Pam Todd
Bracket

Proceedings

of the

24th Annual Northwest Turfgrass Conference

October 7, 8, 9, 1970
Salishan
Glenden Beach, Oregon

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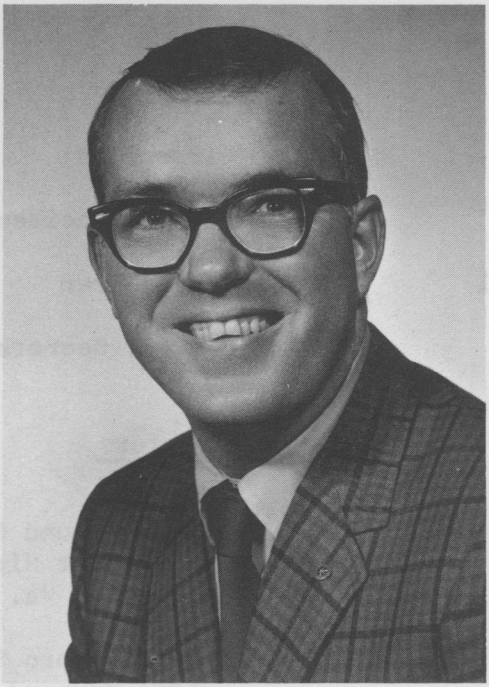
PRESIDENT'S MESSAGE



Welcome to Salishan.

It has been a pleasure serving the Northwest Turfgrass Association in the capacity of President during the past year. I would like to thank the other Directors and all of the committees for their fine cooperation and support. This is the very thing that helps to keep any Association alive, such as ours, especially when we are so widely distributed.

Our membership has increased this year as it has done in previous years which indicates a healthy growth in an organization that is very worthwhile. I look forward to continued association with fellow turfgrass workers and wish the Northwest Turfgrass Association and my successor a most successful future.

NORTHWEST TURFGRASS ASSOCIATION

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Roy L. Goss	Western Wa. Res. & Ext. Center, Puyallup, Wa. 98371

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Environmental Pollution and Marine Life[1]

Joel Hedgpeth[2]

Although the total volume of the ocean is more than 300 million cubic miles, the active part in which life processes of significance to man take place, is much smaller. Proportionately to its volume, this shallow surface region is comparable to the grassy and cultivated areas of the land. This part of the ocean is vulnerable to pollution in ways we still lack complete information to estimate. For example, the development of organochlorine pesticides occurred before we knew about the life process that control the development of shells of marine birds, or, for that matter, before we understood how rapidly spray on land could become part of the atmospheric circulation and enter the active surface layers of the oceans in areas so distant as the Antarctic.

Now we have become aware of the implications of heating water in our power plants, and the possible significance of the predicted volumes of thermally altered water to the productivity of the seas. What has been generally overlooked is that water heated in power plants is deprived of a large fraction - perhaps 90% - of the minute plant life on which all the rest of the life cycle of the ocean depends. Thus sterilization of large volumes of water, as predicted for the future by engineers, could upset the productivity of the seas far more effectively than spilling of oil or release of sewage. In this context, talk of thermal pollution as nothing more than warming environmental water a few degrees, is fatuous optimism.

1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Oregon State University, Resident Director, Marine Science Center, Newport, Oregon

Understanding the Physical Characteristics of Your Putting Green Mix[1]

William B. Davis[2]

Incomplete information and today's high cost of golf course development are two major problems that contribute to putting green failures. Most of us have learned that a new green mix is a subject about which everyone from the bartender to the University turf specialist is an expert. We also have learned that compromise is the rule, not the exception. There is not too much we can do about the experts or the high cost of development but we can improve our information and our understanding of the putting green mixes so we can make wiser decisions.

Each of us knows of greens that have been rated excellent. In most cases the mixes of which they are composed are different. It is not uncommon for some superintendents to recommend that the only true mix is equal parts of sand, soil and organic matter. The most common green mix we see is a 50-50 mix of sand and organic matter. Many of these putting green mixes are reported to be laboratory tested, but only a few are the result of a complete laboratory test.

In the short term almost any soil, sand, or organic matter, short of a subsoil, can be worked and formed into a green. With careful watering and proper nutrition it will grow grass, and weather permitting we can mow it into a putting surface. We don't find out whether or not we have a good putting green mix until we subject it to the stress of our climate and traffic.

Our field experience has told us a great deal about soils and the addition of organic amendments. As we all know, sands drain well, are easy to work and they are droughty. We know that clays become very hard when dry, are difficult to work when wet and that they drain very slowly. In general, most of us prefer loam because it is easier to work over a wider range of soil moisture. It retains water while at the

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1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Extension Turf-Landscape Horticulturist, University of California, Davis.

same time drains fairly well. As for organic amendments, we know they act as a dilutent to make clays and loams easier to work and that they help sands to hold more moisture. We also know that as organic matter breaks down it helps to cement the clay and silt particles together into larger aggregates, giving us a more friable soil. So we ask for a loam, or sandy loam, or loamy sand and think we have an excellent growing medium for putting greens. Unfortunately, when we use these putting greens we subject them to traffic. These loams fail in direct relationship to the amount of traffic on them.

The unique character of a putting green is that it cannot serve its function properly unless it is mowed frequently and its nitrogen nutrition is maintained higher than optimum for the best growth of grass species. The close frequent mowing and the higher nitrogen fertilization produce a restricted root zone. We can ill afford to further stress turfgrass plants by allowing them to compete for water so we tend to always water well ahead of potential water stress. So, our putting green mix is always moist and traffic can now destroy any aggregation of the very small silt and clay particles. These small soil separates can then freely move in between the finer sands that have themselves fitted in between the larger sand particles to reduce the larger pore spaces. This is a long way of explaining compaction. But the mix does become compacted and retains too much water relative to the solids and the air filled spaces between them. This water drains slowly as well. What was once a well-structured loam is now a compacted dense loam that needs frequent aeration or reduced traffic and precise regulation of water if we are not to lose the turf.

What we want is a mix that keeps a good structure even under the conditions imposed upon it in a putting green. This is possible if we can rely on the texture to actually produce a stable structure. All soils and sands are made up on a combination of different particle sizes or texture. (See figure 1.) Individual clay particles range from .002 and smaller while a very coarse sand particle ranges from 1 ml to 2 ml in diameter. A single soil separate such as medium sand, .25 to .5 ml in diameter, uncompacted, has an infiltration rate of approximately 65 inches per hour. Because the individual soil separates are nearly all the same size they do not compact. In mixed sizes of soil separates, their uncompacted infiltration rate is relatively high. Under compaction the infiltration rate becomes much lower and the mix also retains much more water.

There are many ways of looking at some of the physical characteristics of putting green soils that can help us understand or evaluate various sands and/or mixes. One of the most useful procedures is plotting the moisture-release curve to give the relationship between the water and air in any mix at different tensions or at different mix depths. Since we are concerned with the most active root zone of a putting green mix we have studied the air and water relationships in the surface 3 1/2 inches. Moisture-release curves are usually given in percent volume of water, but we have converted these to actual inches of water stored in the surface 3 1/2 inches.

MECHANICAL ANALYSIS SAND #2

SEPARATES	US SIEVE NUMBER	DIAMETER RANGE (mm)	% PASSING SIEVE	% ANALYSIS
FINE GRAVEL	10	2.00 - ½ INCH	100	0
VERY COARSE SAND	18	1.00 - 2.00	99.7	0.3
COARSE SAND	35	0.50 - 1.00	97.4	2.3
MEDIUM SAND	60	0.25 - 0.50	29.1	68.3
FINE SAND	140	0.10 - 0.25	4.5	24.6
VERY FINE SAND	270	0.05 - 0.10	3.6	0.9
SILT	—	.002 - 0.05	—	0.8
CLAY	—	— .002	—	2.8

MECHANICAL ANALYSIS SAND #3

SEPARATES	US SIEVE NUMBER	DIAMETER RANGE (mm)	% PASSING SIEVE	% ANALYSIS
FINE GRAVEL	10	2.00 - ½ INCH	80.1	19.9
VERY COARSE SAND	18	1.00 - 2.00	65.9	14.2
COARSE SAND	35	0.50 - 1.00	32.5	33.4
MEDIUM SAND	60	0.25 - 0.50	14.3	18.2
FINE SAND	140	0.10 - 0.25	7.1	7.2
VERY FINE SAND	270	0.05 - 0.10	5.3	1.8
SILT	—	.002 - 0.05	—	0.8
CLAY	—	— .002	—	4.5

Figure 1.

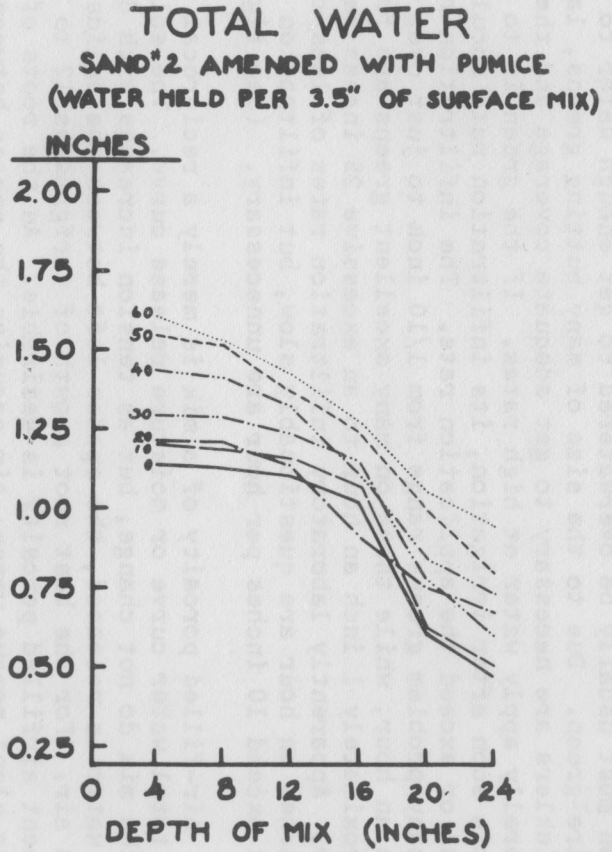
With increasing depth of a mix, there is a corresponding increase of water tension in that mix. At the first break in the curve, water empties from the larger pore spaces. As the depth of the mix increases, more water is released from smaller and smaller pore spaces between the solids. (See figure 2).

A study of the moisture release curves therefore, shows how much water is retailed at a particular depth of the mix. A mix that has good drainage and water retention properties at 12-inch depth may retain too much water at 6 to 8 inches, or be too droughty at 16 to 18 inches.

All sands, soils and/or mixes hold more water at any tension than it is possible for the grass plant to extract from it. This unavailable water is quite important in evaluating different sands and amendments. Some amendments do often improve the water holding capacity of a sand, but this water may not be available to the plant. (See figure 3)

Another extremely important physical characteristic of a putting green mix, is its water infiltration rate. When it rains there is no control over the amount of water or the rate of application to the greens. When we irrigate, even with the best of irrigation systems, some portions of the green must usually be overwatered to get enough water to the entire green. Due to the size of many putting greens, large sprinklers are necessary to get adequate coverage and these generally apply water at high rates. If the green is to be usable soon after irrigation, its infiltration rate should equal or exceed the application rate. The infiltration rates on many problem greens range from 1/10 inch to just over 1 inch an hour, while those on many excellent greens are from approximately 1 inch an hour to an excessive 25 inches per hour. Apparently laboratory infiltration rates of less than 2 inches an hour are questionably slow, but infiltration rates that exceed 10 inches per hour are unnecessary. (See figure 4)

Air-filled porosity of a mix is merely a reciprocal of the total water curve or moisture release curve. The solids in the mix do not change, but as tension increases with depth and water is released, the spaces left between the solids fill with air. For the best root growth of turfgrasses 12 to 18 percent airfilled porosity is desirable. As the roots of the grass plant remove water, air occupies the spaces between the solids; good root activity depends on this oxygen in the root zone. (See figure 5)


TOTAL WATER
SAND #2 AMENDED WITH PUMICE
(WATER HELD PER 3.5" OF SURFACE MIX)
INCHES
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
60
50
40
30
20
10
0
0 4 8 12 16 20 24
DEPTH OF MIX (INCHES)

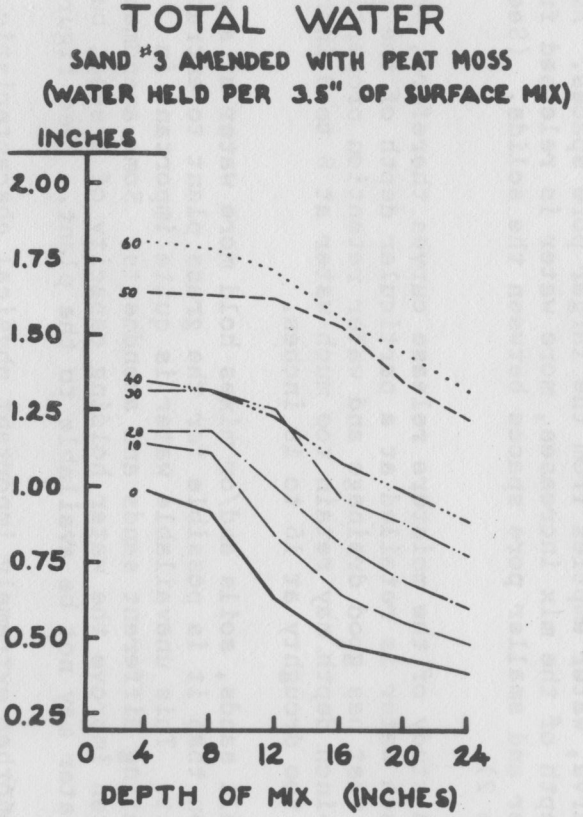
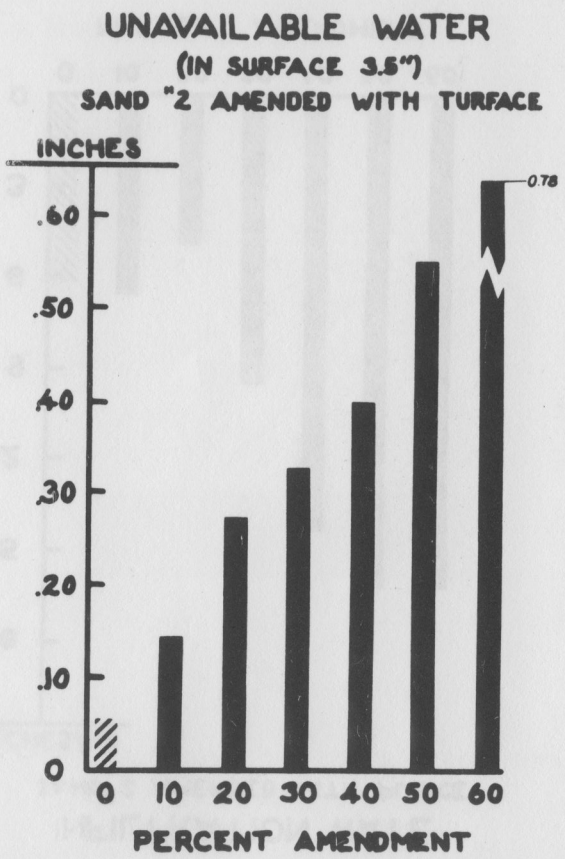

TOTAL WATER
SAND #3 AMENDED WITH PEAT MOSS
(WATER HELD PER 3.5" OF SURFACE MIX)
INCHES
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
60
50
40
30
20
10
0
0 4 8 12 16 20 24
DEPTH OF MIX (INCHES)

Figure 2.


UNAVAILABLE WATER
(IN SURFACE 3.5")
SAND #2 AMENDED WITH TURFACE
INCHES
.60
.50
.40
.30
.20
.10
0
0.78
0 10 20 30 40 50 60
PERCENT AMENDMENT

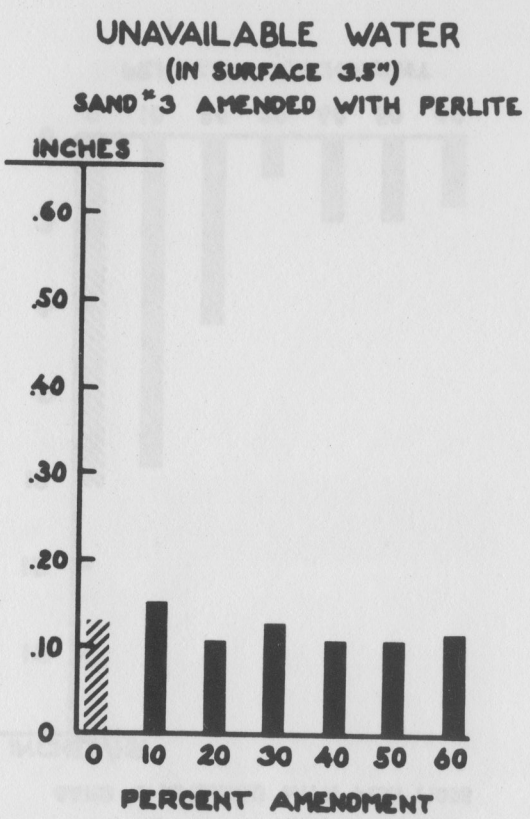
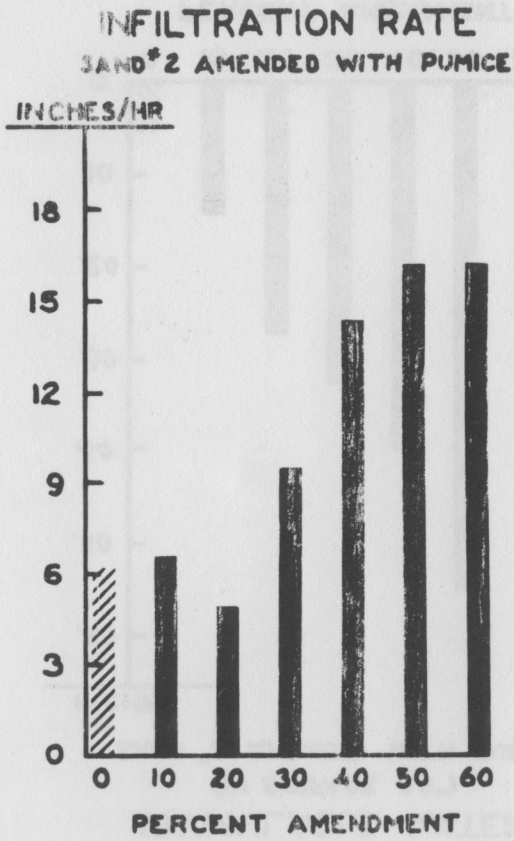

UNAVAILABLE WATER
(IN SURFACE 3.5")
SAND #3 AMENDED WITH PERLITE
INCHES
.60
.50
.40
.30
.20
.10
0
0 10 20 30 40 50 60
PERCENT AMENDMENT

Figure 3


INFILTRATION RATE
SAND #2 AMENDED WITH PUMICE
INCHES/HR
18
15
12
9
6
3
0
0 10 20 30 40 50 60
PERCENT AMENDMENT

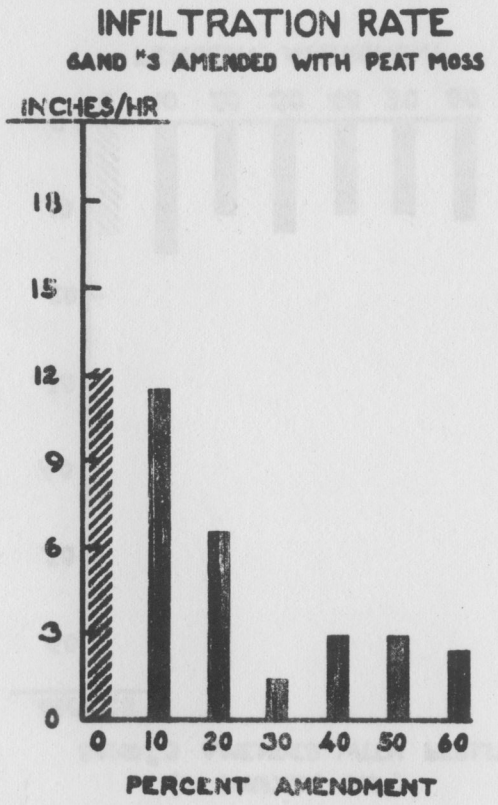

INFILTRATION RATE
SAND #3 AMENDED WITH PEAT MOSS
INCHES/HR
18
15
12
9
6
3
0
0 10 20 30 40 50 60
PERCENT AMENDMENT

Figure 4.

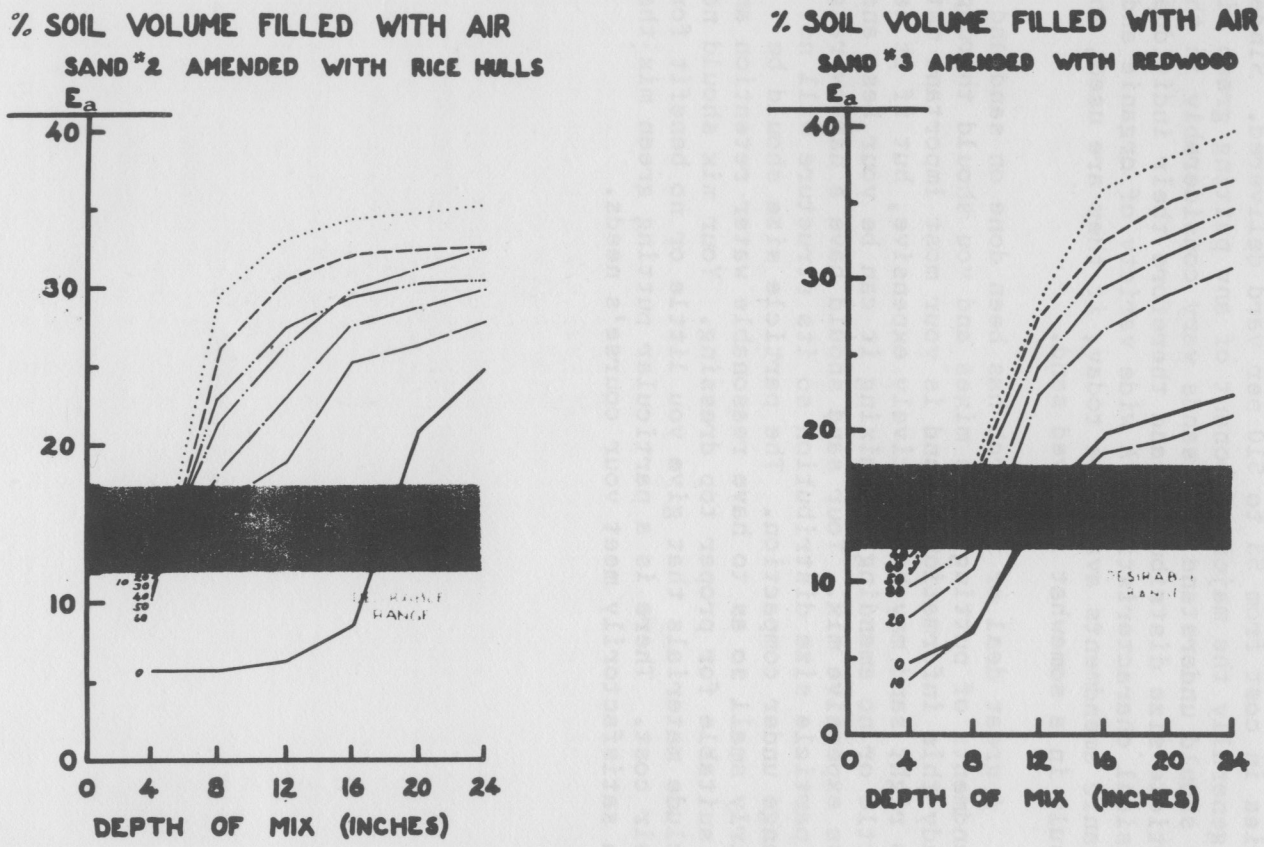

% SOIL VOLUME FILLED WITH AIR
SAND #2 AMENDED WITH RICE HULLS
Ea
40
30
20
10
0
0 4 8 12 16 20 24
DEPTH OF MIX (INCHES)
% SOIL VOLUME FILLED WITH AIR
SAND #3 AMENDED WITH REDWOOD
Ea
40
30
20
10
0
0 4 8 12 16 20 24
DEPTH OF MIX (INCHES)

Figure 5.

While some of these physical characteristics of putting green mixes are important, no single characteristic can be used as the standard for a good mix. Most present day soil mixes consist of 50 to 80 percent by volume of sand which varies in cost from $3 to $10 per yard delivered. Since sand is generally the major component of any putting green mix you should understand that sands vary considerably in their particle size distribution and therefore their individual physical characteristics. A wide variety of organic and inorganic amendments available today, if they are used, should result in a somewhat improved sand.

A great deal of research has been done on sand and amendments of putting green mixes and you should thoroughly study this information. Sand is your most important material. The right sand may be relatively expensive, but if it needs little or no amending and mixing it can be your best and less expensive mix. Your sand should have a narrow range of particle size distribution so its structure will not change under compaction. The particle size should be fairly small so as to have reasonable water retention and be suitable for proper top dressing. Your mix should not include materials that give you little or no benefit for their cost. There is a particular putting green mix that can satisfactorily meet your course's needs.

Parks Are For People[1]

Jack Sim[2]

The sign was so big it did not invite attention, but demanded it! In large letters were written the rules for the park hidden behind the sign:

No Pets Allowed
No Bicycles Allowed
No Ball Playing Allowed
No Picnicking Allowed
KEEP OFF THE GRASS
This is Your Park, Enjoy Yourself!

PARKS ARE FOR PEOPLE - for People to Use and Enjoy! I cannot stress too greatly the word Use, because if they are not built for people to use, then why were they built at all. This one criterion should be foremost in the minds of those individuals given the responsibility of developing parks for public use.

Americans are an active people, and to the majority a park is a place to do things. This is especially true when the entire family becomes involved -- perhaps the parents may want to relax, but the kids seek something to satisfy their interest and to burn up their energy.

Today's park users are seeking some place to have a picnic, play a game of ball, just sit and relax or pitch a tent, park their trailer or camper and settle down for a comfortable night.

A park can have as many types of use as the park department has planned for and will allow.

Most of our parks are Day-Use parks which people visit on a drop-in basis, some for an hour, some for the entire day. Here it is that a visitor may find organized recreation activities geared to all ages: playgrounds for the very young,

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Director of Parks and Forest, Josephine County Oregon, Grants Pass, Oregon

softball diamonds, tennis courts, horseshoe pits, lawn bowling centers, and even dance floors where teen-ager and senior citizen take turns "doing their thing". Picnic areas for families or groups offer an opportunity to the men of the family to burn steaks or hamburgers, as their pocketbooks allow. Parks where activities such as these take place are "happy parks"--a joy to play in and frankly a joy to work in.

The overnight camper, be he a local resident who lives a half a mile away from the park, or the traveler whose home base may be a thousand miles away, is becoming a more and more familiar sight in our parks.

Today, more than ever before, the American public is a mobile, traveling force, one which must be recognized and planned for. While the day-user and the overnight camper may appear to have two separate identities, I believe with proper planning a park can provide for both. In this way the best use of the land may be achieved and the needs of the public filled at the least cost. Aside from his campsite, the camper is seeking the same thing as the day-user, so why duplicate facilities when one can complement the other.

We have come a long way from the time a vacant lot served as a neighborhood park, and a wide spot in the road as an overnight campsite. True, areas like these are still used on an emergency basis, but the majority of the public will no longer tolerate this type of recreational facilities in public ownership. The park user, today, expects to find adequate parking, clean restrooms, playground equipment, and well maintained turfgrass in their day-use parks. The overnight camper expects well maintained campsites with modern hookups of electricity, water and sewers, clean restrooms, dust-free roads, and hopes for well maintained turfgrass.

Camping is fun, fun for dad if he has picked the right areas where he can hike, fish, swim, or loaf, as the mood strikes; fun for the kids, who can meet new friends and hike, swim, or fish, play ball, throw Frisbies, or acquire a tan. Yes, camping is fun for just about everyone except Mother. Mother finds that, except for a change of location, her duties are pretty much the same as at home, or perhaps a little harder. Mother must cook the food, wash the dishes, wash the clothes, and badger the kids to keep clean. It is mother, more than anyone in the family, who is wishing and hoping, (yes, even praying) that the next place they camp is not a dust bowl. When dad turns into an overnight park, it

is mother whose eyes sparkle the most when she sees the open area covered by an inviting mantle of green turfgrass.

Green is beautiful, yes, green is beautiful, especially when that green is well maintained turfgrass, with shrubs and trees in a public park. This is not my opinion alone, but one shared by millions of park users all over the world.

Given a choice, the public will utilize a turfgrass area rather than one covered by any other type of material, be it natural or man-made. This seems hard for some park planners to swallow, and they have spent thousands of dollars creating concrete jungles -- acres of concrete -- when all the public wants is a patch of grass where they can spread a blanket and have a picnic.

Divide any park in half, and on one half maintain a healthy turfgrass cover and on the other half use any other cover, be it bare soil with no vegetation, sand, or concrete; then put the same type improvements on each half. It would not take many days of observing the use pattern to convince you that there is something magnetic about green turfgrass--so magnetic in fact that practically all the people in the park can be found on the green half.

Parks are for people, but unfortunately some park personnel still believe parks should be designed and maintained, not for the public but for the convenience of the park maintenance crew. I have heard the statement more than once, "Yes, turfgrass is nice, but it's too much trouble to maintain." With this type of attitude one would wonder why these people don't find some other type of employment.

Turfgrass is more than "nice." I believe it is essential in today's parks. ESTHETICALLY, IT IS THE PARK! An expanse of green turfgrass means more than all the man-made playground equipment to the youngster who wants to run, tumble and roll; who likes to lie on his back and watch the clouds overhead, or to lie on his stomach and count the leaves on a patch of clover, hoping to find a four-leafed one. To mother it means cleanliness, a safe clean place for the kids and less worry and work for her. To dad it means a quiet place (something we tend to overlook) because grass acts as a sound deadener, and he can relax and read undisturbed. To the whole family it means the difference between just being in a park, and enjoying being in a park!

No one knows better than this group the problems that

come along with the first turn of soil, the first sowing of seed. But, really, are these problems or are they opportunities -- opportunities to plan, to plant and to develop an area where young and old alike can gather for outdoor recreation, for a chance to sit and "unwind" amidst a green oasis.

A man once said we should walk a different way each day, we should talk to people, tell them what we do, share our dreams, and then design your park! It might well make the difference between building a monument to stupidity, or a park filled with happy people thankful that someone cared enough to remember, after all is said and done, PARKS ARE FOR PEOPLE!

Solving Park Problems[1]

Roy L. Goss[2]

GRASSES FOR PARKS

The first consideration in developing turfgrass programs on parks is to decide the intended use of each individual area. If turf is to be established for aesthetic purposes only then we would recommend turf of one type. If the area is to receive considerable traffic, such as on play fields or football fields, then we would use a sturdier grass that will withstand more trampling and compaction. If the turf is to be used in shaded areas around trees, you may wish to use even a third mixture or type of grass. Therefore, the intended use of the area is the prime consideration.

The second important factor is the soil. Aesthetic areas will respond to almost any type of soil provided it will drain reasonably well. As we all know, grasses will grow on practically any kind of soil, provided there is some depth for water-holding capacity and the soil is not impervious to root penetration. The problems on many of our areas begin when we bring in the traffic factor. A good suggestion for lawns for aesthetic areas, would be to use a sandy loam soil. Soils even as heavy as silt loams and sandy clay loams can be used as well, but require a little different system of watering and management.

If the intended use of the area is for play and recreation which receives considerable traffic, then sandier or lighter soils should be considered. These soils must drain rapidly so they will reach moisture equilibrium, as rapidly as possible, after rains.

Underground drainage may be necessary in many of our areas. If the soils are not deep and highly permeable, then drain tiles should probably be installed, particularly in the areas of intensive use. These lines should be installed

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Associate Agronomist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

after the area has been graded prior to planting. It is important, however, to place the drain lines over one foot deep in order to establish good capillary pull or drainage channels into the tile lines. Tile lines established shallower than one foot may not function very well. It is important, of course, to backfill the tile lines with permeable material so some surface water may enter the tiles as well.

The question is frequently asked what can we do with our area because we cannot afford to bring in one foot or more of good sandy soil. The following system briefly described, has been tested and proved satisfactory as a second best approach on difficult sites. Areas intended for heavy traffic can be drained with subsurface lines, subsoiled with good chisels to break up hardpan or compacted soils, graded to the proper grade, preferably with some surface contour toward the drain lines, and last, coated with about 3 inches of sand of putting green specification (falling approximately between 1/4 and 1 ml in size). This three inch coating of sand will prevent the heavier soil beneath from puddling and compacting and provided that the soil has any permeability rate at all, the sand will provide a cushion so this rate will not be lost. As you know, most soils undisturbed, will percolate water at a fairly good rate unless they are puddled or compacted. Therefore, with some protection, we may be able to maintain good permeability rates. This is the purpose of the sand. These sands can be fortified with any good organic additives to maintain better water holding capacity, resiliency, etc. and then planted to the desirable grass for the intended use.

The third step - the grasses themselves. The big question is which grass for which area.

1. Aesthetic purposes only.

   In areas West of the Cascade mountains, bentgrasses and fescues are better adapted, particularly the bentgrasses. Regardless of the type of grass that is planted, the eventual turf will be bentgrass. Therefore, it is suggested that whatever mixture is used, at least a small percentage of bentgrass be added so the bent will take over uniformly rather than to establish in patches. A mixture of 60% red fescue and 40% Colonial-type bent has been used successfully for many years. It is not necessary to add as much as 40% bentgrass, so if you wish, you

may increase the fescue content up to 80% and add 20% bentgrass. A second, or alternate planting for these areas, would be to use at least 50-60% improved Kentucky bluegrass such as Merion, Fylking, Windsor, Cougar, Newport, etc. and add about 30% red fescue and 10-20% Colonial bentgrass. These areas should be seeded at approximately 100 lbs. per acre, however, small seeding rates are satisfactory provided good seed beds and good seeding equipment are employed. For bluegrass fanciers, pure stands of bluegrass can be planted for aesthic purposes but there is no guarantee that they will last.

Shaded areas intended for picnicking or general use, would benefit from higher levels of fescue. A suggested mixture for such an area would be about 80% red fescue and 20% Colonial-type bent. The fescues have been found to withstand about as much shade as any of the other so-called shade-tolerant grasses, although under these conditions, no grass will stand up to excessive traffic. Although ryegrasses are not noted for withstanding excessive shade, the improved ones, such as Manhattan may be planted in some areas with some shade as long as there is more than minimum light requirements.

Play and athletic areas should be planted to either bluegrass mixtures or ryegrasses. The improved bluegrasses have proven to be very effective in areas of heavy traffic. They will withstand considerable trampling. After injury, they will recover quite well due to the rhizomatous habit of growth. Thin stands will become more dense from rhizome development. If the area is not used extensively, small amounts of bentgrasses or fescues may be added with the bluegrass for long-term cover.

The perennial ryegrasses, particularly varieties such as Manhattan, work very well on many play areas. They respond well to traffic as long as they are not worn out completely. The rygrasses will not regenerate growth if the crowns are destroyed, since there are no rhizomes. If the effect is mainly trampling, they can withstand considerable amounts of this type of traffic. It is even reasonable to mix improved bluegrasses and ryegrasses together in the same planting. They are very compatable, roughly the same color, and respond well to management. A suitable blend of ryegrass and bluegrass would be approximately 40-50 lbs. of bluegrass and 100 lbs. of ryegrass combined per acre. If bluegrasses are

planted alone, they should be planted at the rate of 80-100 lbs. per acre.

One important feature of ryegrasses is their growth during cool weather. Bluegrasses growth tends to slow down after frost and before conditions warm up in the spring. The ryegrasses make some growth all winter west of the Cascades and resume growth earlier in the spring than bluegrasses. Parks, however, are used very little during these periods of inclement weather.

The fourth important principle is management. In a brief statement we can say that aesthic areas should be managed much the same as we would a home lawn. If we use a 3-1-2 ratio fertilizer then we should aim for 6-8 lbs. of available nitrogen per 1000 square feet annually for the greatest beauty. Four lbs. per 1000 square feet of nitrogen from this ratio is about minimum. Eight lbs. of nitrogen per 1000 square feet from the 3-1-2 ratio should be applied to areas receiving heavy traffic. Four lbs. of nitrogen per 1000 square feet is probably satisfactory on general use areas. These rates may seem high to some park superintendents. It has been shown, however, in research at Puyallup, that these rates of nitrogen balanced with phosphorus and potassium will help to control weeds in turfgrass areas. Lower nutrition encourages heavy weed growth. The amounts of nitrogen, phosphorus and potassium suggested above, should be divided into 3 or 4 individual applications for maximum benefit to the turf.

Many other practices need to be carried out to maintain good turf conditions. Of them, mowing is probably one of the most important. The aesthic areas should be mowed at heights recommended for lawns which is 3/4 inch or less in west coast areas. All the other general areas and recreational areas should be mowed at 1 1/4 to 1 1/2 inches in height, particularly if they are bluegrasses or ryegrasses. One important thing to keep in mind, also, is that bluegrass areas require higher pH and more lime than bentgrasses and ryegrasses. The pH should be maintained at 6.0 or higher, and this usually requires annual applications of lime in this particular area.

For areas East of the Cascade mountains the same general recommendations can be made except all areas should be planted to bluegrasses except under dense shade. Here again, mixtures with high amounts of fescues will produce better turf than

bluegrasses alone. Ryegrasses may be used East of the Cascades, but, for the most part, bluegrasses are best.

Most areas East of the Cascade mountains have adequate amounts of phosphorus and potassium and would require only nitrogen. Likewise, little or no lime will be required in these areas. The safest bet, whether it is East or West of the mountains, is to obtain soil tests first before applying lime, phosphorus or potassium.

Personnel Management and In-Service[1] Training For Golf Courses

John Zoller[2]

I would like to present to this meeting a matter which should be of interest to us all, and one in which we all share a responsibility. This responsibility is one of propagation of our own profession. Of immediate concern to us should be the problem of where the young men will come from who go into this work. Schools of higher education would be a good source, but in most cases this does not meet the demand. In the first place, the motivation is lacking for them to study this in school. Scholarship money that is available is not being used. Last year the Evans Scholarship Program had more scholarships available than applications for it.

To my knowledge, there is not one student at Oregon State University specializing in Turf Mangement. I am not sure of the number at Washington State University, but it is not many. I know of only one man in Oregon whose goal, at the start of school, was to become Golf Course Superintendent. We have to stop filling our ranks by accident.

What is the solution to this problem we are talking about? One of the best ways would be to interest young people in our employment to follow Turf Management as a career. Almost all clubs hire part time and student help sometime during the year. This make an ideal source with which to start. It can be pointed out that the rewards for golf course work are improving all the time, and even at present offer beginning salaries equal to any other field.

Another plan that has merit is a Coop program with Community Colleges. Most cities now have a Community College program and these schools are aware of the need for trained turf-managers. Lane, Linn Benton, and Multnomah are three such schools that I know of. A Coop training program would be of benefit to both the school and the club. We, at Eugene

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Superintendent, Eugene Golf and Country Club, Eugene, Oregon.

Country Club are ready and willing to participate in such a program. The more we up-grade our profession as a group, the more we will benefit individually.

Much has been said and written in the past about improving the image of the Golf Course Superintendent. A few years ago we went through a white collar and tie era. I am strongly opposed to this. To me, there is no better way to know the condition of the fairways than to sit on the tractor and mow eighteen of them. The same holds true for tees and greens. In some ways this is even better than playing the course. It is not necessary that we try to be something other than we are. The advantages of golf course work are evident and it is not hard to point them out.

In this next year, let each one of us make a project to interest one young person in preparing for a career in Turf Management, and in so doing we will all benefit.

Are You a Good Boss[1]

W. H. Bengeyfield[2]

From 60 percent to 70 percent of your operational budget is spent on labor. It is an indispensable part of maintaining the golf course. And it is your job, as superintendent, to develop and hold a contented, loyal and efficient work force. Human relationships are involved. Good supervisors constantly strive to improve their skills and techniques in handling people successfully. Are you getting the most out of your labor dollar?

American industry has found that good labor management pays off. Large companies continually train and retrain their supervisors in this important field. The following thoughts and facts are time tested and have been used by successful employers for years. If you will spend a moment or two in analyzing them, you too may become a better boss.

YOUR WORKERS REFLECT YOU

No where is there a force of wholly satisfied workers. Each individual has certain abilities and shortcomings. Inexperienced handlers of labor, when confronted with an employee problem first think of "firing" the worker. This is the easiest way, but usually the wrong way to handle the situation. It costs money to hire and train new workers. "Firing" does not always help you do a better job. The employer who has an excessive number of terminations is usually the one at fault, rather than the employee.

Set a good example since everyone tends to imitate others. Your employees are influenced constantly by your example. Many times they are not conscious of this, but it is true nevertheless. What you are, your workers will become. Set a good example for them at all times.

ACQUIRE THE ABILITY TO HANDLE PEOPLE

Some employers are much more skilled than others in

1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Western Director, USGA Green Section, Garden Grove, California

gaining cooperation and enthusiasm from their workers. Such skill is not a mysterious gift, but is the direct result of knowledge and training. First, however, you must have a sincere desire to be a good boss.

Look ahead and be prepared to answer your employees' questions. Be ready to interpret and explain your orders, rules and policies. It's easy to say, "these are the rules." But it will be far more rewarding to take time to tell the employee why the rules are necessary and why you expect him to follow them.

EMPLOYEES WANT TO KNOW

One of the main reasons why an employees' thinking often gets twisted is because he does not have all of the facts and comes to the wrong conclusion, wrong impression and develops the wrong attitude. The less you hold back from your workers, the better you can defend your orders and policies. Tell why if possible. Get him to accept the change. Always tell employees in advance of changes that may affect them. This is an important rule and one not to be overlooked.

Impress each worker with the importance of his job and that he is a vital part in the function of the entire maintenance operation. An employee whose work is unnoticed comes to feel that his job is unimportant and quickly his efficiency drops. If it is unimportant to the boss, it is certainly unimportant to the worker. The wise superintendent, no matter how busy, will find time to show an interest in his workers, even on the most minor jobs.

GIVE PRAISE WHEN DUE

Don't be afraid to give praise. You may pay cash wages in weekly or monthly checks but you pay mental wages by expressing appreciation for a job well done. Mental wages pay dividends. A word of encouragement is needed now and then just as one needs food. Employees will work just as hard for mental wages as for cash wages. Cash wages provide physical needs, but mental wages provide mental needs.

When possible, praise in the presence of others. This impresses the employee receiving the praise with your sincerity and encourages others to merit your approval. But don't give praise too freely. Save it for the unusual job. A just praise to the individual. A few egotistic individuals may

"be carried away," but an occasional pat on the back is all that is needed by most workers. An indirect and effective method of praise is to ask an employee for his ideas. This gives him a sense of importance and helps sustain his ego. Besides, you may learn something along the way.

BE A SQUARE SHOOTER

When a worker comes to you with what may seem a small complaint or grievance, listen attentively to the entire story. Remember it is important to him. Don't cut him short. Sometimes just listening to the grievance may be all that is needed. If you fail to handle complaints and grievances, you may be heading for real trouble. Remember, it's the little things that count.

You cannot keep the respect of your employees unless you play fair and shoot square. Don't favor those whom you like. Let no man say that you have "friends" among your workers. Don't cheat or chisel in any way and always give employees the benefit of the doubt. Be sure to treat everyone alike. Make a conscientious effort to understand and like those who "get on your nerves."

BE A GOOD INSTRUCTOR

Haven't you heard many people say, "I've told that fellow a dozen times how to do that job, and still he doesn't know how." This shows that somebody has done a poor job of training. "Telling" is not instructing.

Instructing is telling, plus showing, plus tryout performance and follow-up. Let the worker do the job. You ask him questions. Let him ask you questions. Before putting him on his own, make sure you know that he knows.

USE EACH PERSON'S ABILITY

Part of your job as superintendent is to discover hidden talent. When a man shows he has abilities that will enable you to give him greater responsibilites and more important tasks, use them if you can. There is nothing more depressing to an employee than the feeling that his abilities are not being employed to best advantage. Look upon your workers as potential candidates for better jobs. Don't try to keep a good man down for fear of losing him. Encourage him to improve his abilities whenever possible. You will benefit.

He will benefit. All this creates loyalty toward you; the quality you want most to foster in your workers.

DON'T TAKE YOURSELF TOO SERIOUSLY

Don't confuse dignity with seriousness. Be cheerful and your whole crew will reflect your good nature. Do not ridicule or be sarcastic, or play practical jokes. One of the bitterest things an employee can say about a boss is that he is sarcastic. Good natured kidding is alright if you are sure the employee is taking it in the spirit it is given. But here again, you must know your man. Relax, don't be a stuffed shirt.

Patience, tolerance, tact, and an honest desire to be a good boss will go a long way toward creating and maintaining labor relations on your crew.

This business of labor management is a big subject and a never-ending one. Constantly refresh yourself by reviewing the above principles. "Being a good boss" pays dividends to all concerned; and this includes the boss himself.

The Importance of In-Service Training[1]

Tom Keel[2]

In this day of high costs of labor and equipment and operations an administrator must always be on the lookout for ways of training personnel. In our type of work today with the maintenance and construction of parks, golf courses and other recreation facilities, it is impossible to hire specialists for every job. Therefore, we must train our personnel to handle more than one specific duty.

Personnel working for the department should have basic skills in plumbing, installing and repairing irrigation systems, mowing, aerifying, verticutting, concrete work, pumps, etc. Another item of training that is important is the ability of personnel using tools and equipment to keep it in working order. I have personnaly seen a lot of waste where good equipment is heavily used but not maintained so the result is many expensive breakdowns and loss of time. Golf course and park equipment is expensive and in most cases the funds in the operating budget is not plentiful so it is important to take proper care of what you have. In the operating of equipment, I have found that some people have a special ability to handle certain equipment better than others however, I still find it important that they all be instructed to maintain it properly.

If a crew is well trained and can handle more than one or two specific jobs, the work schedule is still usable should an emergency arrive due to illness or accident because you can switch your trained personnel around. In the case of vacations, you have people trained to fill in when others are gone. Even though you will still have to hire extra help, they can be hired to do the more unskilled duties and your permanent crew can handle the more skilled work.

The way we have found in our department to train our crew to handle the different types of jobs is "in-service training". What is "in-service training"? The definition I like to use

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Director, Douglas County Parks Department, Roseburg, Oregon.

is the training program set up within your own department. Whether you teach it within your department or handle it outside, it still is sponsored by your department. I would like to discuss three areas that "in-service training" are available.

Area 1 Adult Education: In most areas there are classes offered in adult education. These are generally held in the evening hours so men can attend with no loss of work time. I feel the golf course or park department who will benefit from this man's education should pay the tuition and costs of his required books or supplies. These courses are usually inexpensive and close at hand.

Courses we have found available in adult education suitable for our use has been Carpentry, Welding, Small Motor Repair, Equipment Maintenance, Safety and many others.

Area 2 Junior Colleges: "In-service training" is available at the many local community and junior colleges. The growth of these small colleges in the state of Oregon is tremendous as, I am sure, it is in all the western states. You may have such a facility in your area.

We have found that even though there are few courses at present that would be of benefit to people interested in turf management, in most cases, the college is open to suggestions and are willing to handle these courses with assistance from trained personnel and a guarantee of a minimum number of students; usually ten. Some of the courses available in our local Umpqua Community College are Turf Management, Weed and Disease Control, Recreation Facilities in Forestry, First Aid and Safety, etc. Again, the majority of these courses are held in the evening so personnel can attend without loss of work time.

In our department we have the belief that anyone can take a course if that person is interested. The department pays his tuition and required supplies. His books are bought by the department and after the course is completed, retained in the Parks Department Library. I feel that whenever possible, the department should handle these costs as the employer benefits as much as the employee. Also, compensatory time is given for those who complete the course; those who start and do not finish receive none.

Area 3 Departmental Training: The last area I would like

to talk about today is what you can set up in your own department. I doubt there is one golf course superintendent or parks director here who doesn't have some "in-service training" going on whether he is aware of it or not. There is no reason everyone here can't participate in this for the benefits are well worth the time. For any training program you must include every man in your department who is interested in the course, not just the key members.

An important fact to consider before setting up any "in-service training" program is that the person handling the instruction should be made aware of what you are trying to accomplish so that his instruction is appropriate and not off on some other avenue. I have attended too many sessions where the main topic is lost. For example: the topic may be "New trends in irrigation" and the instructor starts talking about one specific type of irrigation head. This information might be of interest to you but it is not why you came to the class. Also, sometimes, the instruction is too technical when it isn't needed. Another problem is the instructor who tries to cover too much at one time. Give plenty of class hours to important items. You can always set up more classes later on to cover other topics.

In our department, the crews divide into Construction, Maintenance, Park Caretakers and Information Center Receptionists, Green Thumb Crew, Youth Employment and Summer Help. Each of these crews is very important and should receive equal training in their own field. We have found it is a moral builder if they are part of the over-all picture and included inside, or outside, training sessions.

Our construction crew is well-trained construction personnel and most of the training they have received has been through "in-service training" or "on-the-job training," either in our department or sponsored by our department.

Some examples of their tasks is building structures for some of our areas. Construction of boat ramps, both on the coast and inland, roads, walkways, considerable concrete work, installing irrigation systems, water systems, sewer systems, cleaning along with developing park and recreation areas and overnight camping areas. Frequently the weather in our part of Oregon is kind enough that we are able to do the majority of our work during the winter except at the coast.

By the department doing the majority of the construction,

we have been able to save considerable money and therefore, help sell our budget to the budget committee. Also, we have been able to put out to bid the type of construction which takes private enterprise to construct.

Our regular Maintenance Crew is busy the year around maintaining the 50 developed park areas and Salmon Harbor. They are responsible for maintaining the buildings in our park areas, including water-front areas, turf areas, clean up, garbage handling, etc.

The Caretakers and Information Center Receptionists help with the maintenance of the overnight camping areas and are much involved with public relations. These caretakers also collect our camping fees. The above always work together and if either one of them has a working problem it affects the over-all program.

The Green Thumb Crew is made up of older men who are retired. They work under a federal program through the National Farm Bureau Association where the county is to show a 20% contribution. This is shown in the form of supervision, instruction on use of equipment, etc. This we have found to be an excellent program.

We hold a general discussion session with the Green Thumb Crew. From these sessions, we have worked up an improved work schedule for them and the men who assist them in their areas.

The Youth Employment is a sort of counterpart for Green Thumb. These are 16 to 18 year-old boys helping in the development of the park areas by building trails, clearing brush, painting, etc. We assign one boy at a time to an overnight camping area where he assists the caretakers for a period of one or two weeks at a time. This is a period of real "in-service training". During this time they help paint tables, clean fireboxes, mow turf areas, empty garbage, etc.

We include these young people in any department meetings and this has been a help to them and given them a feeling of belonging and being a part of the department. Also, they and their assigned crew feel more closely united. We have found that the generation gap is not a problem in our department and that the old-timers and the young fellows get along well.

The summer crew is made of young men who are enrolled in

college or technical school. They are used in both the Construction and Maintenance crews.

During the course of the year conferences, seminars or workshops are held. Again, I want to emphasize that any personnel who would benefit by the particular session should be included.

Staff meetings, held once a month, where plans, problems and aims of the department are discussed are excellent for communication. These general "bull sessions" often produce ideas that are of real value.

Be sure to include yourself on the "in-service training" program even though you are involved in setting up your program for your department or staff. You, as the top supervisor, should always take part in training sessions to better yourself. A good example is the conference you are attending now.

Another reason that "in-service training" is important is when it comes time for salary review. If you can show that your people have received additional training during the year, this helps you justify an increase. This has helped upgrade our personnel's salaries and job positions.

In conclusion, I feel that it is very important when any recreation oriented agency, whether it be parks, golf courses, or others, to have a strong "in-service training" program for the benefit of both the department and the public who they serve.

Proper Specifications for Irrigation Systems[1]

Roger L. Gordon[2]

I used to think that a lack of competent designers was the major bottleneck in the irrigation industry, but over the past several years I have begun to realize that it is not that simple. The other side of the coin is that the people who purchase the systems generally know very little about what they are buying. They do know the difference between a higher and lower price, however. As a result the sellers of systems are not forced to come up with a better total product but must respond instead to a demand for the lowest price. Too often this means that when a new product such as a controller or valve is introduced, it will be used as a sales gimmick or to somehow make the total system cheaper.

In view of this, I would like to say a few things about what I feel the procedure for obtaining a good irrigation system should be. Then we will get somewhat more technical.

First, the evolution of sprinkler equipment in the last ten years has been phenomenal. Yet most systems which go into the ground today are no different and no better than the ones built ten years ago.

For instance, in large areas like golf courses or parks, it is possible to have central remote programming in one place for a great number of automatic sprinkler controls in the field and to have the sprinklers connected to these field controls according to their individual area requirements. By doing this we eliminate wet and dry areas, we use no more than the minimum amount of water to maintain the plant, and we can compensate for climate variations instantly at one convenient location.

Allowing that we have had some inflation in the last few years, this system will cost no more than the system of five or ten years ago did in its day. But, too often, people are still getting the system of five or ten years ago and paying today's prices to get it. What I am trying to say is

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1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Landscape Irrigation Consultant, Redondo Beach, California.

that with all of the new products and possibilities, it is a full time job to keep up with them and to creatively put them to work for us in the most efficient way.

The first thing that a system purchaser should do is to acquire a knowledge of the criteria for judging the basic theory of a sprinkler design and the competency of the people he is dealing with. We will discuss some of these criteria shortly. He should use this knowledge to hire a consultant to do the actual technical part of the project. With his knowledge of some of the important requirements of his project, the buyer can be of great assistance to the designer and can assure himself that the requirements are being met in the design.

The designer should be retained to prepare complete plans and specifications for the system. They should spell out exactly what he wants and how it is to be installed.

The buyer and designer should at this point make up a list of qualified system installers to consider for the job. They should be selected on the basis of past experience with similar projects, financial responsibility, and reputation for conscientious performance and warrantee service.

Next comes staking of sprinkler locations and lines in the field. Since the buyer is going to pay for this service regardless of who does it, it is only logical that he hire the designer for this service. This keeps the designer on the job as an observer and inspector much more than normal, particularly during the early phases of the installation and is added insurance that the work will go smoothly as planned. I am really amazed that this is not done very often. Most of our projects are done this way. After all, the designer is the only person involved who is familiar enough with the theory of his design, safety factors, and flexibility to be able to make field changes safely and economically.

Finally, we have as-built drawings of the system as it is installed. If you think about it, the typical sprinkler system as-built drawing (if, indeed, one is ever made) is usually nothing more than an original construction plan with a few changes reflecting equipment added or deleted during installation.

In order to keep preventive maintenance and repair costs to a minimum, we believe that, in most cases, the plan should be re-drawn to reflect actual locations of all equipment with

dimensions to all valves, etc. which might be difficult to locate with the passing of time. After all, the original plan was prepared for a construction crew to use in bidding and installing. The as-built plan will be used by the owner or his employees for maintenance purposes. These are vastly different things. Since most contractors are not prepared to go to this extent, it again seems logical to me that the designer should be given this function. Again, most of our projects are done this way, and yet it is the exception rather than the rule. Along with the as-built drawings we give the owner a Watering Program and instructions for it's implementation.

So far, we have been considering what we feel is the necessary procedure in obtaining a good irrigation system. But, what about these criteria we mentioned earlier that a buyer should familiarize himself with. Well, they are some of the basic rules of good design and good installation practice.

The first step in design is the gathering of information. We figure that the more you know about a project, the more value you will ultimately get from the investment. The entire economy of the system and it's operation from the day you buy it to the day you replace it will be determined right here and now on the design board.

The site plan should be obtained, for larger projects at least, from accurate aerial photography. You must have a topographic map of the area with at least 5 foot contours (2 foot contours are better). These are often available from various sources. If they are not, have them made for you by a good aerial survey company.

You should have a planting plan for locations, sizes and varieties of the various grasses, ground covers, shrubs and trees.

It is helpful to have as good a reading as possible on soil types. These may vary throughout the site, but you should always know the worst areas from a water penetration standpoint and their extent.

Climate information is very important. In addition to knowing the various seasons and their extremes, we are particularly interested in normal temperatures, humidity, rainfall, and wind velocity and direction. The design should be based on what you consider as the worst time of the year

from a watering standpoint. Long days, excessive heats, and winds are some of the most critical factors.

Next we should consider what the areas are to be used for. Obviously, such areas as the lawns on a private estate, a football field, a little league ball field, a golf course, a city park, and landscaping along a freeway will all receive different treatment, and varying degrees of quality of maintenance. In the way of illustration, there is a little league ball field near my home which has a well designed and installed, highly sophisticated irrigation system. However, the area is maintained by volunteer help (fathers of the aspiring ball players), most of whom have little or no knowledge of the system or its operation. As a result, the system has never operated up to its potential and is continually mishandled and unmaintained so that it is in constant need of repair. They should have had the simplest type of system possible. It may not have done as good a job under ideal circumstances, but would have been better than what they have. By contrast a golf course has a continuous full time maintenance crew and program and should definitely take advantage of the economy of a more sophisticated system.

Next, know what your water supply is. Be able to describe it both quantitatively and qualitatively. How much water is available in gallons per minute and at what pressure is it available? Are there pumps, reservoirs, wells, water meters, involved? If it is a well, have a test run to determine water quality (chemically), quantity, draw down, and whether sand or other solids are being pumped. If you have one or more existing pumps, obtain performance curves and a description of the starting controls from the manufacturer or company that installed them. If pumping from a reservoir we need to know the total gallonage available, how and at what rate is it filled, how good is the water from the standpoint of algae, weeds, etc., and how is the water screened before entering the pump. For a city water service we need to know the size of the service and static pressure (normal and during peak use periods.) For all of these water sources, we need to know their elevation relative to the area to be watered.

Next we need to know where to obtain a source of electric power. If a pump station is involved, check the availability of 220V and 440V - 3 phase power and whether or not the power company will allow across-the-line starting or require an increment start. For the system automatic controls, a source of 115V - 60 cycle power of fairly low amperage will be required.

Another important thing which must be checked is the various building code requirements. The Health Department and Plumbing Department will no doubt dictate the type of backflow prevention devices required for metered water services and the Electrical Department will have code requirements which will determine whether underground wiring is in conduit or direct burial and how deep it is. Be sure to check all of the requirements with regard to the type of project. I have found an amazingly wide variation in codes from one area to another.

If only part of the area is to be developed now and the rest later, take this into account by providing adequate water and power for the total project along with sufficient pipe and wire size to accomodate the future expansion.

Most of the things I have been talking about will be done by the designer as part of his service. The person buying the system should be aware of them so that he can make sure that they have, in fact, been considered.

Next, I would like to run down what I consider to be some of the major critical design criteria.

1. Sprinkler Head Spacing - Triangular Spacings stated in manufacturers catalogs are often rather idealistic. If you stick with the following rule, you will be on safe ground except under extreme conditions:

   Lawn and shrub sprays -- 60 - 70% of the diameter of coverage of the particular sprinklers.

   Rotor pop-up or above-ground agricultural type impact sprinklers -- 50 - 56% of the diameter of coverage.

   Spacings greater than these will operate very poorly at best in even a light wind condition.

2. Precipitation Rate and Water Requirements

   Presume the following sample system:

   Sprinkler - Rotor pop-up - 20 GPM
   Spacing - 70' triangular

To figure the rate of precipitation, use the following formula:

$$\frac{GPM \times 96.3}{(Sp)^2 \times .866}$$

In our Sample:

$$\frac{20 \times 96.3}{(70)^2 \times .866} = \frac{1926}{4243.4} = .45 \text{ inches per hour}$$

For every hour operation of the entire system, .45 inches of water will be applied. If you need one inch of water per week every sprinkler will have to operate for 2.2 hours or about two hours and twelve minutes.

Normally, of course, a system is not designed to operate all at one time because of water supply limitations. On large systems, it may take as many as 20 to 30 consecutive increments to finally cover the whole area. If each increment must water for two hours and twelve minutes (our sample) and it takes 30 increments, then our total watering time for 1" per week will be 2 hours and 12 minutes x 30 - 66 hours per week.

Now you can begin to see that in some areas where watering time is restricted, we can have a problem. Unfortunately, a common practice to cut the price of a golf course system has been to reduce the quantity of water supply requirement and therefore, pipe sizes. If you are unaware that this means you will be watering while people are golfing, it is easy to fall prey to this trick. On paper the systems may look almost identical.

3. Piping and Pipe Materials

The theory and history of pipe materials is an entire subject by itself. We have not the time here to delve into it deeply. Suffice to say that polyvinyl chloride (PVC) pipe and fittings are the most common ones being used in our industry today. In smaller sizes and for lateral sprinkler lines we use mainly a solvent welded joint. In

larger sizes for mainlines, we are using PVC with a rubber ring joint more and more. In sizes 6" and over we consider the relative economy of asbestos-cement and, if the comparison for an individual project is favorable, we use that. Rubber ring PVC has been available in only class 160, but class 200 is starting to appear. As long as our static and operating pressures do not get much over 125 PSI and our velocities are under about four or five feet per second, the class 160 PVC is adequate. If pressures must run abnormally high for some reason, we would go to an appropriate class of asbestos-cement. For a variety of reason, the smaller lateral lines seem to take the greatest abuse from pressure surges and physical beating due to surface loads transmitted thorugh the sprinklers etc. Therefore, we normally increase the class of pipe on the laterals at least one class. On golf courses we use class 160 in the mains and class 250 or 315 in the laterals.

When calculating pipe sizes for a particular system (presuming all heads are of the same general type) the maximum and minimum pressures anywhere in the system should be within a range amounting to about 20% of the operating pressure of the sprinkler and in no case should the minimum be less than the design operating pressure.

4. I suppose I would be remiss if I did not mention the endless controversy between hydraulic and electric controls for automatic systems. We have always taken the stand that we try to solve every problem in the most economic way consistent with good design and operation. In this case, the problem is to open and close a valve within certain time limitations and with an eye toward uniform response and years of trouble-free service. Over the years we have certainly done a great many hydraulic systems which satisfied these requirements very well. Also, hydraulic has always had an advantage in terms of cost. In areas where the winters are cold, freezing can cause a certain amount of problems and the design of the control system becomes very critical if there is substantial elevation differential on the project site. In addition, there seems to be an increasingly greater variety of equipment and features in electric controls. For

these reasons we have been doing more electric than hydraulic recently. Each case should be decided on its own merits, but electric seems to be gaining a foothold. However, if wire prices do not settle down, this could be an influencing factor.

5. Material and Installation Specifications

Most every piece of sprinkler equipment that I can think of at the moment, be it sprinklers, valves, controllers, pipe, or what have you, is of itself a more or less well designed, serviceable item which which has a place in the industry.

One of the things we watch out for during the design phase is that all of the equipment works well not only as an individual, but is compatible with all of the rest of the system components to make a smooth and efficient assembly.

When writing specifications for the materials we try wherever possible to allow alternate brand names or materials to be submitted. It is important that the specifications be written clearly in a way that does not allow an incompatible group of materials to be submitted.

Installation spcifications should spell out the type of performance we expect during installation. Naturally, they should cover such things as how deep the pipe is to be buried and set standards for compaction of backfill of excavated material. They should also set standards of care and repair of existing sod and plantings. If the project is an existing one that is in use or a new one under construction, it should be carefully spelled out how much interference with these other activities will be allowed. We do a great many system replacements on existing golf courses and our specifications spell out very clearly that we will not close a hole to play. Construction must go on without disrupting play. The loss of revenue in closing a golf course down is far in excess of the small premium you pay for this type of installation. Detail drawings should accompany the specifications to clearly cover such items as swing joints on the sprinkler heads. A

swing joint is a fitting arrangement between pipe and head which allows the head to be set straight and exactly to grade, but its main purpose is to protect the pipe from damage which can occur from surface loads applied to the sprinkler head. All sprinklers on all types of systems from residential to golf courses should have some form of swing joint.

To sum up, every system should be built using only the best quality materials properly installed. Do not save money by cheapening. If costs must be reduced, do it by eliminating some of the less important features of operation or by saving a small area for future installation. Above all, do your economizing on the design board, not after you start construction.

A Look at Oregon Parks - Their Lawns, Play Fields and Golf Courses[1]

Willard Lighty and Wilbur L. Bluhm[2]

Survey questionnaires were sent to 85 Oregon city, county, and district park administrators during July, 1970 to gain information on parks turf programs. Of the 85, 62 responded. The information sought, and received, is summarized in this report. The state was divided into four geographical areas for this report.

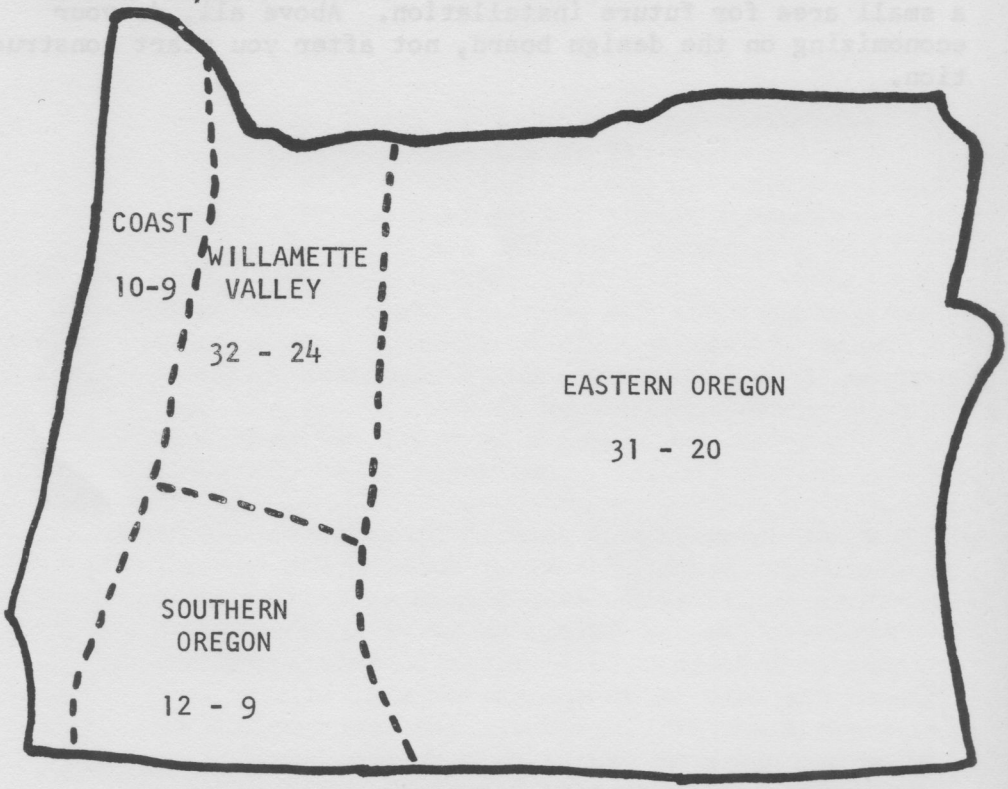

Figure 1. Number of Oregon Parks and Recreation Systems and the Number Responding to the Survey. First number, preceding the hyphen, in each region indicates number of systems to whom surveys were sent. Second number, following hyphen, indicates the number of systems responding to the survey.

1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Area Extension Agents, Oregon State University, Corvallis.

This survey did not include parks facilities operated and maintained by port authorities, various federal and state agencies private ownership, and others than those previously mentioned. Of the 85 which were surveyed, 10 are said to have no parks acreage. The other 75 have approximately 36,000 total park acres. Of those which responded, 53 report maintained turf acreage, 5 have no maintained turf acreage, and 4 have no parks acreage. About 12% of total parks acreage surveyed is in maintained turf. The managed turf is divided about equally between lawn type turf and athletic-golf usage.

Table 1. Total Park and Park Turf Acreages

	Total Acres in Parks			Acreage Maintained as Turf		
Region	Number Reporting	Acreage	Ave.	Number Reporting	Acreage	Ave.
Coast	8	5482	685.3	8	181	22.6
Will. Valley	23	14523	631.4	21	2160	102.9
Southern Ore.	6	8919	1486.5	6	1113	185.5
Eastern Ore.	15	1986	132.4	15	210	60.0

Several parks systems reported to be in various stages of development. Turf programs of these parks often have a lower priority than other parks programs. Several respondents indicated that turf maintenance levels would increase with maturity of the parks system.

Not all respondents answered each question in the questionnaire. Certain questions were not applicable or were unanswerable for some departments. Therefore, some discrepancy in number responding to a given question and number of total respondents (62) will be noted in the information which follows.

No recommendations on administration or management of parks and parks turf programs are intended or should be implied. Nor do results of this survey necessarily indicate desirable or undesirable parks turf management practices.

We greatly appreciate the fine efforts of those who cooperated with us in this survey, and thank them for their help. We hope this report will be of interest and use to them, as well as to others who may, in one way or another, be involved with parks turf programs.

Budgets and Budget Allocations

Budgets of parks systems surveyed range widely, but generally in proportion to population, from a thousand dollars

and less for a number of smaller systems to over a million dollars for several of the larger systems. These budgets are likely to include entries for construction programs, recreational programs, swimming pools, and other facilities as well as turf maintenance and establishment.

Smaller budgeted parks systems tend to use a larger proportion of their total budget for turf maintenance than do those systems with larger total budgets. Parks systems with one or more golf courses tend to devote relatively more of total parks budget to turf maintenance, and the more golf courses maintained, generally the relatively greater amount of total budget spent on turf maintenance.

Seven parks systems surveyed, with total budgets ranging from $130,000 to $975,000, spend on average of 10.6 percent of this total budget on turf maintenance. The range is from a low of 4.3 percent to a high of 54.3 percent.

Ten smaller systems, with total budgets between $200 and $90,000, spend an average of 50.4 percent of their total budget on turf maintenance. The range is from a low of 7.3 percent to a high of nearly 100 percent.

It is difficult to interpret and make conclusions on budgetary matters from the survey. It would appear that many parks departments have unique accounting systems in that they differ from those of other departments. Costs are reported or allocated in differing ways. Many of the smaller departments and districts apparently do not have resources for cost analysis accounting systems. It would appear that, becauce of these factors, the average turf maintenance percentages, given above, are somewhat conservative, especially for those departments with the smaller total budgets.

Some parks systems receive certain turf maintenance items, such as irrigation water and equipment, pest control, and fertilizer, directly from city or county governments and outside of the parks budget. Some are provided labor from a local government labor pool. These are more likely situations with smaller parks systems. Advantages and disadvantages were both expressed on these arrangements.

Nine parks systems reported spending an average of 5.0 percent of their turf maintenance budget on irrigation, and 2.7 percent of it on pest control. Eight spent an average of 9.4 percent of their turf maintenance budget on fertilization, and seven averaged 3.2 percent of this budget on

renovation. Relative amounts allocated to each of these maintenance practices for different types of turf - lawn, athletic and play field, golf - is not uniform as reported, and probably depends upon local needs and other factors rather than turf type per se. Size of the parks systems responding to this part of the survey ranged from $20,000 upward to over a million dollar total budget.

Some departments lump turf maintenance costs with other landscape maintenance items, or possibly with other types of parks maintenance. Costs of turf maintenance and establishment are not specifically allocated to turf. A number of departments were apparently unable to respond to certain parts of the survey for this reason.

Average cost per acre of maintained turf for 18 reporting Oregon parks is $761.66. Those with total parks budgets under $10,000 average $58 per turf acre, but departments with total parks budgets over $10,000 average close to $1000 per acre of maintained turf.

Irrigation

About 3,344 acres of the 3,755 acres of maintained turf or nearly 90% was irrigated. Of the irrigated acreage, 36% was under automatic or semi-automatic systems. The remaining acreage was irrigated by manual or other means.

The highest percentage of automation was found in Eastern Oregon counties.

Table 2. Irrigation Practices According to Region

	Total Irrigated Acreage			*Automated		*Manual	
Region	Number Reporting	Acreage	Ave.	Acreage	Ave.	Acreage	Ave.
Coast	4	91	22.8	5	1.3	82	20.5
Will. Valley	18	1660	91.4	294	16.3	1363	75.7
Southern Oregon	6	1113	185.5	773	128.8	340	56.7
Eastern Oregon	14	398	28.4	133	9.5	265	18.9

Fertilizers

Fertilizers used in the parks ranged from straight nitrogen materials to blends to organics, such as milorganite. These materials used were 45-0-0, 21-0-0, 10-4-6, 12-4-8, 16-4-6, 16-16-0, 14-7-7, 15-5-10, 10-10-20 and 16-20-0. One

department used weed and feed and one department used a liquid fertilizer material.

Out of the 31 departments reporting on fertilizer usage, 11 used urea, 6 used ammonium sulfate, and 6 used a fertilizer with a 3-1-2 nitrogen-phosphate-potash ratio. Eighteen of the departments used one material only while 13 used a variety of fertilizers to furnish the nutrient needs.

Fifteen of the 31 departments reporting on fertilizer usage had athletic fields with 6 also managing golf courses. They all used more than one fertilizer source.

Annual rates of material used are about the equivalent of 1 to 2 pounds of nitrogen/100 sq. feet per year on lawn areas and 4 to 5 on other more intensively used areas.

Timing of applications is divided about equally between the Spring and Fall on lawn type turf with about 2/3 of the applications on athletic and golf fairway turf made in the spring. Greens and tees received fertilizers "as needed" during the entire year.

Renovation

Three renovation practices - aerification, dethatching, and overseeding - were queried. As one might expect, there is considerable difference in the use, methods, and timing of these practices. It may be questionable whether differences in employment of these practices between regions of the State are significant; however, those park systems with larger budgets tend to use turf renovation practices more than those which are less well financed (see Table 3.)

Renovation practices appear to be used according to the specific needs of each parks system as seen by its management. There is no uniformity in use or timing of the practices, even within a given area of the state. For example, one parks department overseeds its athletic and play fields every three weeks, July through mid-October. Others, in the same general area, overseed once in fall, usually September or October. Many renovation practices are reported to be on an "as necessary basis. Such use and variation is probably an adaptation to local turf use, soils, grass varieties, weather conditions, available equipment, labor supply, budgets, and possibly other factors. With such variability it is virtually impossible to detect specific patterns of use. However, it seems reason-

able to assume, from responses to the questions, that parks turf generally would benefit from additional use of renovation practices.

Table 3. Percentage of Oregon Parks Systems, Classified According to Total Budget Size, Employing Various Renovation Practices To Some Extent on Lawn, Athletic and Play Field, and Golf Turf.

Budget (dollars)	Number Reporting	Aerification	Dethatching	Overseeding
0 - 10,000				
Lawn	9	0 %	0 %	0 %
Ath. & Play	4	0	0	75
Golf	0	--	--	--
10,000-50,000				
Lawn	9	33 %	22 %	33 %
Ath. & Play	5	60	20	20
Golf Fairway	1	yes	no	no
Tees	1	yes	no	no
Greens	1	yes	yes	no
50,000-100,000				
Lawn	8	38 %	13 %	13 %
Ath. & Play.	7	43	14	57
Golf Fairway	1	no	no	no
Tees	1	no	no	yes
Greens	1	yes	no	yes
100,000-500,000				
Lawn	5	60 %	60 %	80 %
Ath. & Play.	5	60	20	80
Golf Fairway	1	yes	no	no
Tees	1	no	no	no
Greens	1	yes	yes	yes
Over 500,000				
Lawn	3	67 %	67 %	33 %
Ath. & Play.	4	50	25	75
Golf Fairway	2	100	50	0
Tees	2	100	0	50
Greens	2	100	0	50
State Summary				
Lawn	40	35 %	20 %	28 %
Ath. & Play.	27	37	15	56
Golf Fairway	6	67	17	0
Tees	6	67	17	33
Greens	6	100	50	50

Pests

Weeds, along with moles and gophers, presented the biggest problems to park personnel. Insects and diseases were nearly insignificant except where golf courses were concerned. Diseases on greens gave some cause for concern.

Equipment Investments

Mowers constitute the largest single inventory value of all equipment with a total value of slightly over $234,000. Tractors, aerifiers, fertilizer spreaders and dethatchers were most important in that order.

Table 4. Average Investment In Equipment In Dollars

Item of Equipment	Annual Budget in Thousands of Dollars 0-10	10-50	50-100	100-500	500 and over
Mowers	872	$2,068	$ 3,881	$ 7,917	$ 31,354
Aerifiers	0	650	1,000	1,133	1,081
Dethatchers	0	150	500	550	1,200
Spreaders	292	497	203	383	500
Tractors	750	2,100	3,200	9,334	22,467
Golf Carts	0	1,500	4,500	1,700	52,500
Other Equipment	217	0	3,750	300	4,800
Average Total	$2,131	$6,965	$17,034	$21,317	$113,902

As budgets become larger, the greatest increase in equipment purchase is with mowers. Tractors follow closely with dethatchers in 3rd place. Those operations with budgets under $10,000 sacrificed items such as dethatchers, aerifiers and golf carts. Fertilizer spreaders, tractors and mowers constituted standard equipment on all operations.

Major Problems in Turf Management

Small departments listed budgets, watering, pests, traffic and labor as their most serious problems. As departments increased in size, traffic became the number one concern. Also important, however, were watering, labor, vandalism and soil fertility.

Renovation ranked as least important with most departments. Pests became less important as departments increased in size, possibly because of a greater opportunity to concentrate on those problems.

Responsibility for Turf Establishment and Maintenance Programs

The parks director is more likely to delegate responsibility for turf establishment and maintenance programs in larger parks systems. Although small budgeted parks systems report to have someone other than a parks director responsible, this is be-

Table 5A. Park Problems, Priority Ratings.

(Larger the Number, the More Important the Problem)

Problem	By Regions Coast	Will. Valley	Southern	Eastern	State Average
Traffic	9	7	10	4	9
Vandalism	2	3	6	3	3
Budgets	7	10	3	10	8
Help	8	4	7	6T	6
Pests	10	8	5	8	7
Watering	6T	9	9	9	10
Mowing	6T	5	8	7	5
Fertility	3	6	4	6T	4
Renovation	6T	2	2	1	2
Other	*1	**1	1	***2	1
Number Reporting	5	17	5	13	40

*Drainage, **Soil and Improper Equipment, ***Use of Improper Grasses

Table 5B. Park Problems, Priority Ratings.

(Larger the Number, the More Important the Problem)

Problem	By Annual Total Parks Budget - Thousands of Dollars 0-10	10-50	50-100	100-500	500 and up
Traffic	8T	8	10	7T	10
Vandalism	4	4	2	3	3T
Budgets	10	10	9T	8	5T
Help	8T	7	4	7T	9
Pests	5	9	5	5T	5T
Watering	9	6	9T	10T	8
Mowing	6	3T	6	10T	1
Fertility	3T	5	7	5T	6
Renovation	3T	3T	3	2	3T
Other	1	1	1	1	7
Number Reporting	9	9	8	6	4

Table 5C. Park Problems, Priority Ratings.

(Larger the Number, the More Important the Problem)

Problem	By Number of Turf Employees 0 - 4	5 - 9	10 and over
Traffic	7	6	10
Vandalism	2	2	6
Budgets	9	5	7
Help	5	9T	8
Pests	10	9T	4T
Watering	8	7	9
Mowing	6	10	5
Fertility	4	3	4T
Renovation	3	4	1
Other	1	1	2
Number Reporting	32	5	4

cause the smaller systems have no parks director as such. This responsibility, including turf, is given to the public works director, engineer, county extension agent, other governmental employee, or unpaid public official, such as a councilman, as an additional duty with these smaller parks systems.

Only in the larger departments are personnel assigned to turf maintenance as such. Consequently, this greater opportunity for specialization results in the adoption of more widely used turf management procedures and principles. However, many small departments use their resources very wisely.

There is little uniformity in title, or perhaps in responsibility, of the person, other than parks director, who is responsible for turf programs. Those listed, and number of times given, were as follows: Park Foreman (4); Park Maintenance Foreman (2); Maintenance Supervisor (2); Maintenance Superintendent (2); County Extension Agent (2); Turf Foreman (1); Landscape Foreman (1); Landscape Superintendent (1); Park Superintendent (1); Assistant Director of Operations (1); Construction Superintendent (1); Supervisor (1); Public Works Supervisor (1); County Engineer (1); City Water Marshall (1); and Golf Pro (1).

Equipment For The Turfgrass Industries[1]

Russell E. Rose[2]

My subject is "Cultivating Turf-grass"! This means helping - or "letting" the grass grow instead of "making" the grass grow.

So - - in cultivating Turf-grass, it brings up our two turf-grass maintenance problems, namely, compaction and thatch, what they are - why we have them - and how we control them.

Through the following slides we will explain this - as well as methods of doing the job better with fewer man hours.

CONTINUITY OF 80 RYAN COLOR SLIDES ON AERATION, POWER RAKING, TOP DRESSING & SOD CUTTING.

AERATION:

1. "What is compaction?"

2. "Hardening of the soil, usually the top inch" - the result of squeezing air and moisture out of the soil.

3. "Why do we have compaction?"

4. "Increased traffic" - Increased traffic accounts for a considerable amount of compaction, however -

5. "Elimination of nature's aerators is also a big contributor to compaction" - as night crawlers, earth worms, ants and insects have all been put into the soil by nature for aeration. These creatures make openings and canals in the soil allowing air and moisture, as well as nutrients, to reach the root zone. These creatures have often been eliminated with the use of chemicals.

6. "Why do we aerate?"

7. Aeration can do a number of things - relieving compaction,

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Ryan Equipment Company, St. Paul, Minnesota.

cultivating turfgrass, changes soil in greens, helps to keep turf level and also removes thatch.

8. "How often should we aerate?" - this has some variables and depends on type of grass, type of soil, kind of weather, the amount of traffic and the amount of fertilizers or chemicals being applied.

9. "Soil content" - for grass plants to grow well, a desirable soil is -65% soil, 10% moisture and 25% air. Whenever any of this air or moisture is reduced, compaction develops.

10. "When to aerate - how to test?"

11. The simplest method we know to tell when to aerate, is to try the screwdriver test. Use a medium size screwdriver with about a 4" shank. When this screwdriver shank can be pushed into the turf up to the handle, the grass is growing well. When you can't push the screwdriver in up to the shank, the growth is slowing and may have stopped. Aeration with irrigation afterwards is recommended.

12. Aeration is generally of 3 types - coring, slicing and renovating. Aerators are designed for interchangeable tines, so the tine can be changed to suit the soil condition and the season.

13. The large aerators are designed with floating units to follow the contour of the turf. In this picture, the coring tine is being used.

14. Do the job better without any more manpower. Here a 12' wide by 9' long dragmat is attached to the aerator, which not only crumbles up the cores as they are removed, but it also brushes up the grass blades encouraging more vertical growth and giving more attractive turfgrass.

15. A close-up of the penetration from a slicing tine. The narrow slit quickly closes up after it has absorbed moisture. Therefore, this tine is used in the hot dry season as you receive the benefits of aeration, but evaporation is minimized.

16. Close-up of aerating with the renovating tine which is designed to do a greater job of turf disturbance. Generally it is used in the fall of the year for turf rebuilding and overseeding.

17. And here is visual proof of the value of aeration. Yes, the grass grows in the holes!

18. More evidence of the benefits of aeration - too bad he didn't go over this place twice.

19. Aerating a green - To do the best job possible with the least amount of man hours, is the demand today! The fastest way to aerate a green is in a circle method as there is no time lost in turning off the green. Next, a windrow is attached to the Greensaire, which gives a better job as the wheels of the aerator do not run on top of the cores. Here the Ryan Levelawn, a simple hand tool, is used to push the cores from the middle of the green to a windrow at the edge of the green for easy pickup. 5/8" diameter tines were used on this green. With these large tines, 3 cubic yards of soil cores are removed for every 5,000 square feet of green.

20. The Levelawn will also remove cores that have not been windrowed, but the surface is not quite as smooth, as the wheels of the aerator has pressed some of the cores into the turf.

21. Finishing up in the center (as this picture shows), can be done with the aerator making a figure 8 on each end of the green. The cores are first removed on each end of the green with the Levelawn. Any type of hopper or truckster can be used for picking up the single windrow of cores on the edge of the green. With this method, a 5,000 square foot green can be aerated and cleaned up in one hour.

22. The Greensaire is the best thatch remover available. Regardless of how thick the thatch is, it is removed by the deep penetrating Greensaire tine. The tine removes as large as 5/8" diameter wad of thatch on 2" centers which is more thatch than can be removed by the vertical mowers and it leaves the green in a perfectly playable condition. When good top dressing is applied after aerating and worked into the penetrations, the bacteria and microorganisms now work to decompose the thatch surrounding each hole.

23. Profile of soil showing graphic evidence that grass roots like to grow where the penetrations are made.

24. A look from underneath - a piece of turf lifted to show root development wherever penetrations were made.

25. A look from the top - Yes, the grass grows in the holes! This is a bentgrass green.

26. The same is true with Bermuda grass - the grass grows in the holes.

27. Baseball players are just as tempermental as golfers. Here the Greensaire is used to keep the turfgrass level along the base lines so they don't get a bad bounce of the ball.

28. On this course, the soil cores removed by the Greensaire, are stockpiled, pulverized and used as top dressing. According to this man, this is real top soil as it has all the microorganisms necessary for good growth.

29. Disc spiking - This is the aerator to be used during the hot, dry months, as it cuts just narrow slits in the turf - particularly beneficial on undulated greens where the water slides off the high spots to the lower areas. Penetrations in the high spots open up the turf for the moisture to penetrate.

30. Here is a green that was lost to disease. The Superintendent used the Spikeaire in two directions, overseeded. This is the same green 3 weeks after the operation.

POWER RAKING

31. "What is thatch?"

32. "The Result of Good Growth."

33. Thatch is an accumulation of undecomposed clippings.

34. Dead stems.

35. Dead roots.

36. Dead leaves.

37. "Why do we have thatch?"

38. When we used the field grass or native grass for our lawns, parks and grass areas, thatch was not a problem because nature could well keep up with the decomposing of the clippings, dead stems and roots; decomposing them as necessary and returning them to the growth cycle.

Native grass or field grass has its short comings - it grows thin and is light in color. It is subject to an infestation of weeds.

39. So hybrid grasses were developed. Now this grass grows thicker and is greener, and Mother Nature has just a little bit more trouble decomposing the additional clippings, the additional dead stems and roots. So -- we start having an accumulation of thatch.

40. Now we carry it a step further and we are fertilizing the hybrid grasses, so we are growing the grass 2 and 3 times faster than nature would normally grow it. Now Mother Nature can no longer keep up. The accumulation is greater than the decomposition.

41. And here is the result - yes, thatch! You can readily see that it is very difficult for moisture and nutrients to break through this barrier to reach the root zone. Also, this is a haven for disease and fungi to develop. When this happens, the grass can be lost in just a few hours.

42. There is a place for thatch as in this case - it makes an excellent protective cover. Here it is used for a roof over a refreshment stand. It gives good protection, but that is just what we don't need for good turfgrass growth.

43. "How to test for thatch?"

44. Don't guess - Use a knife to cut out a piece of turf.

45. Generally there is no problem with 1/4" thatch. However, that is the time to start watching because when a thatch develops to 1/2" thick, it can increase quite rapidly to 3/4" and even 1" - and that spells trouble!

46. "Why do we power rake?"

Power raking cuts out crabgrass or low growing weeds. It prepares a seed bed - it removes and controls thatch - it controls grain on putting greens and is also used for pulverizing cores after aerating.

47. "Why power rake?"

48. Here is a garden rake. Note the wide tines. When this

rake is tugged slowly through the turfgrass, it not only pulls much of the good grass out with it, but also distrubs many of the roots of the good grass.

49. Here we see a man raking his lawn with a garden rake.

Not only is it a big job - but also note all the good grass that he is removing. He very likely is removing more good green grass than dead grass.

50. This man uses a power rake on his lawn.

He is removing some 90% dead grass - less than 10% of the good grass. Much easier to do and much gentler on the grass.

51. A comparison of the tines of the garden rake and the reel of a power rake.

Note how the tines of the garden rake are about 1/4" thick, whereas the cutting blades on the power rake is not over 1/16" thick. This reel, running at high speed, gently lifts the dead matter from the soil line, fluffing it up on top of the grass for easy removal.

52. How often should we power rake?

On home lawns with fertilizing once or twice a year, power raking once a year should be adequate.

However - check this by using the knife test.

53. For bentgrass and hybrid burmudas, vertical mowing as often as every 10 days is recommended - going in a different direction each time.

54. A close-up of a vertically mowed green.

It is recommended that we mow more frequently - lightly - as this does not shock the turf and does not inconvenience the golfer.

55. Here is a Tennis club in the northeast section of the country.

They use bentgrass turf and as this picture shows, a large part of the grass died in less than 1/2 day due to

disease. The reason was temperature and humidity - both close to the 100° mark.
THIS TURF DOES NOT COME BACK BY ITSELF - overseeding is necessary!

56. And here we see the vertical mower or power rake preparing the turf for overseeding. This situation not only happened at this Tennis club, but throughout the entire area. It was also a general sight on Golf Course greens and fairways.

57. Overseeding was necessary and here's one of the greens 3 weeks after overseeding.

You can see where the seed has germinated and recovery is started.

58. A thatched home lawn ...

This was one of the nicest lawns in the neighborhood for some 10 years, as the owner fertilized 3 and sometimes 4 times a year.

This spring, however, his neighbor who had done very little outside of mowing his lawn, had a better lawn than he did.

Let's take a look at the reason....

59. Here is a sample of the turf -

It has a full inch of thatch. No wonder the moisture and fertilizer could not get into the root zone for good growth. This is what we do in this case....

60. It is beyond the help of the power rakes and aerators. He had to take a much more drastic measure. Remove the turf and start over!

61. And now he has a new lawn.

You can bet he won't neglect his power raking from now on!

62. And here is another culprit in our lawn maintenance ---

This happens to be crabgrass - but it could be any low-growing, wide-leafed weed. These are very vulnerable to the verticle cutting blades of the power rake and you get

rid of them immediately. Of course, they are going to be back again next year unless a precaution is taken.

63. Here is a nice home with a lawn that has become infested with crabgrass. The owner elected to apply a post-emergence chemical to kill the crabgrass. Now this is the 1st of September and he no longer had a green lawn through the rest of the season.

64. Nor did he have a lawn when Spring came!

Apparently he thought if a little of the chemical is good - I'll just add a little bit more to be sure.

So it killed the grass, but good! The answer to this problem ---

65. Look for yourself - AGAIN, it is necessary to start all over, and that's a big job, as well as an expensive one.

66. Maybe it was worth it in this case. Look at the beautiful bluegrass lawn he now has.

67. At the height of the crabgrass season, use the verticle mowers to cut out the crabgrass or weed, getting rid of it immediately and allowing the good grass to fill in. A catcher can be applied to some of the power rakes, however, only part of the seeds are going to be caught. The best way to control this type of weed is with:

68. The pre-emergence crabgrass chemicals -

This photo was taken 3 years after the treatment. The lawn on the right is still free of crabgrass, whereas, the yard on the left is almost all crabgrass.

69. As we are growing more grass faster - and on large areas such as athletic fields, parks - any area under turf management, it is necessary to power rake so that large area power rakes are available. They are pulled by tractors and they include a hopper to pick up the thatch as well as remove it.

70. Removal of leaves is also necessary where we want healthy turfgrass. Leaves laying on the turf throughout the winter and spring, can actually smother a considerable amount of grass.

71. When using these large size units, it is necessary to make them do a multiple of jobs. The large area power rake also power sweeps -- and here we see it doing a flail mowing.

72. Here the vertical mower or power rake is used to pulverize cores that had been removed from the turf by the Greensaire. The job is done better and faster when cores are left in a windrow as the machine straddles the windrow and the wheels do not run on top of the cores. The reverse direction of the reel makes it possible to completely pulverize the cores with one pass.

The operator particularly likes the reverse action of the reel as it does not throw any of the soil, or it could be a stone or pebble, back at his feet.

TOP DRESSING

73. "Why Top Dress?"

Top dressing does three things: (1) it levels; (2) it helps to control thatch; and (3) it helps to control grain.

74. "When and how often should we top dress?"

75. Top dress (1) when the grass is growing well; and (2) when seeding or overseeding.

76. Another example of how you can do a better job of top dressing with less man hours:

Attached to the top dresser is a 3 section drag which levels in top dressing, followed by the large 6-1/2' wide dragmat which drags in the top dressing before any footprints are made on the top dressing. As in aerating, the circle method is the fastest, going in a counter-clockwise direction, until you get near the center, and then figure 8 the area as we do with the aerators.

A 5,000 square foot green can be top dressed in twenty minutes and can be completely dragged in, in another twenty minutes.

SOD CUTTING

77. Even with the best turfgrass management it becomes necessary

at some times to use the sod cutter, but don't do it this way ...

This is the way they did it back in the early 1900's. It takes a long time and it hurts!

78. Powered Sod Cutters do the job not only better and faster, but the operator rides as the sod is automatically cut, cut-off in 6' lengths and rolled.

79. As the cultured sod farms get bigger, so must the equipment! Here the complete Sod Harvester cuts, rolls and conveys the sod directly onto the truck.

This machine can harvest over 1,000 square yards of sod per hour.

80. And the smaller sod cutter has another use!

By simply changing the blade, the sod cutter becomes a pipe puller. Tubing and wire can be pulled under ground without disturbing the surface of the turfgrass.

SUMMARY

To sum it up - we have shown you cultivation, which is specifically referred to in our business as aerating, power raking, and even top dressing; however, I wish to remind you that this is just ONE phase of a turf maintenance program!

Just as important is proper irrigation - - too much is as bad as too little.

Proper fertilization - - apply lightly more often. Proper mowing - - mow with a sharp mower at the height best suited for that particular grass. Mow often enough so that you will not remove too much of the grass blade at one mowing.

Benefits that can be derived from good cultivation, can all be undone by improper watering, fertilizing, and mowing!

Trees And Their Care[1]

Bernard G. Wesenburg[2]

The current fad for "ecology" and "environment" comes close to an appreciation of trees. Perhaps many of you appreciate trees, but I want to further emphasize their value.

The International Shade Tree Conference, Inc. (I.S.T.C.), in June 1970 recommended the basic value of $9.00 per square inch of trunk cross-section measured 4.5 feet above the ground. To compute this basic value, measure the diameter in inches at four and one-half feet above the ground, square the diameter, then multiply by 0.7854, and finally by $9.00.

Tree Size Diameter 4-1/2 ft. Above Ground	Diameter Squared	Multiplied by 0.7854	Multiplied by $9.00
10"	100	78.54	$ 706.86
16"	256	201	$ 1809.00

This may seem surprisingly high. However, reality is that trees over 6 inches in diameter are practically irreplaceable. And, for the general considerations of landscaping, trees over 2 inches in diameter are out of range of the money commonly allowed for landscaping.

The above method of calculation is for trees which are perfect specimens and in I.S.T.C.'s Group I classification. Trees in Group II have 80 percent of that value, in Group III 60 percent, Group IV 40 percent, and Group V 20 percent.

I.S.T.C. publishes lists of trees for various regions of the country. Here is I.S.T.C.'s lists of trees for Oregon and Washington:

1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Extension Horticulture Specialist, Washington State University, Western Washington Research & Extension Center, Puyallup, Washington.

Class I - 100 Percent Value

Liriodendron tulipifera	Tulip tree
Platanus racemosa	Western Sycamore
Quercus coccinea	Scarlet Oak

Class II - 80 Percent Value

Abies concolor	Colorado Fir
Acer campestre	Hedge Maple
Acer monspessulanum	Montpelier Maple
Acer palmatum	Japanese Maple
Acer platanoides (and forms)	Norway Maple
Acer rubrum	Red Maple
Acer saccharum	Sugar Maple
Aesculus carnea	Red Horsechestnut
Carpinus betulus	European Hornbeam
Carpinus caroliniana	American Hornbeam
Castanea crenata	Japanese Chestnut
Cedrus atlantica 'Glauca'	Blue Atlas Cedar
Cedrus deodara	Deodar Cedar
Chamaecyparis lawsoniana	Lawson False Cypress
Chamaecyparis obtusa	Hinoki Cypress
Cornus florida	Flowering Dogwood
Cornus nuttallii	Pacific Dogwood
Crataegus phaenopyrum	Washington Hawthorn
Ilex aguifolium	English Holly
Juglans regia	Persian Walnut
Libocedrus decurrens	California Incense cedar
Liquidambar styraciflua	Sweetgum
Magnolia kobus	Kobus Magnolia
Picea pungens 'Glauca'	Blue Colorado Spruce
Platanus acerifolia	London Plane-tree
Prunus blireiana	Blireiana Plum
Prunus serrulata 'Kwanzan'	Kwanzan Cherry
Sequoia sempervirens	Redwood
Sequoiadendron giganteum	Giant Sequoia

Class III - 60 Percent Value

Acer negundo Variegatum	Silverleaf Boxelder

Arbutus menziesii	Pacific Madrone
Betula alleghaniensis	Yellow Birch
Crataegus oxyacantha	English Hawthorn
Cryptomeria japonica	Cryptomeria
Fagus sylvatica 'Atropunicea'	Purple European Beech
Gleditsia triacanthos	Honeylocust
Juglans nigra	Black Walnut
Juniperus virginiana (and forms)	Redcedar
Laburnum alpinum	Scotch Laburnum
Laburnum anagyroides	Goldenchain Laburnum
Malus hybrids	Crabapples
Pinus nigra	Austrian Pine

Class III - 60 Percent Value (cont'd.)

Pinus sylvestris	Scotch Pine
Pinus thunbergi	Japanese Black Pine
Prunus cerasifera (and forms)	Purpleleaf Plum
Prunus serrulata (and forms)	Oriental Cherry
Prunus subhirtella (and forms)	Higan Cherry
Prunus vedoensis (and forms)	Hoshino Cherry
Quercus coccinea	Scarlet Oak
Quercus robur	English Oak
Quercus rubra	Eastern Red Oak
Sassafras albidum molle	Sassafras
Thuja plicata	Giant Arborvitae
Tilia cordata	Littleleaf Linden
Ulmus americana	American Elm

Class IV - 40 Percent Value

Aesculus hippocastanum	Horsechestnut
Araucaria araucana	Monkeypuzzle Araucaria
Catalpa bignonioides	Southern Catalpa
Chamaecyparis pisifera	Sawara Falsecypress
Fraxinus latifolia	Oregon Ash
Paulowinia tomentosa	Royal Paulownia
Pinus monticola	Mountain White Pine
Populus nigra 'Italica'	Lombardy Poplar
Prunus avium	Mazzard Cherry
Pseudotsuga menziesii	Common Douglas Fir

Salix babylonica	Babylon Weeping Will
Sorbus aucuparia	European Mountain Ash

Class V - 20 Percent Value

Acer macrophyllum	Bigleaf Maple
Acer saccharinum	Silver Maple

The valuation of trees is next appraised by a horticulturist as to condition and the above value is again multiplied by 100 percent or 80 percent, 60 percent, 40 percent, or 20 percent, depending upon how good a specimen a particular tree was.

The point so far is that trees have a considerable value which is generally unrecognized. Also, the classes of trees as to quality is useful for golf course managers to be aware of.

My time here will be most valuable if I can promote concern for choosing the best trees at planting time. Choose a variety of the very best trees for the locations. Services of a landscape architect are a good route.

Select trees according to the mature sizes desired. It seems few people realize that trees can be chosen which don't grow taller than 25 feet, or 50 feet, or 75 feet, etc.

My assigned subject is "Trees and Their Care". So far I have only considered choice of trees. And, the emphasis deserve to be there.

On March 6-7, 1969, at a golf course workshop at the Washington State University Research and Extension Center in Puyallup, I gave a talk titled "Healthy Shade Trees". That talk is in the April 1969 Northwest Turfgrass Topics, Vol. 11, No. 1

Shade trees and ornamental trees are expected to get along and LOOK GOOD without care or attention, and this is largely the case if reasonably good choices have been made.

Properly placed trees should never require pruning to control size -- only a rare clean-up of dead limbs, or minor shaping of branch pattern, or no pruning at all.

Tree selection is the best course to pursue to have good healthy trees. Trees must be adapted to the climatic extremes of the locality, and tolerant or resistant to insects and diseases. Such trees will not need routine spraying.

Fertilizer applications specifically for shade trees is not generally done at all. Good turf fertilization programs are generally adequate for trees. If certain trees are to be encouraged or invigorated, use 2 to 4 pounds of a complete fertilizer (e.g. 10-6-4) per inch of diameter. Trees under 6 inches diameter should receive one-half that rate.

The method to get the fertilizer to the tree roots is to put the fertilizer below the grass roots. Punch holes with a crowbar, etc. within the branch spread area of the tree, and put the fertilizer down into 12 inch deep holes. Early spring is the best time to apply it.

In conclusion, I want to recommend some excellent trees that should be planted more often. They likely are not the most available, but if you can get them, they are excellent trees.

20-30 feet

Oxdendrum arboreum - Sourwood

30-50 feet

Cladrastis lutea - American Yellowwood

50-75 feet

Quercus palustris - Pin Oak

75-100 feet

Fagus sylvatica - European Beech
Gymnocladus dioicus - Kentucky Coffeetree
Pinus nigra - Austrian Pine
Quercus alba - White Oak
Tilia cordata - Littleleaf Linden

Over 100 feet

Acer saccharum - Sugar Maple
Ginkgo biloba - Ginkgo

Gleditsia triacanthos inermis - Honeylocust
Liquidambar stvraciflua - American Sweetgum

An excellent publication is available from County Agent's offices in both Oregon and Washington titled "Plant Materials for Landscaping". In Washington it is Extension Bulletin 592; in Oregon it is Extension Bulletin 758. It includes shrubs and ground covers, as well as all the size categories of trees.

The Role of Turfgrass in Environmental Pollution[1]

The O. M. Scott Company[2]

Editors note: Due to a late contact with The O. M. Scott Company to present this paper, a manuscript was not prepared in time for the published proceedings, although the Company has kindly agreed to present the talk. The Company further has agreed to the reproduction of the following information which the editor feels is timely and quite important.

Greenery - antidote to pollution

It is reported that the percentage of oxygen in our atmosphere may be steadily declining because of the burning of fossil fuels, various industrial processes, and conversion of farm crops, trees and other greenery to areas covered by concrete and buildings. While current regulatory measures will curtail air pollution, it is estimated that in view of population growth, there will be little net reduction of pollution in the next 25 years.

This raises the question whether there is a practical way to help reverse this trend. One approach has been suggested by John Fischer in an article in the April issue of Harper's. He thinks that the next "Heroes of the Republic," may be those who plant trees instead of subtracting from our greenery with bulldozer and saw. And in our opinion, he might have included as heroes those who plant and nurture grass, shrubbery and gardens.

Other positive action has been suggested, such as mandatory provision for minimum land-use ratios of greenery in any new land development for homes, institutions, office buildings, industrial sites and shopping centers.

Furthermore, wherever possible green belts should be installed along the nation's highways. The green leaves of trees and other plants attract and hold pollutant-laden dust particles which are subsequently washed into the soil where they eventually disintegrate into basic soil elements.

Whatever greenery you now have or plant in the future, the first essential in its life process is water. Next in importance in promoting lively green growth is fertilizer. "But doesn't that add nitrates to our ponds, lakes and underground waters," you ask, " and don't these nourish algae

and other growth that chokes surface waters?" The answer is "no."

Studies extending back many years demonstrate that there is no appreciable movement into ground waters of even the highly soluble forms of nitrogen applied to farm crops. Considering the cost of fertilizers, farmers could not afford to apply them if they were not held in the surface soil to produce the quick green growth needed for satisfactory yields.

The exception is where serious erosion of loose, cultivated soils occurs. In such cases, the fertilizers in the eroded soils may end up in a stream. But even that is relatively low compared to the enormous amounts of nitrogen and phosphate dumped into ponds, lakes, and streams in raw sewage and the effluent from sewage treatment plants.

THE OXYGEN GIVER

A blade of grass.

It is quiet. It has no moving parts. Yet in its growth process, it takes polluting gases from the air and returns pure oxygen.

In a season of active growth, the grass in a well-maintained lawn, 50 by 50 feet, liberates enough exygen to meet the needs of a family of four day after day.

As it performs this miracle, grass also provides the basic food supply for animals and man. It does this by photosynthesis, using the energy of the sun to turn carbon dioxide, water and minerals into green growth.

Every lawnowner is making a worthy contribution of life-sustaining greenery.

Studying The Problem Green[1]

William B. Davis[2]

In the management of today's golf course, the putting green still commands our greatest concern. The game of golf has changed little from its earliest forms and so 40 to 60 percent of the game is concentrated on less than 1/25 of the course's turfgrass area. What big changes have occurred are in the number of courses, the concentration of golfers on a course, and golf's availability to most economic, social, and racial groups. Not too many years ago any relatively smooth surface, reasonably well turfed, and closely mowed, served well enough as a putting green surface. Play on such greens ranged from less than 5,000 to 25,000 rounds each year. Today, very few courses average less than 10,000, most exceed 50,000 and many approach 100,000 rounds a year.

As the number of courses and golfers have increased, so have research and education in turfgrass management. Equipment advances have also kept pace with this growth so that the turfgrass manager of today has the resources to master almost any problem. Why, then, are we faced with so many problem greens?

There are, of course, many answers to this question. Some golf course superintendents may prefer to blame a poor green on the original designer or on the golf course developer who may have been pennywise and dollar foolish. A more positive approach is to simply shoulder the responsibility for the problems that do exist. Once we have committed ourselves to this, we can start solving the problem instead of just talking about it.

First, we must recognize that most superintendents and turfgrass managers have migrated into the field from widely different backgrounds in both experience and education. Some are good golfers, great public relations men, and skilled technicians; some are not. Some of us have only a few years' experience while others have had many years in the field.

1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/A.E.S., Extension Turf-Landscape Horticulturist, University of California, Davis.

Some of continue to have opportunities to learn and gain useful experience, while others may have only the experience of one year repeated over a span of several. Some superintendents and managers are "born" to lead. Others have to learn, sometimes painfully, how to lead. Some of these are skilled workers who are capable of becoming good foremen able to teach or direct others to do an equally skillful job. For success, we must deal with the problems we have and so we must have or develop skills that go beyond our day-to-day operational management. All that we each have in common is our interest and desire to skillfully manage this specialized turfgrass area.

Is this speaking to the subject, the study of problem greens? If you think not, I have already lost you and what follows may have little meaning. The basis of our understanding is the realization that putting greens do not have problems. Men have the problems. Men set up the conditions that produce a poor or a good putting green, and it is their skill or lack of skill that makes the difference. If we can accept this indictment, we are in a better position to do something about it.

It is a common tendency to look for a quick or easy solution to any problem. We have a poor putting green, so maybe it will go away if we aerate. Maybe a wetting agent will help. More fertilizer, perhaps? Could we spray for disease oftener? Or maybe, a new top-dressing mix. We have got a headache and we need quick relief, so we take an aspirin. The aspirin approach does sometimes give us temporary relief, but have we solved the problem? At best, this temporary relief buys time with which to characterize, study, and analyze the problem and to reach a permanent solution.

Unless we own our own private course, we must report to someone or some group of other interested parties. They are the people we must convince that we know our business and what our needs are if we are to function in their behalf. The solution to any problem green almost always means a change or an addition in the overall management program that ultimately translates to more dollars or reallocation of existing dollars. The superintendent will have his chance to prove his ability by presenting a complete analysis of the problem with a carefully worked out solution and possible alternatives.

In the analysis of any problem green, a complete past

history can be most useful. When was the green first constructed? Do we have any original cost figures? How long has this green been a problem? Does this green present only a seasonal problem? What has been our past aspirin treatment? How much time is this green completely out of play? What does it cost in labor and materials as compared with our good greens? Does it have a drainage system, and if so, does it work? These and many similar questions should be answered and written down so they can be digested. In this history of this green, a record of play can be most helpful. Many good greens that are only lightly trafficked now may become serious problem greens under the stress of heavy play. A green that served well in the '30's or '40's may not meet the needs of the '70's. A history of use can be one of the superintendent's greatest allies where solving the problem may involve major expense.

Soil profile samples from poor greens can also be useful in describing and analyzing past practices and understanding the present problem. A well-constructed, well-drained green may have been mis-managed in the past and the solution may be less costly than a superficial inspection indicates. Many greens have been rebuilt when simply installing a proper drainage system or removing a surface organic-sand layer would have solved the problem. Actual samples of the profile will also make word description of the green more meaningful, particularly to the lay person.

A green is seldom built completely as planned or as originally visualized. Over a period of years, it may have become larger or smaller. Just what are the actual contours of the existing green? Just where are the sprinklers located? Is the spacing correct for the type of sprinkler being used? Just what is the present water distribution pattern? What is the infiltration rate? How does it compare with the sprinkler application rate? This information can be easily obtained by the superintendent and two helpers in less than one day in the field. Data taken in the field can then be developed into meaningful graphs which in turn can be studied and will help in the solution of the problem. Even if a complete solution cannot be carried out, the information gained may be useful in improving the present maintenance program.

The equipment and procedures for obtaining data on your present green are not expensive or complicated. You will need a transit or level, three 100-foot tapes, several wire stakes,

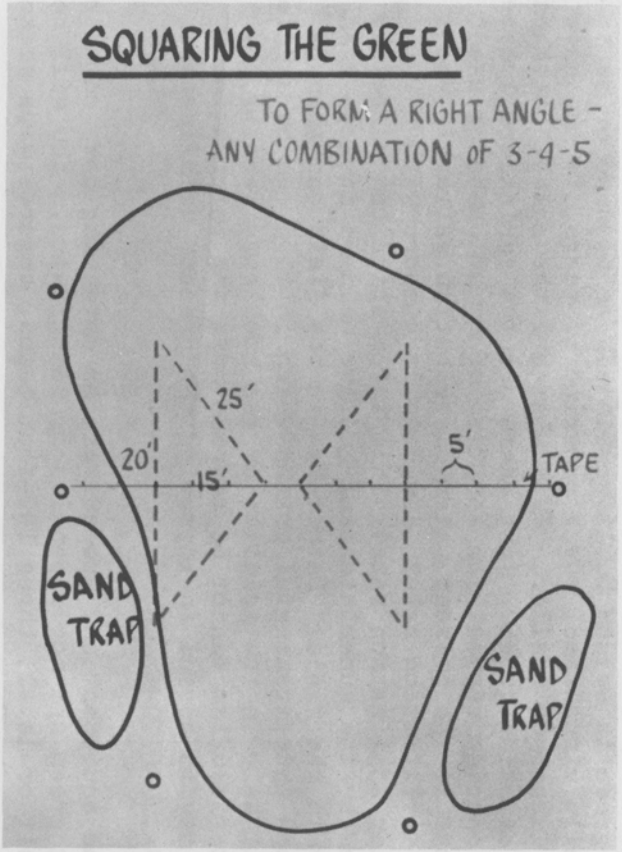

Figure 1.

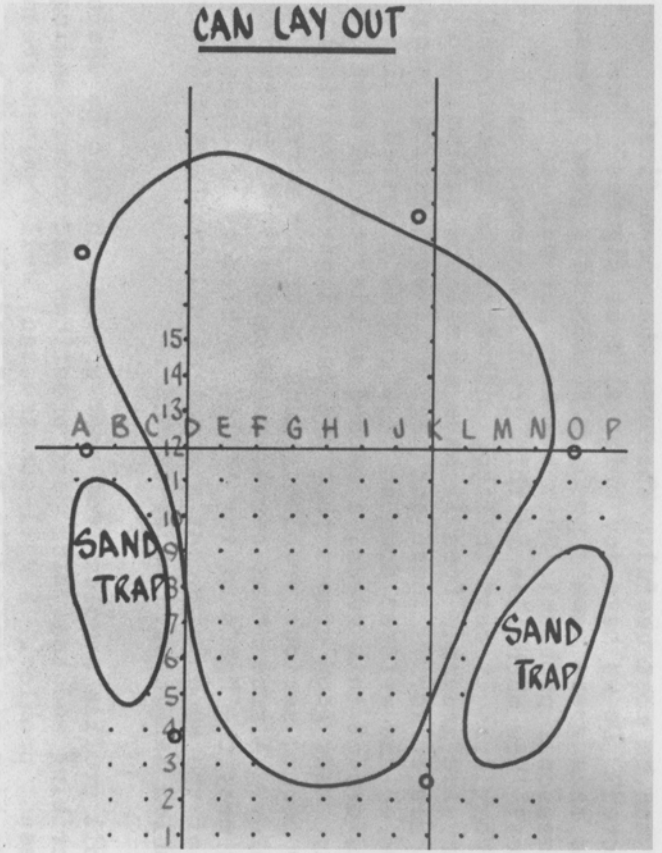

Figure 2.

200 to 400 #2 vegetable or fruit cans depending on the size of the green, one or two 250-ml cylinders, three or four sheets of large graph paper, and one or more ring infiltrometers.

To lay out a green, the #2 cans are placed on 5-foot centers using as a baseline a tape stretched between the two sprinkler heads that nearly bisect the center of the green. From this baseline, square the green and lay out tapes to give you two secondary lines 40 to 60 feet apart that are parallel to each other and perpendicular to the baseline. (See figure 1).

The original baseline tape is then moved to one end of the secondary lines and cans are set out along the tape every 5 feet. Move this baseline tape 5 feet along the secondary lines and repeat setting out cans on 5-foot centers until the entire green is covered. (See figure 2).

This grid of cans on 5-foot centers can now be used to give us a complete and accurate topography of the green. Using a transit, you can take elevations to the nearest tenth of a foot every 5 feet over the entire green and surrounding apron. Field data plotted on graph paper and points of equal elevation connected with contour lines give a picture of the topography of the green as it actually exists. These contour lines will pinpoint surface drainage problems, will be helpful in determining better cup placement, and can be used to study and lay out a more efficient tile drainage system. (See figure 3.)

The sprinkler distribution pattern and its precipitation rate can be determined by running the sprinkling system for 1/2 hour, measuring the water caught in each of the #2 cans. If the system is run for exactly 1/2 hour, the precipitation rate can be read directly to the nearest 1/100 inch per hour by pouring the water from the collection can into a graduated cylinder. Each millimeter marking on the cylinder is equal to approximately 1/100 inch per hour if the sprinkler is run for 1/2 hour. (Example: A reading of 25 millimeters would equal .25 or 1/4 inch. A reading of 175 millimeters would be equal to 1.75 inches or 1 3/4 inches per hour.) When this information is plotted on graph paper and equal precipitation rates are joined by contour lines, we will have the distribution pattern of the sprinkler system. (See figure 4.)

Typically, problem greens may take water or have an

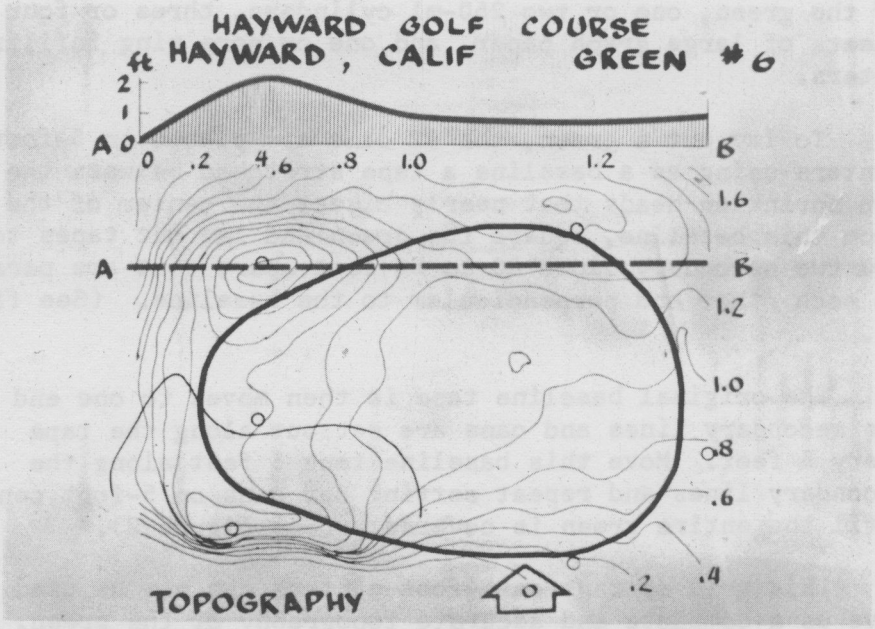

Figure 3.

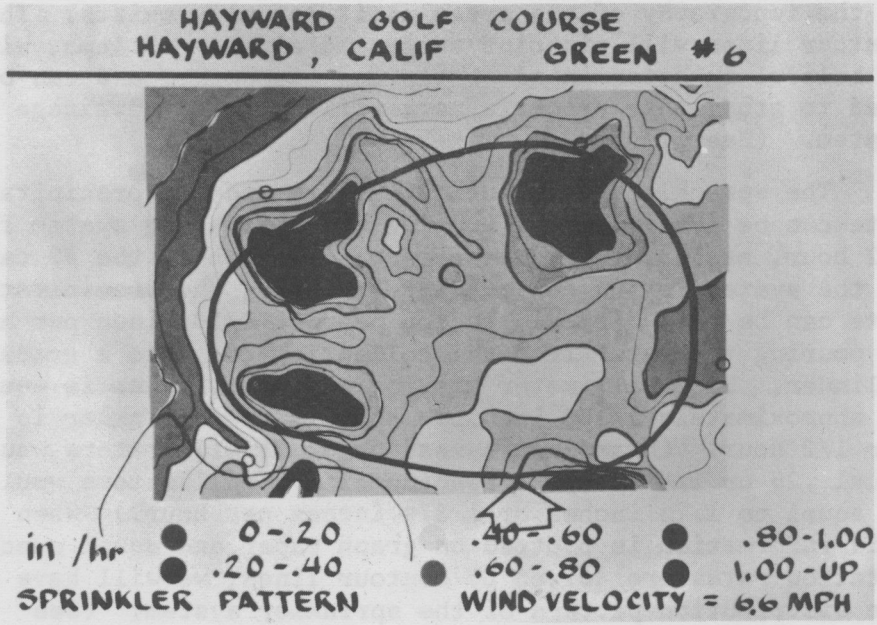

Figure 4.

infiltration rate at less than the application or precipitation rate of the existing sprinkling system. Infilitration rates are measured at saturated flow. This is done by setting ring infiltrometers into the green, filling them with 10 to 12 inches of water, and measuring the loss of water over given time intervals. Ring infiltrometers can be made from well casing, oil drums cut in half, or any large can or cylinder that is open on both ends. These cylinders are driven approximately 4 inches into the green and the soil tamped around the edges of the cylinder to insure no leakage through the outside of the cylinder. The measurement of water loss can be done with a ruler or yardstick accurately to 1/8 inch and with a hook gauge to 1/100 of an inch. Measurements of water loss should be taken at 15-minute intervals until such time as the measured water loss comes into equilibrium. If water is being lost at the rate of 1/4 inch every 15 minutes, this is the infiltration rate of 1 inch per hour at that ring. Several rings should be placed on the green to get a true picture of the infiltration for the green. (See figure 5.)

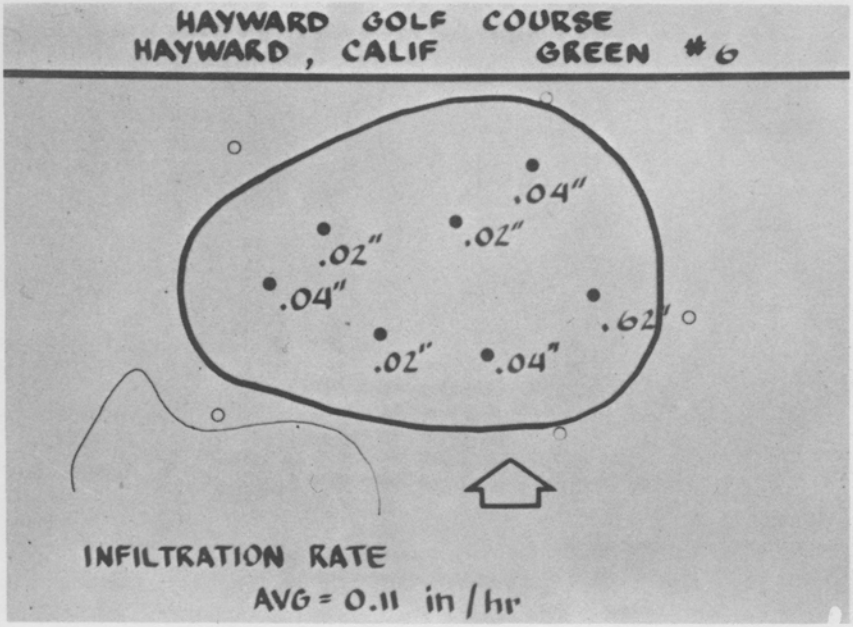

Figure 5.

This system of characterizing some of the physical properties of the green can give the superintendent documented information. He can use it to develop a better management program or take steps to make major improvements, which in

most cases must be sold to a lay group not having a technical background. The superintendent's job is no small task since he is responsible for the organization of the day-to-day maintenance of a golf course, but his true worth is measured by his ability to solve problems.

Pre-and Post-Emergence Controls for *Poa annua*[1]

Roy L. Goss[2]

Poa annua, commonly referred to as annual bluegrass, is probably the most researched weed in the turfgrass industry today. When *Poa annua* moves in, desirable turfgrasses tend to move out. Many basic studies need to be conducted to determine the exact causes of why desirable turfgrass becomes thin and *Poa annua* increases. Certainly, some of these factors of encroachment are associated with diseases, insects and injury factors caused by traffic, chemicals, over application of fertilizer, etc. There may be other unexplained biological or chemical reasons why *Poa annua* is so persistent. The fact remains, however, that in the Pacific Northwest, this weedy grass usually perpetuates itself as a perennial and only occasionally lives up to its name as an annual. This is due, principally, to a "friendly climate" for the most part in this area but occasionally the summers are hot and dry enough that we experience vast losses of annual bluegrass. These are the times when we become most concerned and want to do something about it.

In order to better understand the plant and some if its idiosyncrasies, let us take a look at a few references, in published literature, regarding this plant.

BRIEF LITERATURE REVIEW

Juhren et al. (6) reported in 1957 that high temperatures and high light intensities resulted in good growth of annual bluegrass. He also reported that low temperatures and low light intensities also favored good growth. The poorest conditions for the growth of annual bluegrass were high temperatures and low light intensities. He further reported that the photoperiod was important for the growth and survival of annual bluegrass. A 16-hour photoperiod produced plants that were larger than the 12 or 8 hour period regardless of the temperature. For hot conditions, a photoperiod of at least

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1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Associate Agronomist, Western Washington Research & Ext. Center, Washington State University, Puyallup, Washington.

12 hours was necessary for good survival. Shorter photoperiods under hot conditions resulted in many dead seedlings. Cool 8-hour photoperiods, however, resulted in smaller, yet, very healthy seedlings.

Juska and Hanson (7) have reported on the nutritional requirements for Poa annua. They found that the total top yield was greater for annual bluegrass grown in a silt-loam soil than in loamy sand. In the sand cultures, large decreases in clippings, crowns, and roots were obtained at a pH of 4.5 compared to pH 6.5. This pH effect was not observed in the silt loam soil. They concluded from their tests that annual bluegrass does not differ from other bluegrasses in its response to the major elements N, P, and K. A significant finding by these researchers, was that four times more seedheads were produced by annual bluegrass in loamy sand at a pH of 6.5 than at 4.5. Seedhead numbers did not differ significantly with pH levels in the silt loam soil.

PREEMERGENCE CONTROL

Many of the preemergence herbicides adversely affect the desirable permanent grasses as well as the undesirable annual bluegrass. The only difference is the degree to which the plants can withstand the treatment. Older, more mature plants can withstand much more drastic treatment than the younger seedling grasses with little respect to species differences. The important factor is that most of our desirable turfgrasses, in the mature condition, can withstand the herbicide treatment. Gaskin (3) reported that tests with Zytron, Trifluralin, Dacthal and others showed that these herbicides caused a reduction in the number of rhizomes and number of tillers in Merion bluegrass when applied at the recommended rates. Goss (4) reported from a series of experiments, that Dacthal (DCPA) at 10#/acre and Betasan (Bensulide) at 15#/acre gave good control of annual bluegrass seedlings for a period in excess of 12 weeks. Other materials were effective but only the two materials above were non-phytotoxic to mature turf.

Bingham et al. (1) reported in overseeding experiments with cool season grasses, the following results: With bermuda grass greens, they found that DCPA (Dacthal) and Bensulide (Betasan) inhibited the germination of Poa annua but were able to establish annual ryegrass and red fescue one month after chemical treatment. The red fescue, however, established weaker than the annual ryegrass. This indicates that there

is a gradual weakening or decomposition of the chemical applied and results vary with the species of grass involved.

Juska and Hanson (8) reported satisfactory establishment of bluegrass, red fescue, and annual ryegrass in killed sod in early November, before frost, after three annual applications of chlordane, lead arsenate, calcium arsenate, DCPA (Dacthal) and DMPA (Zytron). The last herbicide application was made in April and the three grass species were overseeded in September. However, the occurrence of heavy frosts and colder weather, there was definite seedling injury. Plant stress apparently is an important consideration with respect to a plant's ability to tolerate toxic materials. In one of these tests, arsenic rates (435#, 870#, and 1740#/acre) all produced the most severe injury to the seedlings. This coincides with personal observations and recommendations in apple orchards in Central Washington. Lead arsenate concentrations were so high in the surface of the soil, that chewings fescue and clover cover-crops had to be established in early spring before heat and moisture stress was a factor. Frequently the arsenic level was high enough to eliminate clover and reduce the fescue stand. Lance (9) reported his success with arsenical programs on golf course fairways. He reported that arsenical programs are more effective at pH of 6.0 or higher but not over 7.8. Two to four weeks must be allowed from the time lime is applied and the arsenic application is made. Lance used 48% tri-calcium arsenate for his treatment. He reported that phosphorus must be eliminated in the fertilizer program or use as little as possible in the case of severe deficiencies. Phosphorus will tend to tie up the soluble arsenic and prevent satisfactory control. Lance does however, recommend the use of ample nitrogen and potassium. The toxicity to annual bluegrass can be achieved with levels of 16 to 30# per 1000 square feet of 48% tri-calcium arsenate depending upon the soil type. Sands take much less than heavier soils. Lance recommends the immediate and continued overseeding with 5-20# bluegrass seed per acre since the bluegrass seedling will survive 8# of calcium arsenate per 1000 square feet any application. He further reports that after the toxic level has been reached, 2-4 pounds of 48% calcium arsenate/1000 square feet applied in the short days of spring or fall will maintain toxicity. He reports that short, cloudy, cool days will enhance the toxicity considerably.

Hawes (5) reported on some effects of calcium arsenate and indicated that in early years some difficulties were encountered since formulations were variable in release of

available arsenic. Some rates were too high because of the high arsenic content and low phosphorus present in the soils of some putting greens. He reports that the level of arsenic necessary to control undesirable grasses is not high enough to kill the desirable ones, it is certainly high enough to weaken these grasses by reducing the efficiency of the plants to produce their own food. Plants, thus weakened, are more susceptable to injury by other stress factors. He further states that the principle reason that permanent grasses do survive in well-drained soils which have received heavy arsenic treatments is due to the fact that arsenicals work by producing a thin layer of chemical at the soil surface and not a toxic condition throughout the soil profile. Unlike most preemergence herbicides, arsenicals do not break down in the soil. After many years of applying arsenicals the layer becomes quite thick. On putting greens where mid-summer roots are often short, it may well be that bentgrasses will have their entire root system existing in the arsenic layer. Where soils have poor surface and sub-surface drainage, losses of permanent turf are very common at or near the arsenic level needed to control Poa annua.

It is often difficult to get successful germination and growth in overseeding when the arsenic level has reached that necessary to control the germination of Poa annua. For this reason, it is usually necessary to vigorously break the soil surface layer by mechanical means before seeding in soil treated with high rates of arsenicals. Goss (unpublished data) found that high rates of lead arsenate completely eliminated bentgrass seedlings while not killing a significant number of Poa annua seedlings. The height of the seedlings were reduced, however.

Miller (10) Superintendent of the Louisville Country Club at Louisville, Kentucky, reported good success on the control of Poa annua in golf course fairways from applications of calcium arsenate. His program was coordinated with Dr. W. H. Daniel of Purdue University. Over a three-year period Miller was able to reduce the Poa annua on his fairways from about 20% down to 2% with successive applications of 200 #/acre of material. 200# of tri-calcium arsenate was applied in October 1966, 200# in March, 1967 and 200# applied in October 1967. In October 1968, another 100#/acre was applied and another 100# in April 1969. In August 1969, the final 100# per acre was applied. In the spring of 1970, Miller reported that 18# of formulation per 1000 square feet had reduced his Poa annua to less than 2%. He quoted that "I feel that calciu

arsenate is an excellent herbicide but must be used with discretion and forethought. It is not a black and white situation in applying X number of pounds of material and getting control of Poa annua and crabgrass. There is a very definite gray area in between and many variables that can effect the results in the material." Daniel (2) reported that when bentgrass-Poa annua fairways were treated with tri-calcium arsenate in the Chicago area, the bentgrass spread rapidly when the Poa was weakened and that overseeding with bluegrasses and bentgrass resulted in a change from 95% Poa annua to 98% bent and bluegrass in less than three years time.

These are but a few of the many references found in the literature but should suffice to point out that considerable work is being done in this area.

POST-EMERGENCE CONTROL

Tri-calcium arsenate is normally considered a pre-emergence herbicide, however, it has been reported as highly successful as a post-emergence treatment. Since many people are not willing to risk the chances of heavy use of arsenicals at this time, other possibilities should be investigated.

Research at the Western Washington Research and Extension Center at Puyallup in 1970 have been initiated in both pre- and post-emergence control of Poa annua. It is felt by the writer that the maintenance of near perfect stands of bentgrass on putting greens is the surest way for pre-emergence control of Poa annua. There are many problems, however, in maintaining pure stands of bent. Diseases probably are the number one enemy of bentgrass areas. When diseases such as Fusarium Patch or Ophiobolus Patch disease kill or severely injure bentgrass turf, re-invading species are likely to be Poa annua. An experiment has been initiated to determine the invasion routes of Poa annua and the speed at which it will invade bluegrass turf. This experiment centers around the use of Betasan, Tri-calcium arsenate, and fungicides in a number of combinations. We desire to learn what will happen if Betasan alone is used without the use of fungicides. Likewise, we would like to know what will happen if we use Betasan in combination with good fungicides to control diseases. Finally, tri-calcium arsenate will be used both alone and in combination with fungicides. It has been felt by the writer for a number of years that misuse of some of the good pre-emergence herbicides is responsible for only partial control of Poa annua. Obviously pre-emergence herbicides decompose gradually over a period of time, until they lose their toxicity. If the

level of toxicity of Bensulide is maintained high throughout the year, there should be little or no establishment of Poa annua. Therefore, part of this test revolves around the use of Bensulide several times per year. Obviously the total amount of active ingredient used will be higher than that recommended for any single application. This is only an idea and is currently being investigated and more results will be discussed next year. Determinations will be made from these experiments as to whether or not the materials being tested will post-emergently remove Poa annua as well as maintaining good pre-emergence control.

A second preliminary test was initiated in the summer of 1970 for the control of Poa annua post-emergently. Kerb, simazine, paraquat, MSMA (organic arsenical) and fenac were all tested in a pilot program. None of these materials are presently being recommended for the control of Poa annua even in bluegrass turf. High rates of Kerb and paraquat completely killed Merion bluegrass turf so the difference between selectivity and complete kill may be quite fine. Previous results indicates that low rates of simazine may be effective in selectively removing Poa annua from Merion bluegrass turf. This is being retested at various rates to determine its effectiveness.

Propane flaming was tested rather extensively on Poa annua infested Merion bluegrass. "Single-pass" flaming and "double" flaming were tested for effectiveness. One-pass flaming was effective in burning off all seedheads of Poa annua, killing some small seedlings, but not killing vigorous mature plants nor injuring Merion bluegrass to any extent. This leaf burn rapidly disappeared when the field greened up immediately. Double flaming resulted in some areas being somewhat charred and killed most of the mature Poa annua plants and all of the seedlings. This double flaming, however, did not kill or destroy the Poa annua seed that had already dropped to the soil surface. The results were that the Merion bluegrass recovered quite rapidly but subsequent germination of the annual bluegrass seed helped to re-establish the population. In one test, the intensity of flaming was stepped up to the point where all vegetation was killed and at this time a perfect stand of Poa annua has been established. This indicates that flaming can be carried to extremes to the point where the desirable grasses are completely eliminated as well as Poa annua but not the seed of Poa annua which was protected in the organic debris on the soil surface.

It is felt that propane flaming has quite a lot to

offer in the future for the control of Poa annua. If Poa annua does not comprise more than 30-50% of the stand then flaming can be used to eradicate the mature plant. Immediately after flaming the area pre-emergent herbicides may be applied to prevent the germination and establishment of additional Poa annua seedlings. If this program is successful, it will be fast and not too expensive.

In summary, it is felt that many inroads are being made into the selective control of Poa annua, pre- and post-emergently. As with crabgrass, some good controls will probably turn up in the next four or five years. In the meantime, well balanced nutritional programs, good disease control programs and good management will help to keep Poa annua at a minimum. Results at the Research Station at Puyallup indicate that applications of wettable sulfur have greatly reduced Poa annua establishment in putting green turf. The rates being tested are from 1 to 3.5 lbs. of wettable sulfur per 1000 square feet per season. The exact reasons for this effect are not well understood, however, pH and phosphorus availability affects are possible. This coincides with the work reported by Juska and Hanson (8) where they stated that four times as many seedheads were produced by Poa annua on loamy sand at a pH of 6.5 than at a pH of 4.5. Therefore, the effects of sulfur may be that in reducing the pH to produce this effect. Investigations are continuing in all phases of this research.

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Fusarium Patch Experiments With New Fungicides[1]

Charles J. Gould[2]

Benlate (benomyl) still appears to be one of the best of the new fungicides for the control of Fusarium Patch (F. nivale) and the production of high quality turf. We have been testing it on two experimental areas at 1 and 2 oz./1000 sq. ft.; at 2, 3 and 4 week intervals; and in combination with a wetting agent and with sulfur. Very promising results have been obtained with 2 oz. of Benlate every 2 or 3 weeks in 10 gallons of water per 1000 sq. ft. Registration of Benlate for use on turf is expected in the near future.

Another promising new compound is Bromosan (a mixture of PMA, thiram and tribromo salicylanilide) at 4 oz./1000 sq. ft. Fore (Dithane M-45), which has become our standard fungicide (at 8 oz./1000 sq. ft), is also giving good results in the current tests. Other fungicides under test are: Mertect 160 (thiabendazole), Mallinckrodt's MF-443, Calo-Clor, PMA, wettable sulfur and iron sulfate.

Unfortunately not enough Fusarium developed last fall or this spring in either one of the experimental areas to enable us to differentiate between excellent and mediocre fungicides. Therefore, we will repeat the tests during the 1970/71 season.

Corticium (C. fuciforme) Red Thread appeared on part of one of the experimental areas during the winter. Mercury-containing fungicides gave the best control; next best were Fore and Benlate.

My deep appreciation goes to my fellow cooperators: Dr. Roy L. Goss and Mr. V. L. Miller for their assistance in this research. For financial and other support I am grateful to the Northwest Turfgrass Association and to the various chemical companies involved.

1/Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/Plant Pathologist, Western Washington Research and Extension Center, Washington State University, Puyallup, Washington.

Agronomic Turfgrass Research Report[1]

Roy L. Goss[2]

NUTRITION RESEARCH

Nitrogen, Phosphorus and Potassium studies are continuing on ten-year old Colonial bentgrass turf. Soil levels of all nutrients including calcium are continuing to dwindle and deficiencies of these elements are becoming more noticeable. Turf that was re-established in the summer of 1969 on the putting green research area, has responded very well to treatment and the same deficiencies exising in the older turf are equally as pronounced, or more so, in the young turf. The plots were re-established without disturbing the soil, but simply by removing the old sod in a very thin layer.

Sulfur research is continuing in combinations with nitrogen and phosphorus. Potassium is being applied in a uniform application to all areas except the check plots in the sulfur research area. Sulfur continues to produce superior quality turf from the standpoint of density, texture, and color quality. Fifty pounds of wettable sulfur per acre (1.15 lbs./1000 square feet) produces a reasonable response but 150 lbs. per acre (3.45 lbs./1000 square feet) produces even better results. Interestingly enough, all sulfur rates, particularly the highest rate, produced plots with little or no Poa annua in them. All plots without sulfur have varying percentages of annual bluegrass and some of them are 50% or more.

All plots receiving phosphorus without sulfur have extremely high populations of Poa annua. Plots receiving both phosphorus and sulfur have some Poa but less than those without sulfur. This indicates a reaction between phosphorus and the incidence of Poa annua and also an interaction between phosphorus and sulfur. It is possible that the sulfur is lowering the pH of the soil, thereby, causing a tie-up of phosphorus, reducing its availability. High amounts of

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1/ Paper presented at the 24th N. W. Turfgrass Conference, Salishan, Gleneden Beach, Oregon, October 7, 8, 9, 1970.

2/ Associate Agronomist, Western Washington Research & Ext. Center, Washington State University, Puyallup, Washington.

phosphorus are generally required by bluegrasses for best growth.

POA ANNUA PRE-EMERGENCE PROGRAM

The Poa annua pre-emergence control program was initiated in the summer of 1970. Combinations of Betasan and fungicides and tri-calcium arsenate and fungicides are being applied to putting green turf (Highland bentgrass) to determine if these treatments will keep down Poa annua. The goals of this research are:

1. Determine what will happen if pre-emergence herbicides are used without fungicides.

2. Determine what will happen if fungicides are used without pre-emergence herbicides.

3. Determine what will happen if fungicides and pre-emergence herbicides are applied to the same area.

4. Consider the same points above only substituting tri-calcium arsenate in the place of the pre-emergence herbicides.

KENTUCKY BLUEGRASS STUDIES

Plots of Merion and Cougar Kentucky bluegrass are mature and have been subjected to treatments for the past year. Attempts are being made to maintain pH levels of approximately 6.0 or higher through annual applications of ground limestone. Pre-emergence herbicides have been applied to the plots in September, 1970. Observations will continue to determine if Kentucky bluegrass can be maintained as a pure mono species in Western Washington.

GROWTH REGULATOR STUDIES

Several different growth regulators were investigated in early summer, 1970, to determine their effect in inhibiting the growth of grasses. Most of the materials were numbered compounds and have not been released on the market. Some of the numbered materials demonstrated fair to good properties. Of those that are on the market, CF-125 Maintain applied alone and mixed with Maintain 3, produced better results than MH-30. Maintain 3 and MH-30, both being very similar products, provided some phytotoxicity initially, but the grasses all recovered.

SEEDHEAD INHIBITORS

Treatments were continued in the spring of 1970 with Po-San, which is a *Poa annua* seedhead inhibitor. Good inhibition was obtained at the manufacturers recommended rate for periods up to eight weeks or so duration. Some yellowing of the turf was noted in the beginning but was soon disappearing and the plots were even a deeper green than the original turf. It appears that these seedhead inhibitors have a place in our total program for *Poa annua* control.

COOPERATIVE AGRONOMIC, PATHOLOGIC STUDIES

Studies are continuing with Dr. C. J. Gould at the Puyallup Research Center for the control of *Fusarium* patch and *Ophiobolus* patch diseases of turf. These will not be elaborated upon at this time since Dr. Gould has presented this report.

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Rt. 1, Box 264
Beaverton, Ore. 97005

Puget Sound Seed Co.
1050 W. Nickerson St.
Seattle, Wa. 98109

Rainbird Sprinklers
W. L. Johnston
Rt. 1, Box 1042
Camas, Wa. 98607

Rainier Golf & Country Cl.
1856 S. 112th St.
Seattle, Wa. 98188

Rediturf Inc.
Box 946
Albany, Ore. 97321

Redmond Golf Links
7730 Leary Way N. E.
Redmond, Wa. 98052

Reed and Cross Inc.
160 Oakway Road
Eugene, Ore. 97401

Riverside Golf & Country C.
8105 N. E. 33rd Drive
Portland, Ore. 97211

James F. Roberts
20875 Valley Green Drive
Apt. 122
Cupertino, Calif 95014

Rock Creek Golf & Country Club
3680 N. W. Columbia Ave.
Somerset, West
Portland, Ore. 97229

Royal Colwood Golf & Country C.
629 Goldstream Ave.
Victoria, British Columbia

Royal Oaks Country Club
8917 N. E. 4th Plain Rd.
Vancouver, Wa.

Sahalee Country Club, Inc.
Box 183
Redmond, Wa. 98052

William Sander
Suite 103
12750 S. W. Pacific Hwy.
Tigard, Ore. 97223

Salishan Properties Inc.
Box 148
Gleneden Beach, Ore. 97388

Sand Point Country Club
8333 55th Ave. N. E.
Seattle, Wa. 98115

David Schodde
Box 622
Enumclaw, Wa. 98022

Scott Lake Golf Course
Rt. 4, Box 393A
Olympia, Wa. 98501

Seattle Golf Club
210 N. W. 145th St.
Seattle, Wa. 98177

Seattle Parks & Rec. Dept.
100 Dexter Ave. N.
Seattle, Wa. 98109

Seattle School Dist. No. 1
Maint. Dept.
815 4th Ave. N.
Seattle, Wa. 98109

Shadow Hills Country Club
Box 2529
Eugene, Ore. 97402

Sham-Na-Pum
(Memorial Park Golf Club Inc.
72 Geo. Washington Way
Richland, Wa. 98352

Shaughnessy Golf & C. C.
4300 S. W. Marine Drive
Vancouver 13, British Columbi

Shelton-Bayshore Golf Club
Box 89
Shelton, Wa.

Sherstobitoff, Nick N.
Catlegar & Dist. Golf Club
P.O. Box 121
Thrums, 6, British Columbia

Shoreline School Dist. No. 412
N. E. 158th & 20th Ave. N. E
Seattle, Wa. 98125

Ed Short Co.
2450 6th Ave. S.
Seattle, Wa. 98134

Jack R. Sim
Rt. 111 Courthouse
Grants Pass, Ore.

Similk Beach Golf Course
Rt. 72 Box 375
Anacortes, Wa.

A. R. Smith & Co., Inc.
919 Houser Way N.
Renton, Wa. 98055

Spokane Country Club
Box 7750
Spokane, Wa. 99208

Spokane Park Dept.
504 City Hall
Spokane, Wa. 98250

Sun Dance Golf Club Inc.
Rt. 1
Nine Mile Falls, Wa. 99026

Sun Irrigation Co.
916 N. E. 64th
Seattle, Wa. 98115

Sun Land Associates,
Kenneth L. Putnam
Rt. 2, Box 29
Sequim, Wa. 98382

Sunriver Golf Course
Sunriver Properties Inc.
Box 1224
Bend, Ore. 97701

Sunset Northwest
1919 Ave. N. E.
Bellevue, Wa. 98004

Suntides Golf Course
2215 Pence Road
Yakima, Wa.

Swift Agricultural Chemical Co.
Box 245 N.
Portland, Ore. 97201

Tacoma Golf & Country Club
Gravelley Lake Drive S. W.
Tacoma, Wa. 98498

Tam O'Shanter Golf Club
1313 183rd Ave. N. E.
Bellevue, Wa. 98004

Taylor, Pearson & Carson Ltd.
2331 Alberta St.
Vancouver, 10, British Columbia

A. H. Taylor
4949 Canada Way
Burnaby 2, British Columbia

Turf & Toro Supply Co.
6001 Maynard Ave. S.
Seattle, Wa. 98104

Tumwater Valley Golf Club
P.O. Box 769
Olympia, Wa. 98501

City of Twin Falls
Box 309
Twin Falls, Idaho 83301

Twin Lakes Golf & Country C.
3460 S. W. 320th
Federal Way, Wa. 98002

Van Waters & Rogers, Inc.
4000 1st Ave. S.
Seattle, Wa. 98104

Vancouver Golf Club
771 Austin Ave.
New Westminster, British Col.

Velsicol Chemical Corp.
341 E. Ohio St.
Chicago, Ill. 60611

Veteran Memorial Golf Course
Walla Walla, Wa. 99362

Wagner's (Ben) Nursery Service
504 Clay St.
Walla Walla, Wa. 99362

Walla Walla Country Club
Box 1236
Walla Walla, Wa. 99362

Wandermere Golf Course
Rt. 5
Spokane, Wa. 98253

Washington Tree Service
17868 28th Ave. N. E.
Seattle, Wa. 98155

Waverley Country Club
Box 1100 S. E. Waverley Dr.
Portland, Ore. 97222

Wellington Hills Golf Course
Woodinville, Wa. 98072

Western Plastics Corp.
2330 Port of Tacoma Rd.
Tacoma, Wa. 98421

West Seattle Golf Course
4470 35th Ave. S. W.
Seattle, Wa. 98106

Willamette Valley Country Cl
2396 N. E. Country Club Dr.
Canby, Ore. 97013

Wing Point Golf & Country Cl
Rt. 5, Box 5195
Bainbridge Island, Wa. 9811

Wenatchee Golf & Country Clu
1479 Box
Wenatchee, Wa.

Wilson & Geo. Meyer & Co.
318 Queen Anne Ave. N.
Seattle, Wa. 98109

Yakima Metro Park District
Box 171
Yakima, Wa.

PB-5923-267-P.PAM
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NORTHWEST TURFGRASS MEMBERSHIP DUES

1. Annual dues, $25.00, payable on or before May 15th each year. Dues are based on annual due date nonprorated.

2. Membership includes registration fee for one person at Annual Turf Conference. Other persons from member organization registration fee $8.00.

3. NO INITIATION FEES ARE CHARGED.

4. Non members may attend the Annual Conference by paying a $15.00 registration fee. For further information on dues, contact the Northwest Turf Treasurer.