morton Chemical Co.
Land, Henry Jr.	23012 Brier Road Alderwood Manor Washington	Sandpoint G & CC
Land, Henry Sr.	9210 Winona Avenue, S. W. Tacoma 99, Washington	Tacoma G & CC
Latham, Jim	Milwaukee, Wisconsin	Milwaukee Sewerage Comm.
Latimer, Dean	11804 Woodbine Lane Tacoma 99, Washington	Fort Lewis GC
Law, Alvin G.	Washington State University Pullman, Washington	Dept. of Agronomy
Lawton, George	1919 N. Madison Olympia, Washington	Olympia G & CC
Ledford, Wes	West 228 Pacific Avenue Spokane 4, Washington	Inland Seed Co.
Leonard, Joe	Box 1083 Boise, Idaho	Hillcrest CC Inc.
Liotta, Al	Pullman, Washington	Pullman GC
Macan, Vernon A.	1110 Beach Drive Victoria, B. C. Canada	Golf Course Architect

MacSwan, Iain C.	Oregon State University Corvallis, Oregon	
McCoy, Gene	Washington State University Pullman, Washington	Dept. of Agronomy
Madsen, L. L.	Washington State University Pullman, Washington	Director, Institute of Agricultural Sciences
Maguire, James D.	Washington State University Pullman, Washington	Dept. of Agronomy
Marrese, R. J.	Cleveland, Ohio	Diamond Alkali Co.
McCracken, Les	Boise, Idaho	Union Farm & Garden Supply
McKay, Gordon	Chilliwack, B. C. Canada	Chilliwack GC
McKenzie, Kenneth	2428 Alaskan Way Seattle, Washington	Galbraith Company
MacLean, Neil	Vancouver, B. C. Canada	Univ. of British Columbia
Miller, Carl	Libby, Montana	Cabinet View GC
Miller, Don	520 South 53rd Street Tacoma, Washington	A-1 Spray Service
Miller, Roy	Portland, Oregon	Miller Products
Mills, Jerry	Portland, Oregon	Miller Products
Mitchell, Charles	Clarkston, Washington	Clarkston CC
Munro, Jerry	7622 Simmonds Road Bothell, Washington	Highland Gardens
Nutter, Gene	Jacksonville Beach, Fla.	Golf Course Supt. Assn.
Oestreicher, Archie	Spokane, Washington	Spokane Park Board
Peatt, Alf	Victoria, B. C. Canada	
Perry, Ray	Dishman, Washington	Jacklin Seed Co.
Proctor, Glen	2222 South 111th Seattle, Washington	Rainier G & CC
Putnam, Kenneth	122 9 N. 172nd Seattle 33, Washington	Seattle GC

Reed, Byron	43 N. E. 202nd Portland, Oregon	E. P. Baltz and Son
Reger, Auston	Box 235 Liberty Lake, Washington	Liberty Lake GC
Rogers, Tom	4126 Airport Way	Bentley Co.
Ripley, Clarence	Route 5 Spokane, Washington	Wandermere GC
Rogers, Ed	7723 24th N. W. Seattle, Washington	Northwest Mower and Marine Co.
Rowe, Chen	P. O. Box 468 Tacoma 2, Washington	Tacoma Seed Company
Runyon, Dale	Spokane, Washington	United Equipment Co.
Sander, Bill	Portland, Oregon	Riverside G & CC
Sater, Neil	6th and H Street Spokane Park Dept.	
Schmidt, Louis	Spokane, Washington	Indian Canyon GC
Schmidt, Ray	Great Falls, Montana	Meadowlark G & CC
Senska, Elizabeth	South 1421 Division Spokane, Washington	Chemical Weed and Pest Control
Schultz, Jack	Portland, Oregon	Forest Hills GC
Slinkard, Al	University of Idaho Moscow, Idaho	Department of Agronomy
Stelzer, Lorin	Richmond, California	California Chemical Co.
Thorpe, Thomas	Victoria, B. C. Canada	Royal Colwood GC
Venable, Marc	7723 24th N. W. Seattle, Washington	Northwest Mower and Marine Co.
Wade, Rolland S.	Walla Walla, Washington	
Werth, Rudy	8023 27th N. W. Seattle, Washington	Jackson Park GC
White, Sidney	Route 3, Chenowith Rd. The Dalles, Route 3 Oregon	The Dalles G & CC
White, Quentin	East 2115 Everette Spokane, Washington	Esmeralda GC
Wiley, Robert	Rahway, New Jersey	Aero-Thatch, Inc.

Williams, Glenn	Walla Walla, Washington	Memorial GC
Woodward, D. A.	Walla Walla, Washington	Walla Walla CC
Wright, Vern	West 228 Pacific Avenue Spokane 4, Washington	Inland Seed Co.
Zirbel, Gerald	Chicago, Illinois	Morton Chemical Co.
Zook, Sam	1100 S. E. Waverley Drive Portland 22, Oregon	Waverley G & CC