

James B. Beard

PROCEEDINGS

of the

F O U R T H A N N U A L T U R F C O N F E R E N C E

held on the campus

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TABLE OF CONTENTS

Officers and Directors.....	1
Attendance.....	2
The Wheel of Turf Improvement.....	4
Eric G. Scharvelle	
The Present Fertilizer Situation.....	9
S. C. Vandecaveye	
Some Eastern Ideas on Turf Production and Management.....	10
G. H. Ahlgren	
Turf Management in Western Oregon and Washington.....	15
H. A. Schoth	
Turf Diseases and Fungicides for 1951.....	18
Eric G. Sharvelle	
A Turf Disease Research Program .....	22
J. P. Meiners	
Irrigation of Turf Areas.....	23
Aldert Molenaar	
Drainage of Turf Areas.....	26
Max C. Jensen	
Weed Problems on Golf Courses.....	29
Milt Bauman	
Weed Control in Lawn and Turf Areas.....	31
V. H. Freed	
Turf Weed Problems.....	34
Louis Schmidt	
Experiences of a Greenkeeper.....	35
Robert Finlay	
Arrangements of Plantings on Turf Areas.....	37
Earl H. New	

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FOURTH ANNUAL TURF CONFERENCE

Northwest Turf Association Members in Attendance:

Abbott, H. T.	504 City Hall	Spokane, Washington
Amsbury, G. A.	N. 4818 Normandie	Spokane, Washington
Baker, C. A.	515 Fifth Street	Bremerton, Washington
Barclay, Glen	Sandpoint Country Club	Seattle, Washington
Bauman, Milt	Kellogg Golf Club	Pinehurst, Idaho
Beaden, Charles	4021 S. E. 47th	Portland 6, Oregon
Blood, Harold	Grass Seed Grower	Palouse, Washington
Boyd, Mavor S.	P. O. Box 84	Polytechnic, Montana
Brusseau, W. C.	2702 W. Kieman	Spokane, Washington
Buckley, W. K.	Elks Golf Course	Colville, Washington
Burkette, Arthur R. 14653	-18th S.W. Gailbraith and Co.	Seattle, Washington
Carlyle, C. L.	1287 Libby	Clarkston, Washington
Coleman, Ray	Rt 1 Box 125	Maple Valley
Everhart, Clifford	Manito. Golf Course	Spokane, Washington
Finlay, Bob	Seattle Golf Club	Seattle, Washington
Fortier, Bud	Route No. 4	Albany, Oregon
Fluter, Edward	Glendover Golf Course	Portland, Oregon
Gill, R. H.	Willard Equip. 860 Beach A.	Vancouver, B.C.
Hammar, George	2101 Cemetery Road	Caldwell, Idaho
Harrison, John	Hayden Lake Golf Club	Hayden Lake, Idaho
Johnsen, Joseph	Golf Club House	Pullman, Washington
Keltz, Ernest G.	P. O. Box 51	LaGrande, Oregon
King, Jack	Columbia Edgewater Country Club	Portland, Oregon
Land, Henry	9212 Winona Avenue	Tacoma, Washington
Lee, Ivan W.	705-4th Avenue	Seattle 4, Washington
Leonard, Joe	Lewiston Golf and C. C.	Lewiston, Idaho
Lucks, Henry	4558 N. E. Sumner	Portland, Oregon
Masterson, P. M.	100 Dexter Avenue	Seattle, Washington
Moen, Hans	Route 4 Box 168	Kirkland, Washington
McMurchie, Ernest	3000 Elm St.	Bellingham, Washington
Niles, Bert	1540 East 148	Seattle, Washington
Null, John E.	1330 19th Avenue	Longview, Washington
O'Brien, Jim	1915 Capilane Rd.	North Vancouver, B.C.
Olsen, Herbert J.	P.O. Box 122	Bellingham, Washington
Proctor, Glenn	11411 Military Rd.	Seattle, Washington
Ratcliff, Murle S.	Route 4	The Dalles, Oregon
Reed, Byron E.	Staff, Jennings, Inc.	Portland, Oregon
Rogers, C. T.	3135 Western Avenue	Seattle, Washington
Rongerude, George	P.O. Box 887	The Dalles, Oregon
Ross, R. R.	110 Eastlake Ave.	Seattle, Washington
Sander, William A.	7910 N. E. Marine Ave.	Portland, Oregon
Scherneck, Joe O.	Route 3	Port Angeles, Washington
Schmidt, Louis J.	6th and H St.	Spokane, Washington
Schroeder, Rudolph	Elks Golf Club	Moscow, Idaho
Scott, Robert	1400 W. 33 Ave.	Vancouver, B.C.
Steiner, R. A.	University of Washington	Seattle 5, Washington
Stover, Chas. H.	3135 Western Avenue	Seattle, Washington
Storlie, Loyd R.	So. 625 McKinnon	Spokane 15, Washington
Strahl, W. H.	1246 South 130th	Seattle 88, Washington
Wade, Rolland S.	507 Chestnut West	Walla Walla, Wash.
Woerner, Robert L.	504 City Hall	Spokane, Washington
Zook, Sam	Pendleton Country Club	Pendleton, Oregon

Others in attendance

Ahlgren, Gilbert H.	New Brunswick	New Jersey
Holton, C. S.	Pullman	Washington
Fischer, G. W.	Pullman	Washington
Meiners, J. P.	Pullman	Washington
Law, A. G.	Pullman	Washington
Schwendiman, John	Pullman	Washington
Molenaar, Aldert	Pullman	Washington
Bertramson, B. R.	Pullman	Washington
Patterson, J. K.	Pullman	Washington
Morrison, Ken	Pullman	Washington
Sharvelle, E. G.	LaFayette	Indiana
Harsten, C. B.	Pullman	Washington
Vandecaveye, S. C.	Pullman	Washington
Schafer, E. G.	Pullman	Washington
Lange, A. W.	Spokane	Washington
Rasmussen, L. W.	Pullman	Washington
Klages, K. H. W.	Moscow	Idaho
Buchanan, M. T.	Pullman	Washington
Schoth, H. G.	Corvallis	Oregon
Compton, Wilson	Pullman	Washington
Jenson, Max	Moscow	Idaho
New, Earl H.	Moscow	Idaho

## THE WHEEL OF TURF IMPROVEMENT

Eric G. Sharvelle  
Purdue University, Lafayette, Indiana

From little acorns mighty oaks have grown, and from small beginnings of not so long ago turf maintenance has grown in 1951 to an established profession followed by a fraternity of skilled and highly qualified specialists-- the Keepers of the Green.

In this spring of 1951, greenkeepers from east to west and north to south have gathered together to exchange ideas and experiences, to learn new skills, and to become acquainted with new chemicals that have earned the right to participate in the problem of keeping greens green and fairways fair. Today, improved, specialized turf is accepted and expected as a necessary adjunct to our American way of life. In 1951, the verdant beauty of well-kept turf will ease the burden of the busy executive who relaxes on the golf course, the better to cope with the problems of tomorrow. The green acres of the city park will delight the city child who escapes the turmoil of civic life by gamboling on the green sward. The airports of today now boast green landing strips that withstand the sudden shock of spinning wheels. And roadside shoulder may now be held in place with binding blankets of green that defy the eroding hand of summer, fall, and winter rains. Almost every well-kept home boasts a prized and carefully tended lawn, and when the reaper takes his toll the tired life is laid to rest in the peaceful green acres of municipal cemeteries. Improved turf in 1951 will occupy its rightful place as the heritage that young Americans may all enjoy, and the task of maintaining this commodity is a proud and useful profession.

Improved turf is a fickle commodity comprised by hundreds of thousands of living individuals that must live and grow and reproduce their kind and die like all the other living things. The turf of every tee, fairway, green, park, cemetery, lawn, and airway landing strip is a vital, living, growing thing subject to the vagaries of an ever-changing environment of sun and rain and heat and cold. Like animal and man, turf reacts unfavorably to abuse and misunderstanding, but flourishes with care and thoughtful understanding. Like you and I, who breathe and have being, so too must improved turf wage its struggle for existence beneath the running feet of city children, the spinning wheels of landing aircraft, and the pounding spikes of the American golfing public.

The maintenance of improved turf is a responsibility shouldered by the greenkeeper of America who must become by force of circumstance a strange and complex blend of engineer, chemist, botanist, physiologist, entomologist, agronomist, psychologist, financier, and skillful diplomat. The American greenkeeper of 1951 is truly a knight of the sod.

The high standard of excellence demanded by a critical public in the greens of America has forced the greenkeeper to pay the penalty of his own accomplishments by striving to make an almost perfect thing still more perfect. To keep pace with the constantly rising standard of turf excellence, greenkeepers have banded together and have solicited the aid of industry and agricultural institutions to wage jointly the "Battle of the Green." Turf improvement associations have been spawned of necessity in every region of the U.S.A. where grass for pleasure, sport, and beauty is admired and respected.

Science is the handmaiden of progress and our bulwark for the future, and in any coordinated program of turf improvement it plays a vital role. A sound turf improvement program may be likened to a many-spoked wheel in which every science assumes its rightful place, each helping the other towards a common goal. In the biological sciences, there can be no such thing as autonomy or priority of one specialized field over another. No one phase of biology can be more important than another, for all are wedded to the task of learning the mysteries of life so it may be improved, prolonged, and preserved. It matters little whether we are concerned with livestock, poultry, cereals, fruits, vegetables, flowers, or turf grasses, for all who engage in the scientific aspects of these fields must strive to contribute toward one objective--the goal of successful, economic, and satisfying achievement. Our wheel of turf improvement will roll down the highway of success with turf if each spoke is fitted in its rightful place and strengthened by the binding rim that every wheel should have.

So that we may better understand the many ramifications of a soundly coordinated turf improvement program, let us build this wheel of turf improvement spoke by spoke and piece by piece, and when it is completed let us apply this wheel to our own individual program and responsibilities.

#### The Axle:

The axle of the mythical wheel of turf improvement is the American way of life with its freedom from fear, freedom from want, freedom of worship, and freedom of opportunity, for under any other social system, a mutual assistance pact such as the turf improvement programs in the northwestern, middlewestern, and eastern United States could not and does not exist.

#### The Hub:

Provided with so stout an axle, wrought in the fire of pioneer hardships and tempered with 175 years of national honor, we are ready to fit the hub that will hold the spokes of our turf improvement wheel. The hub is constituted by the hills and valleys, woods, rivers, plains, and streams--the natural resources of America. Into this hardwood hub of fertile land, colorful scenery, and every variation of climate, we are ready to fit the eight spokes that will support the rim that binds together a sound, coordinated program of turf improvement.

#### The Spoke of Agronomy:

In any well-built wheel, every spoke is essential to strength and proper balance, and no one spoke is more necessary than any other, for each lends strength the one to the other. Thus, we cannot name the most essential spoke in our wheel of turf improvement. However, most greenkeepers would consider the spoke of agronomy as the most seasoned and highly polished of the turf improvement spokes.

The contributions of this science are basic to any turf improvement program. Without specialized strains of bent grass, without new traffic-enduring grasses for driving tees, without soils technology, and without a knowledge of plant fertility, turf cannot even be started, and it certainly cannot be maintained without a sound agronomic foundation. Washington Bent, Merion Bluegrass, Alta Fescue, Kentucky 31, U.3 Bermuda, Zoysia grasses, soil testing kits, and the new liquid fertilizers are all fundamental contributions of the science of agronomy.

This spoke is the most highly burnished of all the spokes in the turf improvement wheel and must be skillfully and solidly welded to the hub of our governing wheel, for it is the standard of excellence that other spokes must achieve if they are to carry their share of the load as the wheel rolls over the bumps that lie in the path of all who travel the highway of success with turf.

#### The Spoke of Chemistry:

Our one-spoked wheel is now unbalanced and, thus equipped, will never roll far on the highway of turf. Other spokes must now be fitted to balance and strengthen the wheel. Next to be fitted is the spoke of chemistry. Many of the secrets of plant life have been unveiled in the chemist's test tube. From the chemist's laboratory have stemmed most of the basic discoveries behind the development of the chemicals that every greenkeeper considers a vital item in his chest of greenkeeping tools. Without the spoke of chemistry, herbicides, fungicides, insecticides, artificial fertilizers, and tissue testing techniques would never have reached the high peak of development they now enjoy. Future developments in these and other fields will originate in the chemist's crystal ball.

#### The Spoke of Botany:

Our two-spoked wheel is once again in balance but not yet strong enough to withstand the rigors of the road that lies ahead. The third spoke in the wheel is the science of botany. Botany is the science that enables us to recognize desirable turf grasses by their individual characteristics and permits unwelcome intruders such as weeds to be identified and purged from the company of their more desirable fellows. Botany, too, has welcomed the chemist's gift of wondrous organic chemicals and has adapted them to their miraculous role of selective herbicides. With uncanny selectivity, chemicals such as 2,4-D, 2,4,5-T, sodium arsenite, PMAS, and maleic hydrazide have been harnessed to eliminate unwelcome weeds from the exclusive company of pure turf stands. These are the contributions of the science of botany, without which our wheel of turf improvement would hesitate and falter in its steady progress down the highway of better turf.

#### The Spoke of Plant Physiology:

The fourth spoke in our growing wheel is the science of plant physiology. Growing plants, such as the grasses that constitute our tees, greens, and fairways, live, respire, and respond to a delicate balance of environment and nutrition. Turf grasses will thrive on a well-balanced diet, and different grasses may even differ in their response and need for artificial feeding. Turf will quickly fade or may even die if incorrectly fed or subjected to an unfavorable balance of soil fertility. If we can learn the inner secrets of growing plants like turf grasses, then we can more readily take advantage of the potentialities they all possess, and they generally can be persuaded to produce finer and more lasting turf when stimulated artificially. The spoke of physiology provides this basic knowledge of why, when, how, and with what we can manipulate the nutritional and physiological environment to encourage and maintain the maximum degree of turf vigor under every condition of a changing seasonal environment.



### The Spoke of Horticulture:

Our four-spoked wheel again is unbalanced and will perhaps for a brief spell support the wheel. But ultimately, it will collapse when least expected and cannot be expected to stand the test of time and changing circumstances. Horticulture is the spoke of pulchritude that adds a touch of beauty to every park cemetery, and country club. A pleasant approach with flowering dogwoods, Hawthorne Flowering Crabs, Shadblow, and stately trees and a modern club house with a well-planned foundation planting of evergreens and flowering shrubs makes any country club more attractive and remembered. Add to this a formal garden or a colorful bed of tulips, gladiolas, roses, or other brightly flowering ornamentals, and an artificial landscape of tees, fairways, sand-traps, and greens becomes a world of restful beauty and an asset to every community.

### The Spoke of Engineering:

Modern greenkeeping has made tremendous strides in the past 25 years and many practices now in common usage would not be possible if it were not for the technological skills of the science of engineering. Engineering is our sixth spoke in the wheel of turf improvement. Without the man made, labor-saving devices of this science, greenkeeping would be an arduous and almost impossible task in 1951. Without surveying instruments, drainage systems, hydraulic pumps, traveling sprinklers, and other mechanized specialized equipment, the chores of turf improvement would become an undertaking of impossible magnitude. Low pressure sprayers, aerifiers, turf ratters, precision mowers, and all the other mechanical greenkeeping aids are the vital contributions of the spoke of engineering.

### The Spoke of Entomology:

Two spokes now remain and our wheel of turf improvement will be ready for the fitting of the rim. Omit these two remaining spokes, and our wheel will be imperfect. The six spokes now fitted in the wheel are basic to good greenkeeping, but alone they will not suffice to keep our turf improvement wheel rolling over the hills and valleys of turf troubles. Two spokes yet remain to supplement and strengthen the framework created by the six basic spokes.

The science of entomology is the seventh and next-to-last spoke to be fitted to the wheel. Improved specialized turf is a community of living individuals constantly waging a competitive struggle for existence under unnatural conditions and the handicaps of public use and abuse. A provident Dame Nature in her infinite wisdom has developed her system of checks and balances so that one species will not eliminate the earth--so that teeming hordes of crawling insects will not devour the fruits of the earth and mar the beauty of nature's creations. Thus, there are insect enemies of turf that seek to destroy greens and fairways that have required months or years of careful thought and concentrated effort for their establishment. Many a green and fairway has been destroyed by colonies of busy, hurrying ants or undermined by burrowing white grubs. Chinch bugs, lawn moths, cutworms, Oriental earthworms, and the unsightly and disfiguring shrouds of bagworms are insect enemies of fine turf familiar to every keeper of the green.

The spoke of entomology has given us the weapons of defense against these insect enemies of fine turf. Lead arsenate, chlordane, aldrin, dieldrin, toxaphene, methoxychlor, DDT, and parathion are the contributions

of Entomology to the greenkeeping profession. The spoke of entomology has its load to carry in the wheel of turf improvement, for it is the greenkeepers' insurance against visitation of turf-destroying insects.

#### The Spoke of Plant Pathology:

Last, but not least, is the eighth spoke--the science of plant pathology. Fine turfs can and do get sick, and diseases such as dollar spot, large brown patch, fairy ring, grease spot, melting-out, zonate eye-spot, copper spot and snow mold all too frequently may appear almost overnight to destroy the greenest green or the fairest fairway. Plant pathology is the science that seeks to unmask these tyrants that trouble turf, to learn their nature and their destructive habits. Once the cause of a turf disease has been properly determined, the cure may then be prescribed. The spoke of plant pathology makes its contribution to turf improvement by offering chemical insurance against disease---the blight busters for better turf---the fungicides that every greenkeeper relies upon for turf disease control. Plant pathology is the newest of the spokes in the wheel of turf improvement, and much remains to be done to shape and fit this "infant" if it is to assume its rightful and productive role in a program of turf improvement.

#### The Rim of Turf Improvement:

The eight spokes of our wheel have now been fitted, each in its rightful place, and our wheel is balanced and ready for the fitting of the rim. A rimless wheel will never roll for long without a loosening of the spokes, and a well-fitted tire is as essential as the eight supporting spokes. The rim of the wheel of turf improvement is the aptitude and skill with which each individual greenkeeper, experiment station worker, or industrial representative makes his contribution to a mutual assistance pact of turf improvement. Interest, knowledge, skill, and opportunity are the four components of the rim. Omit one of these and our wheel is again unbalanced.

Our wheel of turf improvement is now complete--axle, hub, spokes, and rim each fitted in its rightful place--each spoke strengthening the other and bound together with the binding rim of individual effort. Revarnish this wheel at regular intervals with the lacquer of recent developments, and it will roll steadily and surely down the highway of success with turf.

THE PRESENT FERTILIZER SITUATION

S. C. Vandecaveye, Soil Scientist  
The State College of Washington  
Abstract

Crop production to feed and clothe the nation during the present emergency will depend more than ever before upon fertilizers. In order to meet the crop production goals set by the Production Marketing Administration for 1951, the estimated amount of nitrogen, phosphoric oxide, and potash required will approach 5,000,000 tons.

According to recent estimates, there will be 220,000 tons more nitrogen and 175,000 tons more potash, but 139,000 tons less phosphoric oxide available this year than were used last year. Under normal conditions, the supplies of nitrogen and potash would be ample, but there would be a shortage of about 8 per cent of phosphate material. To meet the increased production as set by the crop production goals, there is likely to be a shortage of nitrogen, phosphate, and potash materials, but most phosphates, amounting to about 1/2 million tons.

About 35 per cent of the sulfuric acid produced in the United States is used in making fertilizers, especially phosphates and ammonium sulfate. The allotments of sulfuric acid made to the fertilizer manufacturers last October were 20 per cent less than the amount used last year. This cut is the major bottleneck in phosphate fertilizer production. The available supply of phosphate fertilizers can be made to go farther, however, by reducing its content in mixed fertilizers in areas where more phosphate is used than is needed for maximum crop yields, and by the more efficient use of phosphate fertilizers by band placement instead of broadcast applications.

In spite of larger total supplies of nitrogen fertilizers than ever before, there is likely to be some shortage of the solid granular forms. Liquid ammonia and anhydrous ammonia will have to be used in larger quantities. This will entail some changes in methods of fertilizer application and cause some hardship in mixed fertilizer production. With proper use, there should be no serious shortage of nitrogen fertilizers this year. This applies equally to potash if high level production is continued.

All factors considered including normal weather conditions, and assuming judicious use of the available supplies of fertilizers, it should be possible to meet the crop production goals for 1951 and keep the lawns, golf courses, and parks green.

SOME EASTERN IDEAS ON TURF PRODUCTION AND MANAGEMENT

G. H. Ahlgren, Chairman, Division of Agronomy,  
Rutgers University  
New Brunswick, New Jersey

In 1900, turf on the golf course was only slightly superior to that found on an improved modern cow pasture of today. Fairways were cut by horse-drawn mowers, unskilled hand labor was common and plentiful, and a tolerant club membership prevailed. The home lawn seldom got any commercial fertilizer, and the use of lime on turf was unheard of and unthinkable. No fancy machines for the precision application of fertilizers, insecticides, fungicides, weed-killers, or grass mowing were to be found.

As in many other fields, 50 years of development have changed the warp and woof of turf production and management. Now we have machines for nearly every job and dozens of insecticides, fertilizers, herbicides, and fungicides to choose from and use. New grass species have come in and many grass varieties are to be had. New weeds, insects, and diseases have made their appearance. An insistent demand from the public for better lawns, athletic fields, turf in parks and cemeteries and along highways exists. Our golf courses must have billiard table greens, fairways like the greens used to be, and roughs approximating the old fairways.

The production and management of turf on any sizable area today costs a lot of money and requires a great deal of knowledge, skill, and versatility. A park or golf course superintendent must be a specialist in turf to perform his function most effectively. Some are college graduates, others have obtained additional training at college short courses, and many belong to turf associations whose primary objective is educational. Experience of a practical nature is a must.

Whether you grow and manage turf in the Pacific Northwest or in the Atlantic Northeast, there will be many common problems. I don't propose to go into such items as the passing of skilled hand labor and the complete mechanization of the turf crop, or the problems of budgeting, labor management, and public relations. My purpose in being here is to discuss some of the accepted eastern agronomic practices as applied to turf. These practices may or may not be appropriate and useful in this area.

Choose adapted grasses

It is said that we have a grass for almost any soil or climatic condition. The problem is to find the right one. I suppose no single grass or combination of grasses completely satisfies our needs or desires. We can only approach the ideal grass cover for each objective.

The grass most widely used in the Northeast for lawns, parks, and cemeteries is Kentucky bluegrass. For these purposes it may be grown alone, or it is often grown in association with red or chewings fescue, Colonial bentgrass, and white clover. It is adapted to open, sunny, fertile, and well-drained soils.

Red and chewings fescue are useful for dry, shallow soils so characteristically low in plant nutrients.

Landing strips and playgrounds are sown to Kentucky bluegrass and red or chewings fescue. There is some interest in adding Alta fescue because of the toughness of this species and its ability to remain green during most of the year. Every effort is made to suppress clover and other legumes of this type of turf because they are too slick or slippery. This is partially accomplished by mowing at 2 inches or higher and by feeding with a fertilizer with a high nitrogen content.

Colonial bentgrasses are used on a few lawns, some fairways, and many golf greens. Highland and Astoria are the varieties. Seaside creeping bentgrass is a favorite species for greens because of its vigorous habit of growth. A few courses are establishing green of C-1 and C-19 bentgrasses, these being reproduced by stolon propagation. We even find an occasional green made from velvet bentgrass but this species has not proved satisfactory.

It is common practice to seed companion grasses, such as perennial ryegrass and redtop, in lawn mixtures. These species come up quickly, making the home owner feel good, while the permanent grasses gradually fill in as these go out. Not more than 15 to 20 per cent of the lawn seed mixture is normally made up of seed of these species because they are such strong competitors. There are as many folks against the use of companion grasses as are for them.

Some interest in warm-season grasses combined with the cool-season species exists. Experimentally, efforts are being made to blend Kentucky bluegrass with U-3 Bermuda grass and several of the zoysias, especially Z-52. It is too early to predict the outcome of this work.

Perhaps the outstanding variety of any of the turf grasses is a selection of Kentucky bluegrass known as B-27 or Marion. It seems to be quite resistant to leaf spot, thereby remaining greener than common bluegrass during the summer. It also has a somewhat spreading or decumbent habit of growth and forms a fairly dense turf under close mowing. This is an especially valuable characteristic where bluegrass is used on fairways.

#### Lime is popular

We use a lot of lime for growing turf. An attempt is made to keep the soil pH between 6.0 and 6.5. Years ago, there used to be some resistance to the application of lime on turf, especially the bentgrasses, but for the most part this has disappeared.

Along with the beneficial effect that lime has on soil structure, the grass is often greener and healthier where lime is applied. Under drought conditions, lime-treated turf will be greener than untreated turf.

The practice is to apply lime whenever it is needed to maintain a pH of 6 or above. Usually, this means 40 to 50 pounds of lime per 1,000 square feet or 1 ton per acre every 2 or 3 years.

### Fertilizer treatments are a must

More and more fertilizer is being added to improve and maintain our turf.

The average lawn and turf of this nature is commonly treated to 20 to 25 pounds of a 5-10-5 fertilizer or a similar one per 1,000 square feet each spring and again in the early fall. This is an application of about 1/2 ton per acres annually. A high quality lawn with considerable bentgrass in it may get the same quantity of a fertilizer such as an 8-6-2, and a goodly portion of the nitrogen supplied will be in the organic or slowly available form. This latter fertilizer ratio is also commonly used on golf greens and fairways.

Organic nitrogen fertilizers, such as Milorganite and Agrinite, are popular on greens, fairways, and high quality lawns. Recent tests with Uramon show that its behavior is similar to these older organic nitrogen fertilizers in that it releases nitrogen slowly to the grass over much of the growing season. This type of fertilizer is very satisfactory and popular in the east.

Fertilizers are usually applied early in the fall and again early in the spring for general turf maintenance. At these seasons our grasses are able to grow most vigorously filling in and thickening up as a result of the stimulation given them. If applied during the late spring or summer, the desirable grasses often do not respond adequately, since they are partially dormant. Accordingly, the weeds, especially crabgrass, will get the maximum benefit-to our regret.

Golf greens are often fed during each month of the growing season, the heavier treatments being applied in early spring and fall and light applications during the summer.

### Artificial soil aeration is popular

Greens, fairways, and tees on the golf course are being aerified by many clubs. Some athletic fields have also been so treated with good results. Such machines as the West Point Aerifier, the Turforator, and Perforator are being used to perform this work.

Aerification stimulates root abundance and elongation. I have dug around aerification holes and noted the mass of roots commonly found in them as well as the increased depth of root penetration. On slopes, moisture penetrates into the soil better and there is less runoff. While it has not been proven, lime and fertilizer probably move down into aerified soil faster than in soils not so treated.

Many golf courses consider aerification essential to their turf maintenance program and have equipped themselves with suitable machinery. Regular fall and spring aerification is part of their work, and because some superintendents like it so much, they squeeze an extra treatment or two in during late spring or in the summer. It is possible that this treatment is being overdone somewhat, but basically it seems sound for managing high quality and valuable turf.

Some weeds are still with us

The new selective weed-killer, 2,4-D, has helped a lot to eliminate such pests as dandelions and the plantains. The spot treatment of chickweed with sodium arsenite is practised and is reasonably effective. Potassium cyanate was widely used this past season in the East to kill crabgrass in general turf mixtures used for lawns and recreation.

White clover is often a problem on fairways and greens. We have been fairly successful spraying fairways for clover control with the ester form of 2,4-D in the early fall. Spraying at this time of the year weakens the clover plants and many of them winter kill. Repeat treatments are often necessary to do a completely satisfactory job. The clover problem on the green is an especially tough one. Ammonium sulfate at the rate of a pound per 1,000 square feet of green periodically applied probably helps to keep clover under control, but there is no good, clear-cut answer here.

Poa annua or annual bluegrass is another difficult pest on greens and approaches. We delay fertilizing in the spring on heavily infested areas, applying our plant food after Poa annua has passed its most vigorous growth period. This treatment is not very satisfactory because the greens become run down and yellowish, and there is often a lot of member complaint.

Crabgrass is taken out of our greens using dilute concentrations of phenyl mercury compounds, especially phenyl mercury acetate. This is much cheaper and more effective than hand weeding.

Once the weeds are temporarily eliminated, wise feeding, watering, and management is introduced to stimulate thin turf, thicken it up, and thus make it harder for the weeds to reinfest. Such follow up treatment is considered essential or money spent on weed control may be largely wasted.

Go easy on the water

We have a watering principle that we try to adhere to carefully. If irrigation is practiced, then water only as needed and then deeply. Be sure the water gets into the soil to a depth of 5 or 6 inches and then stop watering until the soil is dry again.

Overwatering is a serious hazard to good turf. Frequent shallow watering or a continuous excess of water so that the soil is waterlogged encourages two serious pests of fine turf--white clover and Poa annua. The improper use of water, especially on fairways, will soon result in a very poor, inferior quality turf and call for large financial outlays to renovate and bring the good grass back.

Adjust the mower

Bentgrass turf on greens is cut from 3/16 to 5/16 inch, Bent turf on fairways at 1/2 to 3/4 inch, and fairway bluegrass at 3/4 to 1 1/4 inch. Our common lawn and park grasses thrive best if cut at a 1 1/2 inch height, or higher. For landing strips and playing fields, mowing is at 2- or 3-inch heights.

In my opinion, more turf in the northeast is ruined by improper mowing than by any other single factor. The bentgrasses must be cut close and regularly to reduce the extremely dense, mat-like growth that otherwise develops. Bluegrass thins out under close cutting, permitting invasion from weeds. Mowing grasses at 2 inches or above helps control clover and annual bluegrass and results in a deep rooted tough sod.

#### Turf associations prove useful

Many of the northeastern states have turf or greenkeepers associations. I believe these organizations are extremely valuable in promoting good turf based on sound development, production, and maintenance principles. They work closely with the colleges and with industry. Through unified efforts of their membership and by educational means, they are yearly improving their status financially and professionally. The free exchange of information among their members and between associations is now accepted and encouraged. Frequent meetings take place at a member's club or park. Turf authorities are invited to meet and discuss their specialty with such groups. An annual meeting is usually held at the experiment station for review of the turf research program. They demand and sponsor turf short courses to keep abreast of new information.

The old belief that growing grass is more of an art than a science is gradually disappearing. In my opinion, the sooner it is gone, the better. Scientific grass growing teamed with experience has no equal.

The turf associations do more than sponsor education for themselves. They promote education and training for young men interested in the field. They sponsor and advise on turf research problems, working hand and hand with the state experiment stations. Thus, they encourage research, cooperate in conducting research, and lend stability to the turf work of the colleges.

As turf research and education progress, so does the professional status of men engaged in turf work. We have come along way, but there is much yet to be done.



TURF MANAGEMENT IN WESTERN OREGON AND WASHINGTON

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The Pacific Northwest has two very distinct regions from the standpoint of turf management problems, divided by the Cascade Mountains. In the region west of the Cascades, there are extremely wide variations in climatic and physical conditions.

Precipitation varies from 17 to 20 inches up to 100 inches or more annually. Summers are generally dry and winters wet. Temperatures are quite variable, being mildest in the coastal section and considerably colder in the inter-mountain valleys and at the higher altitudes, particularly as the Cascade Mountains are approached. The growing seasons are long, probably averaging at least 200 days of good growing weather, with considerably over this in the coastal sections and quite a bit less in the inter-mountain valleys.

There is a wide range of soils. The structure and water-holding capacity is extremely variable. This is true also from the standpoint of natural fertility, exposures and elevations, drainage, acidity, and natural turf plant-growing ability.

This makes for a possible use of a wide range of good turf-producing plants. There are already quite a number of such plants in use and more are in the process of development.

In the minds of many people, and in all probability truthfully so, turf experts are expected to be over-all specialists. They could be referred to as agriculturists, or farmers. But when it comes right down to fine points, they can quite truthfully be referred to as applied scientists. From the applied scientist's standpoint, they are agronomists, which in turn means the science of soils and plants. Their soil problems have to do with fertility, irrigation, drainage, rebuilding, cultivation, management, etc. As for plants, they must have knowledge of kinds, uses, establishing or reestablishing, maintenance, renovation, management, and interest points.

A turf specialist should have at least a speaking acquaintance with such sciences as entomology, pathology, physiology, bacteriology, botany, and chemistry. In addition, he should be a plant selector, forester, landscaper, weed controller, mechanic, and have the ability to do a certain amount of experimental work. While he may not think so, he should be at least partially familiar with the role of an educator and in all probability also with extension work, both of which will aid him in handling his various problems as they arise.

All of this adds up to the fact that turf specialists continually need and desire information on developments pertaining to turf plants, fertilizers, insects and diseases, weeds and weed destroyers, equipment, management practice, and economy practices without impairing qualities.

How are they going to get this information?

First, through practical experience. This may be a long and hard road in some cases. Second, through experimental work, primarily as carried on under particular conditions. Third, through learning from the efforts of others.

There are a number of various management practices that have a regular distinct bearing on turf production for western Oregon and western Washington:

1. Providing of adequate and satisfactory drainage before establishment of the turf and then keeping such drainage active.
2. Equalizing soil constitution wherever possible or desirable before seeding or planting, and keeping it that way. This results in considerably more uniformity of the turf than might otherwise be the case.
3. Providing plenty of available plant food for the establishment of turf. It is always sound practice to have a rather high state of soil fertility for the establishment of turf so that the oncoming plants will get off to a good start and develop a satisfactory soil cover in the shortest time possible.
4. Reducing possibilities of initial weed development. There appears to be no better time to get rid of a possible weed population than previous to seeding or planting of turf plants.
5. There is rather wide diversity of opinion as to the best times for seeding. A lot depends upon local climatic and soil conditions. Fall seedings should generally be made during the late summer or very early fall to give the plants an opportunity to get well established before adverse winter weather conditions develop. Likewise, spring seedings should be made fairly early in the spring so that the plants will get well established before the dry summer weather occurs.
6. The rates of seedings are extremely variable, depending, of course, on the kind of plant or plants used. Too little seed may result in thin stands to begin with and bring on certain management practices that may be slow with thin seedings. On the other hand, extremely heavy seedings may also cause difficulties as the result of the crowding of the plants and the possible development of diseases such as damping-off. Nature will generally thicken thin stands and thin heavy stands, but nature can generally be assisted by proper rates of seeding. For the very fine seeded grasses and legumes, 3 to 3½ pounds per 1,000 square feet is generally considered ample. On the other hand, for the plants having fairly large seeds such as the fescues, 4 pounds per 1,000 square feet is not out of line. When considering the rates of seeding, a germination test of the seed is worthwhile. This may be used as a gauge for the proper rate of seeding to obtain a good stand at the beginning. Good turf grass plants should have a seed germination of 90 per cent or better. The purity, of course, should be the highest possible.
7. Fortunately for the region west of the Cascade Mountains, there is a rather wide range of planting materials for turf use. These include the various bents, red fescues, white clover (where that may seem desirable), and on occasion, redtop, Kentucky bluegrass, alta fescue, and for some situations, perennial ryegrass. There are, of course, some being used that are of comparatively little value, such as common ryegrass, timothy, and the various typical coarse-leaved bunchgrasses. The dryland grasses are of very little value. The same can also be said of southern grasses such as Bermuda and Centipede grass.

8. The irrigation of turf for most satisfactory plant growth should be such that the water penetrates deep enough into the soil to provide the major portion of the rooting system with plenty of water. Light applications with shallow penetration are more harmful than beneficial. The water should be clean as well as plentiful. It should be particularly free from detrimental fungi or bacteria.

9. Plants, for most satisfactory growth, should have reasonably free air movement in the soil around the roots. Generally, when such a condition prevails, there is opportunity for ample amounts of moisture and plant foods to get into the roots zones for most satisfactory and beneficial use. This situation may require certain renovation practices, such as spiking or other turf-opening measures. The opening up of the soils, particularly of the surface, allows for more freedom of movement of water, air, and plant foods, and certain beneficial bacterial actions.

10. The role of fertilizers is an important one. It is, of course, agreed that nitrogen is necessary for satisfactory grass nourishment; phosphorus assumes the same position for legumes. There appears to be a growing opinion that a complete fertilizer should be given consideration since undoubtedly there are places where all are very necessary. Perhaps even to carry this still further, some of the minor elements may enter into the picture. Which is the best fertilizer, or fertilizers, can usually be determined by the individual or individuals working with the turf, because they generally know what the growing conditions are, what the soil situation is, the extent of soil moisture supplies, turf utility purposes, and the numerous other factors entering into the picture.

11. Weed control is an important factor in turf management. With the numerous weedicides now available and many others in the process of development, the control of weeds is being simplified in a great many instances, and more efficient and more rapid control is being secured.

12. The control of insects, pests, and diseases is of paramount importance. In case the management of a turf area cannot determine rapidly what the specific difficulties are, arrangement should be made for consultation with experts so as to lose as little time as possible developing ways and means of correcting the situation.

13. There is considerable variation in opinion as to first, the desirability of top dressing, and second, the kind of top dressing or turf. It seems to be rather generally agreed that top dressing on heavily used, closely mowed turf is a very desirable thing to keep the turf in the best possible condition. On comparatively lightly used turf, this is not such a factor. The constitution of top dressing should be such that it contains a high percentage of organic matter, is relatively porous, and has a fairly high degree of fertility. The pH should be somewhere near neutral. It should be free from insects and diseases, of a relatively fine constitution, and of a character that will not puddle after being distributed and watered.

14. It is generally agreed that closely mowed turf is most difficult to maintain. This is probably because the shorter the turf plants are cut, the lower the percentage of roots. This in turn, of course, indicates that it is more difficult to continue a good turf with continuous close mowing unless the plants are provided with plenty of readily available food and moisture. A rapid renewal of plant roots is very desirable and, as a matter of fact, practically necessary for the continuity of a good turf.

Because of numerous variations, either natural or man made, much of the success of turf management depends on the skill and ingenuity of personnel

TURF DISEASES AND FUNGICIDES FOR 1951

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In 1951, the American golfing public--professional, amateur, good, poor, and indifferent--will expect a standard of excellence on the greens of America equal or superior to that enjoyed in 1950. The professional and expert player will expect greens to be green and fairways to be fair, for they know from long experience that the standard of their play will be determined to a large extent by the state of the greens. The amateur golfer and "week end dub" will admire the smooth verdant beauty of well-kept greens which he perhaps will accept with the casual passing reflection that the golf greens of '51 have indeed attained a high standard of excellence. Only a small percentage of the golfing fraternity will pause to reflect that the dense green carpet of Washington bent or number 16 green is the offspring of years of research and months of painstaking thought, care, patience and application of highly developed and hard earned skills.

In 1951, the improved, highly specialized turfs that beautify our country clubs, parks, and cemeteries can only result by maintaining a delicate balance of fertility, vigor, disease and insect control, weed prevention, and good greenkeeping practices that requires the wisdom of Solomon, the patience of Job, and the diplomacy of Disraeli. The professional greenkeeper of 1951 is truly a knight of the sod, whose skills, knowledge, and responsibilities should entitle him to inclusion in the ranks of the professional members of our national society.

The hazards of greenkeeping are many and varied and present a constantly shifting array of difficult problems that change from month to month and year to year. None of these hazards reigns supreme as "Chief Tyrant of the Green." But each in its own troublesome way, alone or in partnership with other troubles, strives to defeat the best efforts to maintain the green standards required by the American public. Turf diseases are now recognized as one type of hazard the greenkeeper may expect to encounter in his task of maintaining perfect turf. Turf diseases have finally been accorded recognition as "gremlins of the green" in only relatively recent times, and the knowledge of their cause and method of operation has become the professional vocation of a very small group of plant pathologists, in still more recent times. Turf diseases have been recognized as distinctive troubles, and numerous common names have been used to designate them. Names such as dollar spot, large brown patch, Typhula snowmold, grease spot, melting-out, copper spot, fairy ring, and zonate eye-spot are certainly descriptive, but they tell nothing of the cause of these troubles and offer still less for the methods necessary for their prevention.

Among the presently recognized turf diseases, fungi or parasitic molds are the only criminals that have been proved guilty of the crime of turf sabotage. The turf disease fungi are in most cases microscopic, soil-inhabiting molds that have adopted the parasitic mode of life and have become highly specialized as despoilers of fine turf. These fungi are as highly specific as are the microorganisms that are responsible for human ailments and animal diseases.

The dollar spot fungus, Sclerotinia homeocarpa, attacks bent grasses, causing characteristic straw-colored areas of dead turf about the size of a dollar piece. This gremlin of the green is most active in late spring,

early summer, and early fall. By contrast, the brown patch fungus, Pellicularia filamentosa causes dead areas of turf from 2 inches in diameter to as large as 2 feet in diameter, with a characteristic "smoky" appearance. This turf fungus operates best during humid weather when temperatures of 80-90° F. prevail.

Again, by contrast, the pink showmold fungus, Fusarium nivale, and Typhula snowmold, Typhula itoana, operate best when soil acidity is below pH 6 and only during the cool winter months, and then only when a blanket of snow is provided to shelter this winter worker on the greens. The grease spot disease, or the trouble sometimes referred to as spot blight, is caused by Pythium butleri, which can only do its damaging work at very high temperatures of 85-95° F. following periods of high humidity.

These are but a few of the turf diseases. Several others, equally distinctive, could be described. Generally, these diseases of turf can be recognized by most greenkeepers and turf pathologists. Occasionally their symptoms are not characteristic and are masked by unusual weather conditions or other circumstances.

Further new or unusual troubles often appear. Their diagnosis is difficult for those untrained for such specialized duties. Correct diagnosis of turf diseases is a vital prerequisite to their prevention. The specialized turf pathologist has an important role to play in this respect. Equipped with the advantages of modern laboratories, high powered microscopes, laboratory isolation methods, and pure culture techniques, the turf pathologist can eliminate the guesswork in identifying turf troubles and can unmask the real criminal, the true cause of the trouble. Every greenkeeper and every turf improvement program should recognize the important role the plant pathologist can assume in promoting success with turf.

Only the true cause of a turf disease is recognized, can the remedy be prescribed and applied. The new fungicides are as specific as the wonder drugs penicillin and aureomycin. The use of a fungicide incapable of stopping a specific disease is useless, wasteful, and disillusioning. The wrong fungicide, used incorrectly and at the wrong time, often may result in greater damage that may be done by the disease.

The story of turf fungicides is an interesting example of gradual progress with increasing knowledge. Bordeaux mixture, consisting of a combination of copper sulphate and lime, which was discovered by accident in southern France, proved to be a practical remedy for the downy mildew disease of grapes. This grandfather of all the fungicides was imported into the U.S.A. in 1885 and quickly became a panacea for all the ills of growing plants. In 1917, Bordeaux mixture was first used for the prevention of turf diseases with only partial success and satisfaction.

Since these early days, technological advances in this country have won world acclaim for American ingenuity. Industry, science, and agriculture have been jointly responsible for noteworthy progress in the formulation of new chemicals for plant disease prevention. Greenkeepers have watched a confusing array of "blight busters for better turf" parade across the stage of modern turf improvement. The metallic mercuries that reigned for several years as "sprays supreme" for dollar spot, large brown patch, and snowmold prevention have in some instances abdicated in favor of the modern organic fungicides.

With the introduction of the quinones in the form of Spergon as a chemical seed protectant for peas and lima beans in 1940, the organic age of fungicides was born. In the past 5 years, members of the greenkeeping profession have witnessed in awed confusion the introduction of fourteen organic turf fungicides with weird sounding names and complicated chemical formulations. The universal cry has become: What are these new fungicides, what are they good for, and how may they be most effectively used?

The modern turf fungicides may be grouped in four major categories. Many of these new materials have unusual properties that qualify them for special uses. None of them are panaceas for all the ills of turf. All of them will prevent turf diseases if properly applied, but few of them are satisfactory if resorted to only when diseases are well established.

#### The Inorganic Mercuries.

In this category are included the old timers of turf fungicides. The inorganic mercuries consist of mercuric and mercurous chlorides and mixtures of these chemicals that have appeared under trade names such as Calo-Clor, Calomel, Calogren, and Auragreen. While these chemicals will quickly and effectively stop diseases such as dollar spot and large brown patch, their use during the hot summer months often is accompanied by serious turf injury. They have been largely supplanted by newer fungicides for this reason. However, fall and spring applications of inorganic mercurials continue to be the most satisfactory practice for the prevention of snowmold.

#### The Cadmium Compounds.

In the past 2 years, a group of complex cadmium compounds has been widely used by many greenkeepers. This group includes proprietary preparations such as Cadminate, Crag 531, F.531, Crag 1025, Merck 258T, Puraturf 177, and Puraturf GG. These materials are complexes composed of calcium, zinc, copper, or mercury with various cadmiums such as cadmium succinate or para amino phenyl cadmiums. The cadmium fungicides have been nationally outstanding for dollar spot control and may be used with safety even during the period when high temperatures prevail in June, July, and August. The cadmium compounds have also been effective for the prevention of pink patch and copper spot.

#### The Organic Mercurials.

The prominent role played by certain organic mercurials as selective herbicides has attracted attention to their potentialities as fungicides. Phenyl mercuric acetate, which is the active ingredient of products such as PMAS, Tat-C-Lect, and Dynacide, has been surprisingly effective for dollar spot control. In nationally coordinated fungicide trials in 1950, phenyl mercuries were quite effective for dollar spot and brown patch control. Another organic mercurial, phenyl mercury triethanol ammonium lactate, distributed under the name of Puraturf, has given excellent dollar spot control and is one of the few materials that will reduce the damage caused by *Helminthosporium* leaf spot to blue grass. The other organic mercurial is hydroxymercurichlorophenol, better known as Special Semesan, that has been widely used for brown patch and dollar spot control.

The Non-Mercurials.

In this category are to be included several miscellaneous compounds comprised of organic chemicals which do not contain mercury as their active constituent. The quinones represented by Spergon have been effective in preventing damping-off in newly seeded turf areas. The thiuramdisulphides represented by Tersan have been most widely used for large brown patch control and will effectively prevent dollar spot if applied often enough at the correct rate of application. Two other non-mercurial fungicides not generally available at present have shown promise of becoming useful turf protectors. A new chemical known as Orthocide 406 (n-trichloromethylthiotetrahydro phthalimide) appeared promising for large brown patch control in New Jersey and is one of the chemicals research workers will be investigating further in 1951. Another unusual material, which is a by-product of the streptomycin industry, and is known as Acti-dione, has been tested for its value as a turf fungicide by workers in Michigan. Acti-dione has effectively prevented dollar spot and has shown unusually promising results for preventing Helminthosporium melting-out disease of bent grass. No other fungicides have adequately controlled the disease. The availability of this product in 1951 will be dependent upon the outcome of national and international affairs.

In 1951, greenkeepers will be confronted with the possibility of damage to their greens and fairways from one or more of seven major diseases:

Brown Patch	Helminthosporium melting-out
Dollar Spot	Zonate Eye-Spot
Snowmold	Algae
Pythium Spot Blight	

The tools of turf disease control in 1951 are the newer fungicides previously described. Fungicides are the supplementary weapons in our arsenal of defense against these problems. If used for the purpose they were intended for, in the way suggested by competent specialists, and if employed in conjunction with the accepted practices of a sound greenkeeping program, fungicides may be expected to provide adequate insurance against turf diseases in 1951.

A TURF DISEASE RESEARCH PROGRAM

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Abstract

A program of research on control measures for turf diseases is being undertaken by the Department of Plant Pathology of the Washington Agricultural Experiment Stations at Pullman. This program is limited in scope at present but may be expanded in the future.

The research program will have three aspects:

First, a survey of the state to determine the prevalence and severity of turf diseases.

Second, an investigation of the fairy ring disease which is a problem in western Washington.

Third, participation in the National Cooperative Turf Fungicide trials which are set up to compare promising turf fungicides as to their action against the more important turf diseases under various regional conditions.

The success of this turf disease research program depends largely on cooperation between the plant pathologists at Washington State College and the turf growers throughout the state.



## IRRIGATION OF TURF AREAS

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Irrigation is the artificial application of water to soils whenever rainfall becomes insufficient to meet the full moisture requirements of the growing plants. Good irrigation practice depends on an understanding of, or at least an appreciation of, fundamental soil, moisture, and plant relationships.

### Moisture Characteristics of Soils.

The soil plays a very important part in irrigation practice. Every soil has a capacity for storing moisture, but some will retain more than others. Moisture in a soil occurs in the following forms:

Hygroscopic Water: It is the moisture held so closely and with such great force by the soil particles that it is entirely unavailable to the plants.

Capillary Water: It is the moisture held in thin films around the soil grains and in wedges between the grains. It is, for the greater part, considered to be the water that is available to plants. Capillary water cannot be removed by drainage. It leaves the soil by evaporation from near the surface and as moisture used by the growing plants.

Gravitational Water: It is the water occurring in the soil in excess of maximum capillary capacity. It is free to move through the soil pores under the influence of gravity. In well drained soils, the gravitational water usually moves too rapidly to be considered a soil moisture property.

Whenever moisture is applied to a soil, either as rainfall or as irrigation water, it tends to sink into the soil due to the combined forces of gravity and capillarity. The capillary capacity of the surface layer is quickly reached. Additional water applied penetrates deeper into the soil and brings the moisture content of successive layers up to capillary capacity. The maximum amount of moisture a soil will hold against the force of gravity is the maximum capillary capacity, more commonly referred to as "field capacity."

Plants growing on a soil will remove most of the moisture classified as capillary water. When the moisture content has been reduced to a point where the plants wilt permanently, the available moisture has been used up. The percentage of moisture remaining in the soil when wilting occurs is called the permanent wilting percentage of the soil.

Both field capacity and permanent wilting percentage vary in different soils. In coarse, sandy soils they are both lower than in the finer textured silt and clay loams, and generally, the available range is considerably greater in soils of fine texture.

### Irrigation of Well Drained Soils.

In the irrigation of well drained soils, the capillary or available water is of major concern. The amount of this so-called available water held

in a unit depth of soil depends on the texture of the soil. Total useful storage capacity in any particular soil, however, depends on the depth of the root zone of the crop. Some of our field crops, like alfalfa, go to great depths and in irrigation practice, we usually attempt to wet the soil to a depth of 6 feet at each irrigation.

Turf, on the other hand, is shallow rooted. The major concentration of the roots probably occurs in the top 4 to 6 inches of the soil. The problem, therefore, is to keep these roots supplied with moisture. This calls for frequent irrigation in the summer months.

#### Conditions Affecting Moisture Movement.

Thus far we have considered deep, well drained soils. On many of our turf areas, however, downward movement of moisture is restricted. The restrictive influence may occur at the soil surface or anywhere within the soil profile. It may be a natural obstruction or, as is more often the case, it may be the result of some action or practice on the part of man.

The obstruction to downward passage of water may be a high water table. The presence of the water table near the soil surface may be a natural condition, or it may be the result of over-irrigation. If the water stands within 3 or 4 feet of the surface, the downward movement of irrigation water, especially when the application is heavy, will be greatly retarded.

As brought out so very vividly by Dr. G. O. Mott of Purdue University during the 1950 conference of this group, the common practice of building up golf greens in alternate layers of sand and clay does very greatly reduce the rate of moisture movement through the soil. As a result, even a very light irrigation may cause water to pond on a golf green.

Another illustration is the problem experienced last fall with the newly placed sod on the playing field of the Spokane Memorial Stadium. There, sod was placed in strips and, to hide the seams and to smooth out the field, a thin layer of loose dirt was spread over the sod. The sod and loose dirt were then packed down by rolling. This rolling caused the surface to seal tightly. Subsequent heavy rains created a serious drainage problem, leaving large puddles of water standing on the field.

Somewhat similar conditions may occur in park areas and on golf course fairways where heavy foot traffic may cause compaction of the surface layers of the soil. Evidences of this condition show up on areas used as foot paths.

#### Irrigation Requirements of Turf.

Probably the month of greatest need for irrigation is July. According to the best information now available, the irrigation water requirements of turf during a July month of average temperature and average precipitation will vary from location to location in the state of Washington as follows:

##### Central Washington

Yakima	7.50 inches
Kennewick	6.25 inches
Ephrata	6.00 inches
Wenatchee	6.00 inches
Ellensburg	5.50 inches

Eastern Washington

Omak	6.50	inches
Walla Walla	6.25	inches
Spokane	5.75	inches

Western Washington

Tacoma	4.25	inches
Centralia	4.25	inches
Vancouver	4.25	inches
Everett	3.75	inches
Bellingham	3.75	inches

These depths of water required are in addition to whatever precipitation may fall during the month. They represent water required by the plants for transpiration and include evaporation from the soil surface. The other losses-- deep percolation and run-off--are not included. If the irrigation is carelessly done, or if too much water is applied at any one irrigation, part of the water put on is lost as run-off or sinks so far into the soil as to be of no use to the crop. The values reported need then be increased by whatever depth of water is wasted.

## DRAINAGE OF TURF AREAS

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Turf grasses and legumes grow best under a particular range of moisture in the soil--not too much, and not too little. Too little moisture causes the plants to turn dark green and become dormant if no moisture is supplied. Too much water will turn the turf light green and then to die. In this paper I would like to focus attention on the condition of too much water.

Too much water for too long a time results in drowning. The roots of good turf vegetation are like human beings--they require air and they require water. Too much of one at the expense of the other causes trouble. When the turf vegetation dies, the ground is bare, or a less desirable plant that can stand the "swimming" condition may start to grow.

Actually, most turf vegetation is tolerant to a wide range of moisture conditions. The roots are in the top foot of soil and relatively few reach an 18-inch depth. Because of these shallow roots, turf will often thrive on land too wet for deep rooted crops.

Some of the penalties for poor drainage are poor turf vegetation, wet spots late in the spring or after rains, and development of "salty" or "alkali" spots which kill the vegetation. These areas are often brushed off by applying the term "bad spot" and living with them. There is a cause, however, and a solution. Sometimes solutions are more costly than the area is worth, but frequently the correct solution is not only economical but highly desirable. In either case, the situation will merit careful consideration.

The solution of the drainage problem may only require the removal of the water on top of the ground. We all know that water runs down-hill. By applying this principle in one way or another, surface drainage is usually not too difficult. It is also common knowledge that water flows readily in the properly sloped clean channel, but when weeds plug it, the water hardly moves. Open channels should be kept clean.

It is usually harder to figure out how to remove the waters below the surface of the ground. Let's take a quick look at why a high water table occurs.

Probably everyone attending this conference has looked with wonder on some big waterfall. The Horse Tail waterfall on the Columbia River drive is a good example. The water pours over the cliff and drops freely through the air a great distance. Water falls because it is attracted toward the earth's center. For this same reason, it flows in channels. The ground surface is full of little pores so that when water comes into contact with it, water flows into the soil--still toward the center of the earth. The soil is not the same all the way down. When the water hits a layer which won't let it through as fast as it is flowing, it backs up.

As it backs up, it builds up a sloping surface so that it flows sideways--again because of its attraction to the center of the earth. The sloping surface of the water in the soil is called the water table. Air is forced out from the saturated zone below the water table.

These "less porous" layers may be the original rock from which soil is derived. They may be clays, or they may be a cemented area which has developed in the soil we refer to as "hard pan."

A clay pan or hard pan originally started from parent rock material. The rock, over a period of a few hundred years, weathers down into sands and smaller particles called silts and still smaller particles termed clays. It takes 1,200 or 1,400 years to convert a 1-inch layer of rock into what we would call soil. The wind and the water sort the particles out by size and move them from place to place. When a layer of very fine particles is deposited at one location, we find a clay layer.

There are common methods used to drain underground water. Our objective is to take off enough of the water in the soil so that the water table will not hurt our turf.

One method often talked over at meetings of this kind is mole drainage. Mole drainage involves the making of mole-like tunnels through the soil for water to flow through. The mole tunnels lead to a ditch or low area where the water will drain away. These tunnels are made by pulling a bullet-shaped cylinder, or similar device, through the soil at a constant depth below the ground surface. The cylinder is connected by a plow-type beam to a frame supported by wheels. The machine is pulled by a tractor. It is common to make the tunnels from 30 to 40 inches below the ground surface and 3 to 5 feet apart. The tunnels are run up and down the slope so they will drain freely. They are satisfactory only in heavy type soils where they will usually last 2 or 3 years. Because the equipment roughs the ground surface each time the tunnels are re-established, I do not consider this method very desirable for turf drainage.

Open drains are frequently very effective in draining land. They are an eye-sore, however, which is not desirably associated with the beauty of a well-kept turf.

Pumping from the ground water reservoir is often most effective in draining large areas. It is seldom applicable to turf drainage as a small unit, however.

A fourth method is tile drainage. Tile drainage provides a cased channel concealed from the ground surface to remove the offending water. It accomplishes the job of an open drain without a surface ditch. This method is the one generally most usable for turf draining. New equipment has cut installation cost considerably. Tile installation can now often be made at costs comparable to those required for a suitable open drain.

The more complicated drainage problem is like a case of appendicitis, in that it is best to have a specialist handle the problem. The simpler problems, however, are like the ordinary headache where a known home remedy will do the job without the cost of the physician. In either event, the keeper should recognize a few symptoms and know facts for the good cure.

In draining a wet spot caused by surface water, it is necessary to provide a free-running channel on a downhill grade. A good example of a situation of this nature occurred on the University of Idaho golf course. The bottom of the main draw on the course remained wet until late in the spring because the water coming from the hills wasn't readily drained off. The keeper installed a 4-inch tile in a trench about 18 inches deep dug down the draw bottom. He backfilled with cinders in which turf will not grow. Drainage was effectively accomplished without a noticeable structure.

Where wet spots are caused by water seeping out of the ground, it is necessary to intercept the water before it gets near enough to the surface to cause trouble. Boring a few holes around the wet area will usually disclose where the water is coming from.

Drain tile are either clay or concrete. I once attended a farmer demonstration in which the agent mentioned the superiority of his drainage tile because water flowed through its walls. This is actually a weakness, since the tile walls should be sound and water tight. Water gets into drain tile through the joints.

Tile should be laid deep enough to lower the water sufficiently to do the job. If there is a porous layer, such as sand, within reach from the surface, it's a good idea to take advantage of the freer water movement in the sand by putting the tile down in the layer.

Tile should be laid to constant grade. The grade itself is not nearly so important as laying the tile uniformly. The penalty for grade changes is eventual clogging of the tile due to silt deposition in low or slow spots. Generally for small jobs, 4-inch tile is used. Smaller sizes are not standard in drain tile and would not be desirable from a clogging standpoint.

Drain tile should be encircled with a layer of gravel. It is good practice to lay the tile on a couple of inches of gravel. Gravel should also be used to fill the trench to 3 or 4 inches above the tile. The first earth backfill should be placed on the gravel by hand to further protect the tile from shifting. Then machine backfill is all right.

One last point to consider in tile drainage is that tree roots will plug the line--especially willows. Turf roots are too shallow to affect a suitable tile installation. The tree roots, however, will seek out the water in the tile and accumulate from year to year, and the tile is rendered useless.

## WEED PROBLEMS ON GOLF COURSES

Milt Bauman, Greenkeeper  
Kellogg Country Club

I will begin by naming the weeds with which we have to contend. In the fairways and on the tees, dandelions and plantain are the predominating weeds. We have had trouble with Japanese clover, and in a few spots, with chickweed also in the greens; the only weed that causes trouble is pearlwort.

In the summer of 1947, we mounted a sprayer on a pickup. The sprayer was home-constructed and consisted of a 55-gallon oil barrel and a 3-gallon-a-minute pump powered by  $1\frac{1}{2}$  horsepower Briggs and Stratton motor. We prepared a solution of  $\frac{1}{2}$  gallon of 2,4-D liquid ester to 50 gallons of water. This was forced through a  $\frac{1}{4}$ -inch hose with from 35 to 40 pounds pressure. This went into a sprayer bar 8 feet long with seven nozzles which was mounted on the pickup about 18 inches above the ground. We had a very even overlapping spray.

With our sprayer mounted and in good working order, we started spot spraying in the fairways, where the weeds were the thickest, at a rate of about 3 miles per hour. We did not spray the entire course because it was August, nor did we use any fertilizer. We were just experimenting. The results of this spraying were an approximate kill of 20 per cent of the dandelions, 5 per cent of plantain, and none of the Japanese clover or chickweed.

In the spring of 1948, we mounted the sprayer drum on wheels with a tongue or handle. The sprayer bar was mounted on a framework of pipes in wheelbarrow fashion with an air-inflated rubber tire and set about 17 inches above the ground. To it was attached 200 feet of  $\frac{1}{4}$ -inch hose. The sprayer drum was set in the middle of the fairway and, with the 200 feet of hose attached to the sprayer bar, we could spray better than 100 feet of the fairway before the sprayer tank needed to be moved. This time we moved about 2 miles an hour with the same pressure and the same solution of the 2,4-D ester that we had used the previous year.

Being a small club and not overly supplied with man-power, we started to fertilize ahead of the spraying. We started fertilizing about the first of June and started spraying about the fifteenth. Before we were through, some of the fertilizing was done after the spraying. Also, we didn't have enough fertilizer for a large share of the golf course.

We did not water the fairway for 3 days before the spraying or 3 days afterward. The weather was ideal -- warm and sunny with very little rain. The Japanese clover was blooming very nicely, the dandelions were past their peak of blooming, and the plantain had gone to seed.

The dandelions and Japanese clover started to die in about 10 days to 2 weeks. The plantain was not affected until 20 to 30 days after spraying. Results of this spraying were: approximately 70 per cent kill on dandelions and plantain on all fairways and tees. Where fertilizer was applied ahead of time, the kill on dandelions and plantain was about 95 per cent. I cannot remember seeing any Japanese clover since that application. As for the chickweed, I could not notice any effect at all.

This process of spraying between our other work took the better part of a month.

Our club has not been sprayed since 1948, and a good share of it is still fairly free of weeds. Some low spots and places that were not fertilized are building up with plantain and dandelions again, and we plan on spot fertilizing and spraying these areas this summer.

I could not find where any of the grass was damaged by the 2,4-D. In some sections of our fairways, we have quite a bit of Astoria bent. It seemed to stand the spraying very well.

I mentioned at the beginning that pearlwort is the only weed we have to contend with in our greens. Once in awhile I find a plantain or dandelion, maybe a dozen or so a season. These I remove with a knife. Occasionally a patch of chickweed will show up. I dust a little highpowered fertilizer on it and in a week or so it is gone.

We keep a small nursery to repair any damage to our greens. For several summers I tried to cut the pearlwort out and replace it with grass from our nursery. I would take highpowered liquid fertilizer and apply enough of this solution on each spot of pearlwort to kill it. Then I would take a cup cutter and cut the dead pearlwort out and replace it with grass from the nursery. During the summer of 1947, I would say we transplanted some 4,000 cup plugs from this nursery into the greens. We cut out every bit we could find. The next summer it came back almost as bad as the year before. We still kept cutting it out but couldn't seem to gain on it. I started to find spots growing in the fairways. These I would mark and burn out and let the grass fill in by itself.

A year ago last September, I went down to the Hayden Lake Golf Club to see the job John Harrison did on his greens with iron sulphate. He sprayed at the rate of 4 pounds per 1000 square feet and had a good kill on pearlwort. Last September, we sprayed our greens with iron sulphate and used about 5 pounds per 1000 square feet. I would estimate a 50 per cent kill on pearlwort and no effect on any of the grass. I believe that pearlwort can be kept down with iron sulphate if applied properly and at the right time. I also sprayed some sections of fairway and hand-dusted thick heavy patches with very good results.

I would like to mention here my experience with sodium chlorate. If applied at the rate of  $1\frac{1}{2}$  pounds per 100 square feet, it sterilizes the soil for about 3 years. I have used it with good results in keeping weeds out of sand traps. The sand should be removed, the sodium chlorate applied, and the sand put back in place. If the sodium chlorate is applied on top of the sand, it is blasted out onto the grass or greens and the grass dies. We have a dairy adjoining our club, and the cows feed through the fence as far as they can reach. In a short time, they weakened the fence enough to climb through. Last spring I applied sodium chlorate for 2 feet on both sides of the fence and completely eliminated this trouble. If you do use sodium chlorate around any livestock, it should be soaked into the soil in the same manner as with the application of fertilizer. Then you will eliminate any chance of the livestock eating it.



CONTROL IN LAWN AND TURF AREAS

V. H. Freed, Weed Specialist  
Oregon State College

The control of weeds is a perennial headache in turf maintenance. It is discouraging, to say the least, to lavish all sorts of attention on a turf area only to find that this attention not only encourages the growth of grass but many weeds as well. How to get rid of these unwanted pests has engaged the attention of turf experts for a long time.

Within the past few years, we have seen the development of a number of remarkable new chemicals for selective weed control. Many of these chemicals are very helpful in solving our weed problem in turf areas, but by now I think we all are aware of the fact that these chemicals are not cure-alls in themselves. I think that it is important to emphasize that good turf management is still in vogue as a preventive weed control measure.

I am not going to attempt to set up any standards of turf management that might contribute to weed control, since I will devote most of this talk to the problems of chemical weed control. It won't be possible to write a prescription for the varied weed problems each of you encounter, so I think we had best spend our time examining some information about the various chemicals used for weed control in turf areas, and their advantages and limitations.

Many of the new selective weed killing chemicals have been especially effective for control of broadleaved plants such as dandelion, plantain, and others in turf areas. However effective these materials are on many plants, they are not a panacea for all weed problems. Before discussing the use of these chemicals, I would like to take just a moment to present a little information on the chemicals themselves and how they act.

The first chemical that I think we ought to take up is dinitro selective. We have known this chemical for many years since it first came to our attention as Sinox or law Sinox. The dinitro selective compounds are salts of dinitrophenols which are related to carbolic acid. These chemicals kill only tissue with which they come into contact. That is to say, they are not translocated in the plant. They merely kill the vegetation which they wet. When used on a grass planting, the selectivity of these compounds in a large measure is based on the fact that they do not wet grass plants but do wet and kill the broadleaved weeds. These chemicals have been found to be more suitable for spraying seedling grass for the control of annual weeds such as pigweed, lamb's-quarter, and mustard, rather than using them in a well-established turf for control of perennial weeds. We might say, however, that these chemicals still have a place in established turf areas for control of chickweed, which, under our conditions in the West we have found hard to control with 2,4-D.

The next chemical that we encounter on our list of selective weed killers is 2,4-D. Almost everyone is acquainted with this chemical and the spectacular results that have been obtained with it. 2,4-D is our major selective weed killer for control of broadleaved weeds in many crops and especially on turfs. This chemical is a growth-regulating compound that,

when applied to one part of the plant, translocates to another, thereby giving us a kill of both tops and roots of susceptible plants. However, this chemical is not the universal weed killer that we once thought it to be. We have found that a number of plants, including broadleaved plants, are not susceptible to the action of the chemical.

One of the newer weed killers that has come into some prominence is 2,4,5-T. This chemical is, figuratively speaking, a blood brother of 2,4-D. While 2,4,5-T does not kill nearly so many plants as 2,4-D, it is effective on many plants which appear to be resistant to 2,4-D. This chemical is not being used much alone on turf but is being used in a mixture with 2,4-D. The mixture of these two chemicals, either as a 1 to 1, or a 1 part 2,4,5-T to 2 parts 2,4-D, is proving quite effective for the control of many plants that we have not been able to control heretofore with 2,4-D. We are finding that certain species of speedwell, chickweed, and some of the docks are controlled better by this mixture than by either chemical alone.

A new chemical that is getting quite a bit of publicity for chickweed control, as well as for control of certain of the weedy annual grasses such as crabgrass, is potassium cyanate. This chemical is a lot like the dinitro selective in that it is a contact weed killer and depends on the wettability of the plant for its selectivity. This chemical doesn't appear to be ready for general usage yet, because there are a lot of factors such as timing, rates of application, conditions under which it must be applied, etc., to be worked out before it is entirely foolproof.

The choice of a selective weed killer for the control of broadleaved weeds in lawns will be determined in a large measure by what weeds are to be controlled. As a general rule, however, I think that the 2,4-D - 2,4,5-T mixtures probably are nearly universal choice for this purpose. For 2,4-D, or mixtures of 2,4-D with 2,4,5-T, rates of application of the chemicals vary from 1 to 2 pounds per acre, depending on the weed and the grass. It has been found that this amount of chemical could be successfully applied in as little as 10 gallons of water and is equally effective applied in as much as 100 gallons of water per acre. It has been my experience in turf spraying, however, that a rate of application of between 40 and 60 gallons of water per acre is the most satisfactory.

Selective weed control in turf areas may be initiated almost any time during the year, although fall and spring seem to be the preferred time. Under our conditions here in the West, I believe fall is the better time to spray for the selective control of chickweed, rather than any other time of the year. We have found that at almost any other time of the year our control of this plant was not nearly as satisfactory as a fall application of an ester form of weed killer.

One of the most troubling problems in turf management is the control of weedy annual grasses such as crabgrass, annual blue grass, and water grass, as well as control of some of the perennial grasses, such as velvet and quackgrass. A number of chemicals have been tried for the control of these grasses in turfs of perennial grasses, with varying degrees of success. I believe that crabgrass has probably received more attention and publicity than any of these other grasses.

Among the chemicals that have been tried for control of crab-grass, and of course some of the other annual weedy grasses, are the phenyl mercury compounds. These include materials such as PMAS or phenyl mercury acetate and several others. This chemical seems most toxic to young seedling grasses, whereas the older perennial grasses are somewhat tolerant of it. Formulations of the mercury compounds range all the way from liquids to dry formulations of dusts of pelleted material that may be sprinkled on the lawn. These chemicals, when used for the control of crabgrass, must be applied at weekly to 10-day intervals over a period of time to assure successful control of the plant. The chemicals seem to have very little residual action in the soil. Care should be exercised in using these materials, particularly on bent-grasses, to avoid discoloration of the desirable grass.

Potassium cyanate is currently receiving quite a bit of attention as a possible crabgrass killer as well as a control measure for chickweed. This material, used at rates of 8 to 16 pounds per acre applied at weekly intervals, controls seedling plants.

A number of other materials are being studied for the control of crabgrass, including such materials as maleic hydrazide, chloro IPC, oils, etc.

I should mention that here in the West, annual blue grass is perhaps as serious a problem for us in turf areas as crabgrass is in the East. No thoroughly satisfactory control has yet been worked out for this plant, but a chemical known as IPC has shown some promise of at least reducing the problem. Most of the perennial grasses, including bentgrass, will tolerate 4 or 5 pounds of IPC per acre, which is sufficient IPC to kill out germinating and seedling annual blue grass. For most successful treatment, this chemical should be applied in the fall or in the very early spring. The high temperatures during the summer break the chemical down and destroy its effectiveness. But if the blue grass is satisfactorily controlled in the fall or early spring, the problem will not be nearly so serious during the summer months.

Before closing, I believe it wouldn't be right to skip over the problem of regulating the growth of lawn grasses. Several different chemicals have shown considerable promise of retarding the growth of lawn and turf grasses, but none of them has been perfected to the point where mowing is eliminated. The principal chemicals that have shown any likelihood of retarding the growth of grasses are maleic hydrazide, IPC, and chloro IPC. It appears to be a matter of time before the use of these chemicals is perfected to the point to where they could be recommended at least for certain uses.

The weakness of these chemicals for retarding the growth of grass so far appears to be in discoloration of the grass. Since we have all grown accustomed to seeing turf areas a rather brilliant green, it strikes a note of discord to see them go through a yellowish-green to a reddish-brown color even though this does retard their growth. Under conditions at Corvallis, we had best luck with fall or spring applications of IPC for retardation of growth. Again, you will remember that high summer temperatures break this chemical down very rapidly, which means that midsummer applications are not very effective. The maleic hydrazide, on the other hand, is very efficient in retarding the growth of grass but seems to be the worst one for discoloration. I believe that with proper study we may find how to use this chemical at low enough rates and frequent enough applications to retard this growth without causing discoloration. But before we go out and put this practice in general use, I think we had better let someone perfect it on an experimental basis rather than finding out how to use it the hard way.

TURF WEED PROBLEMS

Louis Schmidt, Greenkeeper  
Indian Canyon Golf Club

Weeds present about the same problem at Indian Canyon Golf Course as they do on any other grassed area. Ten years ago, our greens were 25 per cent clover and chickweed. That spring I used a weak solution of sulfate of ammonia as a spray and burned out 95 per cent. It didn't look or putt very well for a couple of weeks, but it did the job. Since that time we have used enough nitrogen to keep the grass growing vigorously and the clover is no problem. Chickweed doesn't seem to be able to stand the daily raking it gets.

Plantain causes me a lot of trouble after a bad infestation of snow mold. In fact, 3 years ago there were probably five or more plants to the square foot. After some experimenting, it was found that 2,4-D mixed at one-fourth the recommended strength and sprayed with a hand broom at 80 pounds pressure did a beautiful job. We had no burn whatsoever with that mix.

We sprayed most of the grassed areas late one fall with 20 per cent more 2,4-D than instructions on the container called for. Probable 90 per cent of the wide leaf weeds were gone before snow. The mistake I made was not fertilizing, because the next fall there were four or five little plants in the bare spots where the large ones died. It's been my thinking that you should either fertilize heavily along with the weed killing programs or spray 3 successive years.

Last fall I used a double dose of 2,4-D on a patch of morning glory and Klamath weed. The morning glory was in full bloom, and spraying seemed to get about half the plants. Klamath weed wasn't bothered. This spring will tell the story.

Dwarf daisy is very hard to kill. I've sprayed, and every spraying I increase the concentration of 2,4-D. It kills the plants to the ground, but soon they reappear. At triple the amount, I finally did get some killing. I would like to get some answer to Canada thistle and more experimenting on Klamath weeds.

EXPERIENCES OF A GREENKEEPER

Robert Finlay  
Seattle Golf Club, Seattle, Washington

I am to talk to you about my experience as a greenkeeper. A greenkeeper is expected to be a carpenter, painter, plumber, mechanic, and to have a good knowledge of grass.

Things have changed in the past 20 years. We are living in a mechanical age now, and have every kind of tool to do any job on the golf course, so we must advance with the times, the same as any other plant or industry.

I would like to talk to you about preparations for tournament championships. It is quite a job top dressing and fertilizing before the tournament so the greens may be in shape to stand the test. I have had many fine tournaments, like the Western Amateur, the Women's Western, Washington State P.N.G.A., and many others. Next year, 1952, the Seattle Golf Club has been awarded the U.S.G.A. Amateur Championship, which will be late in August, 1952. I have been preparing for this event for some time, so I thought you would be interested to know some of the changes we have made to improve our golf course.

We have closed in quite a few sand traps all over the course which were more of an expense than a penalty to our players. The seventh fairway has been lengthened about 50 yards, which will make it 475 yards.

The 8th, a short hole of about 140 yards, with a terrrace green, we made a little larger on the upper shelf. It is a very sporty one-shot hole surrounded with sand traps. We also made a new tee on the right of the present one, which gives a new angle to the green.

Number 10 fairway will be lengthened to 370 yards, which will give the player a better view of the green from the tee. Number 12 fairway and green have been completely changed, the fairway from the tee being quite a steep climb. It was decided to cut the hill down making a valley through the center by cutting as deep as 16 feet in places and using this dirt to fill in all the other fairways planned on this program. About 60,000 yards of dirt were moved from this hill, making a big improvement as viewed from the tee. This is a dogleg to the left about 400 yards. On the right of the fairway, sand dunes have been built to catch a slice shot. This green is tightly trapped and built up well at the back and can be seen all over from any approach shot.

Number 13 will be a one-shot hole of 165 yards. This green is well trapped on both sides.

The number 16 hole is one of the nicest as seen from the tee. It is a water hole from the tee to the edge of the lake and is about 290 yards downhill. This is another slight dogleg to the left. This part of the fairway has been filled in from 3 feet to 9 feet at places. The second shot on this hole must carry the lake and be very accurate to get on the green, because it is trapped on the right and has woods on the left.

The drainage on this new construction work has been a big job. About 2000 feet of tile from 6 inches to 12 inches in diameter have been installed, concentrating all this drainage into the lake. A pumping system has been installed so that the lake can be kept at any desired depth.

Now I have given you an idea of my experience on the golf course for the past year, so if you happen to be in Seattle in August, 1952, I invite you to come out and see some real golf.

ARRANGEMENTS OF PLANTINGS ON TURF AREAS

Earl H. New  
Assistant Professor of Horticulture  
University of Idaho, Moscow, Idaho

You will all realize that first impressions are often lasting ones. The first place you will have a chance to impress people is at the entrance to your grounds. Entrances should be well planned and planted so that they are inviting. Maybe your cemetery caretakers can say, "Oh! They all come here sooner or later, anyway." Be that as it may. A pleasant cemetery entrance can help ease the sorrow of those who accompany the deceased on his last ride. It can give those who are left the impression that the cemetery will be well kept and, therefore, the last resting place of the loved one well kept.

Golf course and park entrances can also be improved. The way you plant those entrances are an indication of what can be found within. Many park entrances are better off without the great masses of plants sometimes used. Use restraint and good taste, for each situation is different.

Massive stone gates, extreme ornamentation, and show-offness are not in good repute at the present time. Simple lines and simple plantings reflecting quality and neatness are to be desired. It may be that a few low-growing shrubs or prostrate evergreens will be in keeping, depending greatly on the contour and other features of the approach.

You will notice that I have not given you any cut-and-dried formula for entrance plantings. There is no such thing. Each entrance must be given individual treatment. Probably it will be best to give you a few "don'ts" about entrance plantings:

1. Don't obstruct the view of traffic.
2. Don't crowd the plants.
3. Don't plant just to be planting. Have a reason.

Obviously you'll have to follow the drive to get to the golf club house, the inner reaches of the park, or the graveside in a cemetery. I am assuming that you have drives suitable to the traffic pattern or the funds available to build them.

The question now is how to plant the drives. Do you want a long avenue with overhanging trees? Or do you want the grounds to appear as though the drive was through a natural grove with open vistas? You'll have to answer these questions before you proceed.

Long, straight drives with regularly spaced trees give an air of formality. There are places where such arrangements are desirable. Personally, I prefer curved drives and informal placement of the trees along them. After all, the park drive is not a busy city avenue.

Natural placement is best where natural placement can be achieved. By this I mean placing the trees in natural, uneven spaced clusters with open areas between.

Take a tip from the trend in architecture. Use simple lines, curves, and amounts in your landscaping.

Now here is where divergence begins. Extreme simplicity of planting in cemeteries is the rule. Plantings that do not interfere with ease of maintenance have become a necessity. This means an open, parklike treatment with headstones flush with the ground and rather tall, high-canopied trees so grass can grow below, is the most useful. The trees should not be spaced at even intervals if the cemetery is on a hillside. In fact, the layout of such a cemetery should follow the contours of the land and the planting development should be as natural as possible.

The best development from a landscape viewpoint is often not the most economical from an area use viewpoint. Somewhere in between lies the true answer. Nevertheless, one should try to achieve a type of clustering interspersed with open spots. To cover the entire area with shade trees just to have it covered is neither desirable nor in good taste.

Now, let's leave the cemetery for a few moments and develop the golf course and park plantings. Long vistas with clustered groups of trees and shrubs can be used for both. For golf courses, the treatment is more open and sparse--yet a cluster of trees can be used as a hazard or to turn a fairway. Whatever you do, make it appear as though the cluster belonged there. You have a sense of balance and proportion, so use that sense to give the feeling that that group belongs. Study your natural contour, the setting, and the need, and if they call for a group planting there, put it there.

Suppose some golfer questions your intelligence regarding your selection of a site for a golf course planting. I understand that golfers' language can be very colorful at times. And when one loses a ball in one of your man-made booby traps, such language is liable to flow fluently and in abundance. Such outbreaks and questionings can be averted only if your course plan and landscape plan are in harmony. Certainly the two should be planned together. You know enough about golf course design to take advantage of the contours of the land to make a course sufficiently hard to challenge the best and not discourage the worst. Do the same with your landscaping.

Don't put the trees in such a place that they are obviously meant to be a trap. Make it appear that the trees belong there and the course was built around them. Make them fit!

Good golf courses are characterized by open, reasonably clear fairways, bordered by various types of roughs, such as long grass and shrub or tree clusters. You get the impression of long vistas and sparse planting, for after all, too much interference with the progress of the little white pill is not wise planning.



In park planting, we see a greater intensifying of planting. For instance, the vistas you have on the golf course are shortened and narrowed in the park, more plants are used, and a new feature is introduced. That new feature is hidden bays and nooks. It makes the visitor walk on to see what is around the corner.

You know the human is the most curious creature you ever saw. If something is half hidden it is intriguing, if fully exposed it is of only passing interest. This is as true of landscape features as with anything else. What one doesn't see readily, one must.

The secret of successful vistas and bays is the balance and scale used. Graceful curves, the type that look like they belong there, help balance and scale the plantings. Along their borders are the flower beds and shrub plantings, the low materials out front with the higher background materials to the back.

What? No trees plunked out in the center? No flower beds out where everyone can see all sides? Frankly, how do you like the old tire flower bed in the home owner's front lawn?

Chopping up lawn areas is as dead as the dodo in the best regulated landscape circles. Keep your plantings to the edge. You will get an impression of greater spaciousness if you do. You will also hear such comments as, "My, I didn't know this park was so big."

We do have other considerations in planting parks. We sometimes have arboretum areas. These should be given as natural a treatment as possible. Keep them grouped. Keep the plants to one side, follow the contour, and give them the space necessary for best development.

We need picnic areas in the park. This poses another problem--shade. It is much more pleasant to picnic in the shade than in the hot, glaring sun. Rather high canopied trees that throw a reasonably good shade, yet open enough for good grass growth, should be used. Traffic here will be terrific. The spacing of the trees should be such as to give a reasonable amount of shade, yet not so close that shade and foot traffic will run the grass out.

What spacing should we use here? Very frankly, I don't know. All I do know is that it will depend upon the kind of trees planted. I will say that there are some rules of thumb for tree spacing. The best one is not to place two trees closer than the combined radius of the mature canopy of those trees.

Now let's tear that apart. What about cluster planting? In that case, closer planting is permissible because of the effect desired. The above rule is generally for avenue spacing, which means that many large avenue trees should be spaced 60 feet apart. You may wish to space farther for picnic areas or use a modified cluster planting so several tables can be grouped in one area and semi-privacy achieved by having some open space intervening between clusters.

You know, I haven't said a thing about plantings around your service buildings. Those that you wish to hide can be screened out with plants, while those you wish to show off can be given the same treatment you would a house. There will be a need for frame and background trees and for a restrained foundation planting of mixed evergreens and shrubs.

I won't go into details on foundation plantings. I would like to caution, though, against using shrubs that will be too large for where they are used when they have matured. And that isn't all, I'll come back and haunt you if you put those "cute little" blue spruces in a foundation planting.

How you plant your own type of grounds will depend greatly on the "lay-of-the-land." Profound rules have been advanced for good landscape design. These rules are of help only as we meet standard situations. On the rest, you'll have to feel your way through, using a knowledge of plant material and your own artistic ability, for the only difference between the landscaper and the artist is the materials used to create a picture. There is no cut and dried formula I can give you. Therefore, I haven't.

"Oh!" you are all saying, "he didn't give any consideration to growing grass under those trees and shrubs." My advice is: don't try to grow grass under low shrubs. Give them clean cultivation and keep them out of the lawn area. If they are used for border or foundation plantings, that solves that.

About growing grass under trees, wise spacing is the answer to most of those problems. In the park, trees used in the border plantings with shrub facers do not need a grass ground cover. They are often planted closer together for a mass effect, anyway. It is those trees used on the cemetery and golf course or picnic area that must be spaced for grass growing. Selection of high branching or open top trees will help considerably.

It is impossible to set up any concrete examples in the time allotted or to cover the entire field in detail. You will have to use your own good tastes. About all I can really tell you is to strive for naturalness, stay away from crowding, and don't clutter up the lawn areas by plantings.