PACIFIC NORTHWEST PROCEEDINGS 1953

PROCEEDINGS OF

7TH ANNUAL NORTHWEST TURF CONFERENCE 1953

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PACIFIC NORTHWEST TURF ASSOCIATION

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West Point, Pennsylvania

NORTHWEST TURF ASSOCIATION - OCTOBER 1952 -----

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PROGRAM

TUESDAY
September 22, 1953.

Morning

9:00 - 10:00 --

Registration. Room 213, Compton Union Building
HENRY LAND and A. G. LAW

Chairman: JAMES O'BRIEN, Vice President, Pacific Northwest Turf Association

10:00 - 10:15--

Welcome, M. T. BUCHANAN, Director, Agricultural Experiment Stations, WSC, Pullman, Washington

10:15 - 11:00 --

Turf Management. O. J. NOER, Sewerage Commission, City of Milwaukee, Milwaukee, Wisconsin.

11:00 - 11:30 --

Thatch on Golf Greens, TOM MASCARO, West Point Products Corporation, West Point, Pennsylvania

11:30 - 11:45 --

Insect Control. H. S. TELFORD, Chairman, Department of Entomology, WSC, Pullman, Washington

Afternoon

1:30 - 3:00 --

Business Meeting. ED FLUTER, President, Pacific Northwest Turf Association, 923 N. E. 155th, Portland, Oregon.

3:15 - 4:00 --

Reports of Research. JACK MEINERS, Pathologist, WSC, Pullman, Washington; and DON PETERSON, Agronomist, Western Washington Experiment Station, Puyallup, Washington

4:00 - 4:30 --

Questions

7:00 --

Annual Banquet -- Compton Union Building

WEDNESDAY

September 23, 1953 - Morning

8:30 --

Sectional Meetings, Compton Union Building Speakers for the two Sections will be shifted at 10:15.

Greens Management
Room 216

Chairman: KEN MORRISON,
Extension Agronomist, WSC,
Pullman, Washington

Water Management, CHARLIE WILSON, Western Director, USGA, P. O. Box 241, Davis, California

Water Movement in Soils. WALTER GARDNER, Soil Scientist, WSC, Pullman, Washington

Landscape Design. W. S. SUMMERS, Horticulturist, WSC, Pullman, Washington

Merion Blue Grass. ARDEN JACKLIN, Jacklin Seed Company, Dishman, Washington

Parks Cemeteries, Highways Management
Room 207

Chairman: B. R. BERTRAMSON, Chairman,
Department of Agronomy, WSC, Pullman,
Washington

Weed Control. HENRY WOLFE, Extension Weed Specialist, WSC, Pullman, Washington

Turf Fertilizer. PAUL BROWN, The Charles H. Lilly Co., Seattle, Washington

Roadside Turf. LESTER ORTON, State Highways Commission Salem, Oregon

Krilium Experiments, WILLIAM R. BURNETT, Montsanto Chemical Company, 4224 N. E., 29th Street, Portland 11, Oregon

Afternoon

1:30 - 2:30--

Field Trip to Grass Research Plots. KENNETH PATTERSON, Agronomist, WSC, Pullman, Washington

3:30 --

Leave for Hayden Lake

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THATCH ON GOLF GREENS

TOM MASCARO
West Point Products Corporation

Control of grain, thatch and mat is an important part of turfgrass management. All these undesirable conditions arise from the same factor -- an excessive amount of growth that is not removed by ordinary mowing practices. The golfer complains about the grain on the greens, that interferes with the accuracy of his putting. The superintendent is bothered by thatch and mat because they complicate every phase of maintenance.

When does grass growth become a problem? We aerify, fertilize and water to stimulate healthy, dense grass growth. We choose aggressive grasses that grow fast and heal quickly. Ordinary mowing removes the tips of the grass blades and controls the height of growth. But ordinary mowing does not remove the accumulation of surface stems and old leaves at the base of the plants. It is this accumulated growth that causes the headaches.

The accumulation between the new grass growth and the surface of the soil interferes with proper mowing. When the mower is set to cut at 3/16 or 1/4 inch, it cuts at this height above the thatch layer -- not above the soil. You no longer have the close-cut greens the golfers desire. The longer grass lies over, the ball skids across the blades and controlled, accurate putting is impossible.

When the golfers begin to complain, the superintendent has to do something to correct the situation. The most direct way of getting rid of the trash would be to plow it under and begin all over again. Dr. William Daniel of the Midwest Regional Turf Foundation often points out that the Indiana farmer is fortunate in that he can bury his mistakes every year when he plows. But the superintendent cannot plow up the greens; he must live with his mistakes.

Thatch does not develop overnight. It builds up a little at a time. You may not notice what is happening until the thatch has become heavy enough to be a major headache. It is better practice to observe the condition of the greens and control the thatch before it becomes serious. A sharp knife with a long blade is the only equipment needed to check on thatch build-up. Cut a plug from the green and you will see at once how great is the distance between the growing grass tip and the soil.

If a heavy thatch layer exists, it is likely that very little water is reaching the soil. The thatch is as good as a roof to shed water. Aerification will make openings to allow the water to pass through the thatch and into the soil. This is a quick way to allow water to get to the dry spots. But prevention is better than cure. A program should be instituted to get rid of existing thatch and prevent future accumulations.

Thatch not only sheds water and fertilizer. It is a breeding place for the organisms that cause plant disease. An accumulation of trash makes unsanitary living conditions for grass as well as people. Moreover, it has been shown that disease occurs chiefly on the older leaves of the grass. Healthy new growth is less susceptible. If old growth is allowed to accumulate at the base of the plants, disease attacks are more likely to occur.

The problems caused by thatch do not end here. Thatch keeps out the moisture and air needed for decomposition. As leaves and stems die they cannot be decayed into soil humus. Instead they form a partially decomposed organic layer, which many superintendents call "under-neath mat". This felt-like layer is even more impermeable to water.

Although thatch and mat are composed of the same materials, correcting these two conditions must be done by different methods. A surface thatch can be removed mechanically with hand or power tools. The underneath mat cannot be removed by surface working tools. Aerification to break it up and mix the material with soil is the only way to correct this condition.

Let's consider first the tools for removing surface thatch. Over the years many tools have been made for this purpose. Superintendents have used hand rakes with flexible or rigid teeth. Surface spiking tools have been used in the attempt to remove thatch. Many superintendents have devised their own tools to be pulled across the greens to remove thatch material. Ellis Van Gorder, Stanford University Golf Course, devised a tractor-pulled surface thatch remover composed of two rows of stable brooms with a row of flexible wire teeth between them. Ted Weisser, Scranton Country Club, Pennsylvania, has a home-made tool composed of two rows of closely spaced flexible steel teeth, that can be pulled over thatched areas with a small power unit. Toro Manufacturing Company had a tool many years ago that could be installed in one of their mowers. It consists of a series of kidney-shaped knives that rotate and cut slices into the turf.

As the importance of thatch control becomes recognized, many tools will be devised to help control it. We at West Point have been aware of the problem for several years. Professor Musser, Pennsylvania State University, suggested many times that an efficient power tool should be developed to help control surface thatch. Many superintendents recognized the need for better tools to control surface thatch. If thatch control has not been satisfactory in the past, it was because there were no adequate tools to control it.

At West Point we believed the ideal thatch control tool should combine efficient operation with satisfactory results. Hand tools are too slow and costly for more than once or twice a year use. Also, rakes and brushes roughen the putting surface. So we came up with the Verti-cut, a vertical mower that does its work with sharp blades rotating at high speed. We put power on the Verti-cut so it would be practical to use it at frequent intervals. And the sharp blades are designed to "shave" off the thatch, without any tearing or pulling to roughen the surface.

The Verti-Cut is as perfect as we can make it for the removal of surface thatch. But it is not intended to remove the underneath mat. Underneath mat can be overcome only through bacterial decomposition. Conditions must be made favorable for bacterial activity. The bacteria exist in the soil. Aerification mixes soil with the organic layer and it admits the oxygen and moisture needed by the bacteria. Frequently lime is needed to assist decomposition.

The organisms that break down thatch use nitrogen, and will compete with the grass for available nitrogen. You may notice a yellowing effect on the turf when decomposition is active. An application of nitrogen will supplement the supply in the soil and provide food for the grass as well as the bacteria.

It should be remembered that thatch and mat build up slowly. And it will take time to overcome them, too. Don't become impatient and try some drastic operation to get rid of the material all at one time. A long range program should be put into effect to bring about gradual control, with a minimum of inconvenience to the players.

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INSECT CONTROL ON TURF

H. S. TELFORD
Dept. of Entomology, State College
of Washington, and Carl A. Johansen

Chlordane is one of the most versatile insecticides for turf insect control. Not only can it be used as a soil treatment, but it is also effective for certain species of insects occurring on the oliage or on the crown. Turf managers should seriously consider pre-planting treatment of soil with DDT or Chlordane for such insects as wireworms, white grubs, and related soil-inhabiting insects.

A relatively new insecticide which will gain more widespread use is a systemic material called <u>Systox.</u> While it may not have widespread use on turf insects per se, turf managers will find it particularly useful to control aphids, mites, and perhaps other sucking insects on ornamental plantings. The chief value of this material is its ability to be translocated in the sap of the plant, protecting foliage for considerable periods of time. The plant remains toxic because rains, sprinklers, wind, etc., do not remove this protective residue. It is not recommended on gardens or food crops as the problem of the toxicity of residues has not been fully evaluated. Hazards from exposures must also be guarded against and precaution should be taken similar to parathion and other related toxic phosphate insecticides.

Insecticides

1. Wettable powders - composed of toxicant, diluent powder and wetting agent. Must be kept agitated to keep it in suspension.

2. Dust - composed of toxicant and diluent. Applied dry.

3. Emulsifiable concentrate - composed of toxicant, solvents and emulsifier. Forms a milky emulsion that doesn't need agitation.

Various toxicants are used in insecticides. Different poisions act in different ways, and some are more effective than others against specific pests.

The inorganic toxicants include lead arsenate, sulfur and selenium. Their toxic action occurs in the stomach or intestine. They are moderately toxic to warm blooded animals. Plants often are susceptible, too. They are used mainly for chewing insects.

Botanicals, or plant materials, include nicotine and rotenone. They usually are very low in toxicity to warm blooded animals and to plants. They are, therefore, excellent for household and livestock sprays.

The chlorinated hydrocarbons include DDT, DDD, Chlordane, Toxophene,Ovotran, and Aramite. These chemicals act mainly through contact action. They have long residual action and can give some trouble to livestock. They are very effective against many insects, with the exception of Ovotran and Aramite which are specific for mites only.

The organic phosphates include Parathion, TEPP, Systox, Pestox, Malathion and Dithione. As a group they are toxic to warm blooded animals. But they break down quickly so there is little danger except when applying. They have excellent contact and fumigant action. As a group they are most effective against aphids and mites. Parathion is effective against the widest range of pests. Malathion is excellent against mites and aphids. It is similar to Parathion, but less toxic to warm blooded animals.

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RESULTS OF THE TURF FUNGICIDE TRIALS - 1952 - 1953

WASHINGTON AGRICULTURAL EXPERIMENT STATIONS
PULLMAN, WASHINGTON

Jack P. Meiners

Fungicide screening trials on snow mold control were conducted at Washington in 1952 in cooperation with the National Cooperative Turf Fungicide Trials. These trials were initiated at this station in 1951, when 15 fungicides included in the screening test, were evaluated for snow mold control. The unusually heavy infestation of the disease, which occurred in 1951 subjected these fungicides to a severe test and those which gave little or no control were not included in the 1952 trials. One fungicide (Phenyl Mercury Acetate Solubilized No. 10) has been added.

As in the previous year, the trials were conducted on golf greens at two locations: one at the Indian Canyon Municipal Golf Course in Spokane, and the other at the Washington State College Golf Course in Pullman. In both locations the turf consists of Seaside Bent and was fertilized for the final time in August, '52.

In Spokane, the chemicals were applied in mid-November to greens which were frozen. Five by ten foot plots in duplicate on each of two greens were used, but snow mold developed on only one green. Each of the eight fungicides was applied at two dosages. In Pullman, eleven fungicides were applied in late November to frozen greens, using 8 x 80 foot plots, with one plot of each fungicide on each of three greens. In both locations, application of the fungicide was made either in dry form using sand as a carrier (10 qts. /1000 sq. ft.) or as a spray using water as a diluent (5 gals. /1000 sq. ft.). In general, heavier dosages of materials were used in 1952, because the lighter dosages used in 1951 failed to give complete control.

In spite of very little snow cover, abundant snow mold developed on the untreated plots in both Pullman and Spokane in the winter of 1952-53 so that a good test of the fungicide was obtained. In Pullman, and on some of the greens in Spokane, - the disease was associated primarily with Fusarium nivale; whereas, on the green on which the plots were located in Spokane, Typhula itoana was the dominant organism. Disease readings were taken early in March, 1953, and were recorded as per cent of the turf showing symptoms of snow mold. The results are summarized in the accompanying table.

The results obtained in 1952 agree very closely with those obtained in 1951. In both years and both locations, the liquid phenyl mercuries (PMAS, Puraturf, Phenyl Mercury Acetate Solubilized No. 10, Tat-C-Lect) were outstanding in reducing the percentage of snow mold. Cadminate, used at much heavier dosages this year, also gave excellent control at Spokane, although some injury to the turf was evident at the heavier dosage (4 oz.) This same material ranked just

Effect of Fungicides on Per Cent Snow Mold at Pullman and Spokane, Washington in 1952-53

Treatment	Dosage per 1000 sq. ft.	Method of Application	Per Cent Snow Mold[1]
Pullman[2]			
Untreated	---	---	48.0
Phenyl Mercury Acetate Solubilized No. 10	2 oz.	wet	1.7
Tat-C-Lect 10%	2 oz.	wet	1.7
PMAS 10%	2 oz.	wet	1.8
Puraturf 6%	3 oz.	wet	2.0
Cadminate	2 oz.	wet	3.8
Calo-clor	3 oz.	dry	4.8
Special Semesan	5 oz.	wet	9.6
Puraturf GG	1 oz.	wet	10.6
Calocure	3 oz.	dry	17.5
Spergon	6 oz.	wet	35.5
Tersan 75	6 oz.	wet	38.0
Spokane[3]			
Untreated	---	---	26.7
Cadminate	2 oz.	wet	0.0
Cadminate	4 oz.	wet	0.0
Phenyl Mercury Acetate Solub. No.10	.1 pt.	wet	1.5
Phenyl Mercury Acetate Solub. No.10	.2 pt.	wet	0.0
PMAS 10%	.1 pt.	wet	3.5
PMAS 10%	.2 pt.	wet	0.0
Tersan 75	3 oz.	wet	4.0
Tersan 75	6 oz.	wet	1.5
Calo-clor	2 oz.	dry	5.7
Calo-clor	3 oz.	dry	4.0
Calocure	3 oz.	dry	6.2
Calocure	4 oz.	dry	4.7
Spergon	3 oz.	wet	2.2
Spergon	6 oz.	wet	6.7
Special Semesan	3 oz.	dry	17.5
Special Semesan	6 oz.	dry	9.7

[1] Pullman - average of three replications
Spokane - average of two replications

[2] Dominant organism *Fusarium nivale*

[3] Dominant organism *Typhula itoana*

behind the phenyl mercuries at Pullman. Calo-clor also reduced snow mold percentages considerably at both locations, but ranked well behind the phenyl mercuries in giving efficient and consistent control of the disease. As in 1951, Tersan was effective in Spokane, but ineffective in Pullman. The remaining fungicides tested did not provide adequate control of the disease.

In an additional trial conducted at Pullman, to determine the minimum effective dosage of PMAS required to control snow mold, it was found that one ounce in five gallons of water per 1000 square feet did not provide as good control as did two ounces, but that three ounces provided no additional control. Where one-half gallon of water per 1000 square feet was substituted for five gallons of water as a diluent no difference was noted in degree of control obtained.

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PROGRESS REPORT OF THE PEARLWORT CONTROL PROJECT AT THE WESTERN WASHINGTON EXPERIMENT STATION

Donald R. Peterson

Among the many troublesome weeds that are prevalent on golf courses throughout the Pacific Northwest none are more widespread or persistent than pearlwort (Sagina procumbens.) For years golf course superintendents have attempted to combat this perennial pest by removing the infested portions of their greens by means of cup-cutters or other similar devices and resodding these areas with pearlwort-free turf, an operation that is both costly and time-consuming and frequently ineffective. Certainly no aspect of greens management is more deserving of the attentions and facilities of agronomic research than the problem of pearlwort control. With this object in mind, a study, sponsored jointly by the Pacific Northwest Turf Association and the State College of Washington, was initiated to discover ways and means whereby an effective control of this weed might be obtained.

In the fall of 1951 a seedbed, built up of equal parts of a well-decomposed peat, sawdust, sand and the parent soil (an impervious clay) to a depth of 12 inches, was constructed. These materials, together with sufficient lime to bring the soil reaction to approximately 5.6, were mixed thoroughly. The green, 4000 square feet in area, was then seeded to a mixture of Colonial bentgrass and creeping red fescue. In the following spring, four species of plots, each series including eleven 5' x 10' plots, were laid out. Thirty plugs of sod were removed from each plot and these were replaced by plugs of pearlwort which were obtained from golf courses in the area. The turf management, including watering, fertilizing, and mowing, to which this experimental area has been subjected during the course of this study has been similar to the management practices generally employed on golf greens in the western Washington area.

Ten treatments, comprising the most promising of a number of materials tested in a preliminary study conducted in the greenhouse and the recommendations made by weed and turf specialists from the various cooperating agencies, have been studied in replicated plots during the past two years. In addition, check or no treatment plots were also included within the scope of this experiment. The treatments, form, rate, and time of application, and the results obtained are presented in tabular form on the following page.

Bear in mind that in developing a control for pearlwort, the objective was to find a material or combination of materials that would not immediately kill or burn out the weed, causing severe discoloration and disfigurement to the turf, but would weaken it to such an extent that the desirable grasses might gradually "crowd" it out of the turf. The only treatment that satisfied these requirements was a combination of sodium arsenite (1/2 oz. per 1000 sq. ft.) mixed thoroughly with an organic fertilizer (5-4-0); the mixture was then applied at biweekly intervals at the rate of 16 pounds per 1000 square feet. This treatment not only reduced the infestation of pearlwort, but also largely eliminated annual bluegrass (Poa annua) from the turf. Sodium arsenite, applied in the same manner at the rate of 1/4 oz. per 1000 square feet, was not nearly so effective in reducing the infestation of pearlwort. Spray applications of 2, 4-D checked the growth of pearlwort and broad-leaved weeds alike, however, this effect was accompanied by a severe burning of the bentgrass, particularly at the heavier rate of application. Chlordane, applied as a spray at two rates, was neither effective as a control for pearlwort nor for other broad-leaved weeds that encroached into the plot area. Chlordane, mixed dry with an organic fertilizer and applied in that manner, was somewhat more effective. Supplemental applications of commercial nitrogen fertilizer improved the general appearance of the turf, but at the same time stimulated markedly the growth of pearlwort.

TREATMENT				RESPONSE OF PEARLWORT	REMARKS
Material	Form	Rate of Application	Time of Application		
No. treat.	---	---------	---------	no change, new infestation	nutrient deficiency, infested with annual bluegrass
2, 4-D	spray	0. 2% water soln. turf wetted thoro.	June 19	weakened, new infestation	nutrient deficiency, burn injury to grass
2, 4-D	spray	0. 4% water soln. turf wetted thoro.	June 19	weakened, very little new infestation	nutrient deficiency, severe burn injury to grass
Chlordane	spray	6 oz. actual 1000 sq. ft.	June 19	spreading, new infestation	nutrient deficiency, infested with chickweed, plantain, annual bluegrass
Chlordane	spray	12 oz. actual 1000 sq. ft.	June 19	no change, new infestation	nutrient deficiency, infested with chickweed, plantain, annual bluegrass
Chlordane	spray	6 oz. actual 1000 sq. ft. 0. 2 soln.	June 19	no change, new infestation	nutrient deficiency, burn injury to grass
Nitrogen	dry ammonium sulphate	3/8 lb. N/1000 sq. ft.	June 19-there after bi-weekly intervals	no change, new infestation	good color, dense turf, no visible nutrient deficiency
Sodium	dry	1/4oz. /1000	June 19-there after bi-weekly intervals	weakened, very little new infestation	good color, dense turf, no visible nutrient deficiency

TREATMENT				RESPONSE OF PEARLWORT	REMARKS
Material	Form	Rate of Application	Time of Application		
Sodium arsenite Nitroganic	dry mix	1/2 oz. /1000 sq. ft.	June 19-there after bi-weekly intervals	severely weakened, no infestation	good color, dense turf, no visible nutrient deficiency
Chlordane Nitroganic	dry mix	6oz. actual 1000 sq. ft.	June 19-there after bi-weekly intervals	no change, little new in-festation	good color, turf dense, no visible nutrient deficiency
Sodium arsenite Nitroganic	dry mix	1/4oz. /1000 sq. ft. 16 lbs. /1000 sq. ft.	June 19, there-after bi-weekly intervals	weakened, very little new infestation	good color, dense turf, no visible nutrient deficiency
Sodium arsenite Nitroganic	dry mix	1/2oz. /1000 sq. ft. 16 lbs. /1000 sq. ft.	June 19, there-bi-weekly intervals	severely weakened, no infestation	good color, dense turf, no visible nutrient deficiency
Chlordane Nitroganic	dry mix	6 oz. /actual 1000 sq. ft. 16 lbs. /1000 sq. ft.	June 19, there-after bi-weekly intervals	no change, little new infestation	good color, turf dense, no visible nutrient deficiency

In view of the effectiveness of sodium arsenite when used in combination with a supplemental fertilizer, treatments, employing five different rates of this material, were applied at bi-weekly intervals on a pitching green located at the Ranier Golf and Country Club in Seattle. These treatments, initiated in late summer of this year, should give a more comprehensive picture of the effectiveness of this material under actual golf-use conditions.

Another herbicide, namely a sodium salt of 2, 4-D, has also shown exceptional promise as a control of pearlwort. In a series of treatments conducted in 1952 at the Tacoma Golf and Country Club this material, when applied in a dry mix with an organic fertilizer, checked completely the growth of pearlwort. However, the dry or powder preparations of 2, 4-D that were so very effective in these early tests are no longer available on the market. Recently, a small quantity of a similar 2, 4-D material was obtained for experimental purposes. A series of test plots which will include the application of this material at several rates will be set out in 1954.

The information that has been obtained thus far strongly recommends the use of sodium arsenite (1/2 oz./1000 sq. ft.) applied in a dry mix with a supplemental fertilizer. The importance of the supplemental fertilizer cannot be over-emphasized. The desirable grasses in a golf green must be strengthened and invigorated to resist any new infestation of pearlwort and to crowd out existing clumps of this weed that have been weakened by the application of the herbicide. Sodium arsenite, when applied in dry form at regular two-week intervals, has weakened the pearlwort thereby contributing to its gradual disappearance without burning or otherwise disfiguring the green.

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WATER MANAGEMENT

CHARLES G. WILSON

Western Director, USGA Green Section,
Western Office, Davis, California

My subject for today is Water Management, and certainly the Green Section feels that the use, or misuse, of water is the primary cause of most of our turf headaches. It influences the disease and weed symptoms that we see; it is tremendously important as far as plant food requirements and turf species are concerned; and in the case of surface feeding insects, our watering practices often nullify the results obtained from using good insecticides. And of course during critical hot spells it is usually water that is primarily responsible for the condition known as scald or melting out.

In order to properly understand how to water it is necessary to understand some of the fundamentals facts of water management. To begin with, sprinklers do not apply moisture at the rate that the soil under our turf has the ability to absorb it. Most of the sprinklers in common use today apply water entirely too rapidly. Other fundamental facts relate to the nonuniformity of wetting of various soils because of ground contours that allow run-off; the management that we employ in building false water tables by applying alternate layers of sand, soil and peat as topdressing; andof course nature's built-in headaches, which we call hard pan.

Soils do not wet uniformly and this is known by everyone because of the condition known as localized drying or dry spots that appear on our turf areas. One reason for dry spots is an improper sprinkler distribution pattern.

Although sprinkler design may look good on paper, wind movement can disrupt the distribution of the best designed sprinkler system.

Compaction by foot, by caddy cart, and heavy machinery used in construction is responsible in many instances for localized drying and poor water infiltration.

Root competition (both trees and shrubs) also is a cause of rapid drying out because of the competitive factor for moisture. With most of our turfgrasses we find that the build up of thatch or partially decomposed organic matter from stems, stolons, and clippings tend to shed water on the high spots, resulting in ununiform wetting.

Another fundamental fact is that it is impossible to partially wet a soil. How often have you heard the statement that we could put on the water for one half hour tonight with the thought in mind that the entire soil profile would be uniformly wet. Of course this cannot happen because the surface or any type soil must reach its field capacity before percolation or gravitation will wet the lower depths.

Another thing about wetting soils is that you can't tell if moisture is adequate or not by the feel of the turf underfoot. As an example, we have allowed a plot of grass to remove all the available moisture to a depth of two feet, and then watered a portion of the area to apply 2-inches of moisture, and another portion to apply 2-feet of water. Immediately after the sprinklers are turned off the feel underfoot is exactly the same. You need a soil sampling probe to ascertain how much water is needed. In California a few golf and lawn supply dealers are handling these 18 to 20 inch soil sampling probes. We feel that the intelligent irrigator needs such a tool.

What exactly do we mean by under and over watering? The fundamental rule is this: when more water is applied than is necessary to wet the soil in the effective zone of rooting, you are definitely overwatering, regardless of soil type. How often have you heard the erroneous statement that you can't overwater a sandy soil? The thought in mind probably being that since a sandy soil is well drained you never notice any puddling on the surface. This does not mean however that you can't overwater a well drained sandy porous soil. The fact is that by allowing sprinklers to run on such a soil for long periods of time you not only waste water, but in addition you leach out valuable plant food nutrients, thus increasing your fertilizer as well as your water bill. Actually it is often the heavy soils that are notoriously underwatered rather than overwatered. I know this statement may sound strange to some of you. However, it is fairly obvious in that a heavy soil (clay) takes a great deal more water in the form of surface inches of rainfall or irrigation to wet the soil to a given depth when compared to a sandy soil.

Most turf areas are both under and over watered, and this can happen within a relatively small area, such as on a putting green. We find that a proper setting for a green that is open and high on a windy hill is usually entirely too much for a pocketed green. This is influenced of course by air movement which in turn influences your evaporation rate. Competition from tree roots, temperature, and humidity also are factors that make it impossible to use the same sprinkler setting on each green. Sprinkler settings that adequately water the high spots on any given putting green or turf area invariably apply too much water to the low areas. Actually, we like to see localized dry spots on collars and backs because it indicates that at least excess water is not being applied in the low spots.

Soils should dry from the top down, not from the bottom up. When sub-soil capable of encouraging grass roots is overly wet you are overwatering. When it is dry you are underwatering.

What are the rooting capabilities of some of our major turf grasses? For this information you are referred to Dr. R. M. Hagan's article on "Know How to Water", which appeared in the February 1953 issue of our USGA JOURNAL AND TURF MANAGEMENT. You will note that the creeping red fescues have effective roots approximately 2-inches deeper than did the Chewings fescue. Highland bent was a little bit better than the fescues. Kentucky bluegrass almost doubled the amount of effective roots by penetrating to the 30-inch level. Merion bluegrass was even better than common Kentucky bluegrass. Our tall fescues, such as Kentucky 31 (Alta is another example) have root systems at a depth of better than 36 - inches. Bermuda, both the improved U-3 and the common strain, have effective root systems to a great deal more than 36-inches. In this study considerable moisture extraction took place below the depths you actually see on the chart. As an example roots were found below the 5-foot depth on Merion bluegrass, and considerably below 6-feet on bermudagrasses.

Another chart in this article shows the elapsed days before distinct wilting took place. With the creeping fescues and bents, the grasses went 14 days without any loss of color. It took this long before wilting or tracking occurred. Kentucky bluegrass went 24 days between irrigations. Merion bluegrass 30 days, and the Kentucky 31 fescue approximately 36 days. You will note that bermuda is not listed. It is the most drought tolerant of all grasses tested, and the reason it hasn't been listed is that it was watered one time, by accident, in 1952. We do not know how long it would have gone before wilting took place. During 1953 it was never watered, and Davis was both hot and dry with a water use rate that closely approached 2-inches per week. Better than 130 days elapsed between rains.

We were dissatisfied with the performance of red fescue because we know it to be one of our most drought tolerant grasses in the Northwest and also in part of the East. We think therefore, that this same experiment might well be repeated here in the Northwest, in the event that some other factor, for instance heat, may have influenced the depth of rooting of our red fescues.

Possibly the most outstanding finding of all is the importance of uniformity of soil to a tremendous depth. In other words, no false water tables by adding sand and then peat and then going back to soil again, because such layers will interfere with maximum depth of rooting.

How then should we water? Well, certainly we can say that insofar as our turf use will allow, itshould be infrequently and deeply. The schedule of course is going to depend upon soil texture, water use rate in your area, effective depth of rooting, and the delivery rate of your sprinkler. Delivery rate can be easily ascertained by using coffee cans as rain gauges. These can be spaced from the sprinkler setting to the outer perimeter and will tell you in short order how much water your sprinkler is delivering. It should be appreciated that we loose pressure and increase frictional losses as we get farther away from the pump. Therefore, the same type sprinkler may be delivering a different amount of water in two different areas.

Soil texture is a known fact and your county agent or agricultural experiment station can tell you whether or not you have a sand or a loam or clay. We also know that we can grow grass on any type of soil as long as it is uniform. In fact many of our turf headaches result from improper mixing of soil materials during construction. We find that the use of a Rototiller often floats the fines to the top which results in layering, and use of disc often leaves pockets of one material or another where turns are made. For this reason the USGA Green Section advocates mixing soil materials off of the green site.

The water use rate in your area, or the approximate rate at least, is probably available through your local experiment station or from your county agents office. Naturally it will differ with the season and from hour to hour during the day. It probably approaches 1-inch a week along the coast, and ease of the mountains possibly is 1 1/2 to 1 3/4 inches per week during the hot summer season.

Water management is the most important influence on the effective depth of rooting. Deep roots are the best measure of turf quality that we have. Almost invariably good roots will mean good tops. How do we know what our depth of rooting is? Again I will repeat, you need some sort of a soil probe to find out. How about a cup cutter change? It works fine, except you never know on the high spots because cups are never set there. I can say that on tests I made on greens in the spring of this year, in both the Western and Eastern parts of Washington and Oregon we found many greens where roots were emerging from the bottom of our 18-inch soil probe. Another one of Dr. Hagan's charts explains irrigation interval as influenced by soil texture and depth of root zone where the water use rate is 1-inch per week, or similar to the use rate in the Seattle, Portland area. This information tells us that with effective roots 24-inches deep the turf should go for at least 16 days between irrigations on a loam soil, 7 1/2 days on a sandy soil, and 27 days on a clay soil.

Another chart tells us the amount of surface inches of water required to wet soils to given depths, assuming no surface run-off. From this chart we find that if you wish to wet a 12-inch depth of loam soil it is going to take approximately 1 1/2 inches of water to do it. With a sandy soil it will take about 3/4 inch and with a clay soil it will take about 2 1/2 inches of water to wet the soil to a 1-foot depth.

This logically leads us to the next point concerning the sprinklers that are in use today. How long must they run on an average to deliver an inch of water? This varies with make and size, and as previously mentioned each superintendent should find out by using cans as rain gauges. If, as an example, it delivers 1/3-inch per hour the sprinkler will have to run for 3 hours to apply 1-inch of water. On a loam soil it would have to run approximately 4 1/2 hours to wet the soil to a depth of one foot, assuming that the grass had removed all available moisture to this depth. Thus it is very very hard to water properly, because when we water infrequently our sprinklers have to set for long periods to put on enough water, and even so they apply moisture too rapidly. On many areas we can't allow sprinklers to run for long periods of time without getting excessive run-off. Therefore, we must resort to maximum settings before run-off occurs. The intelligent irrigator picks up during the day by hand, with soakers, with sub root irrigators, or in some instances the use of plastic perforated hose that will apply moisture slowly. Dry spots can be identified on bentgrass before wilting takes place by the lack of dew or guttational water on the tips of the blades in early morning. We can use aeration tools to increase water infiltration and thus hold the moisture on the slopes without getting excessive run-off. We can resort to root pruning with a tree root pruner or edging our turf areas to prevent competition from tree and shrub roots robbing our turf grasses of moisture.

In closing, I will again point out that you can't water properly on a fixed schedule. Most of us do water on a fixed schedule. If soil sampling probes show that moisture is adequate, we think it advisable for each turf manager to let the night water men sweep out the barn or tool shed on occasion, and better turf will be the result.

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PHYSICAL PROPERTIES OF SOILS WITH SPECIAL REFERENCE TO WATER MANAGEMENT

WALTER H. GARDNER
Pullman, Washington

SOIL PHYSICAL CONDITION AND PLANT GROWTH

The factors which are important to plant growth and which depend largely on soil physical conditions are:

aeration

water supply

soil temperature

mechanical impedence to roots and shoots

These factors depend upon the nature of the mineral and organic constituents of the soil and upon the geometry or physical arrangement of the primary soil particles. The sizes and size distribution of primary soil particles are discussed using the terms "soil texture" and "soil textural class". Soil particles whose diameter is less than 0.002 mm. are classed as clay, those particles greater, than 0.002 mm. but less than 0.05 mm. are classed as silt, particles greater than 2 mm. are classed as gravel. Depending upon the relative quantities of sand, silt or clay contained in the soil various textural class names are used to describe a soil. These are indicated in the textural triangle of Figure 1.

The physical arrangement of primary particles into coherent groups and the arrangement of primary particles and coherent groups in the bulk soil is thought of as soil structure. The coherent groups are called aggregates and the stability of these coherent groups against various destructive forces is called aggregate stability. A common measure of aggregate stability calls for subjecting a soil sample to an arbitrary disruptive force (commonly moving water) and then measuring the size and size distribution of the aggregates which remain unbroken after the soil has been subjected to this disruptive force for a suitable interval of time. In discussing aggregate stability one must always specify the nature of the disruptive force against which the aggregates are stable.

About 35 per cent of the soil volume of ordinary agricultural soils is occupied by soil particles with the remaining voids being occupied by air and water. The total volume of soil voids and the dimensions and shape of the void spaces depends upon both the textural class of the soil and the structure of the soil.

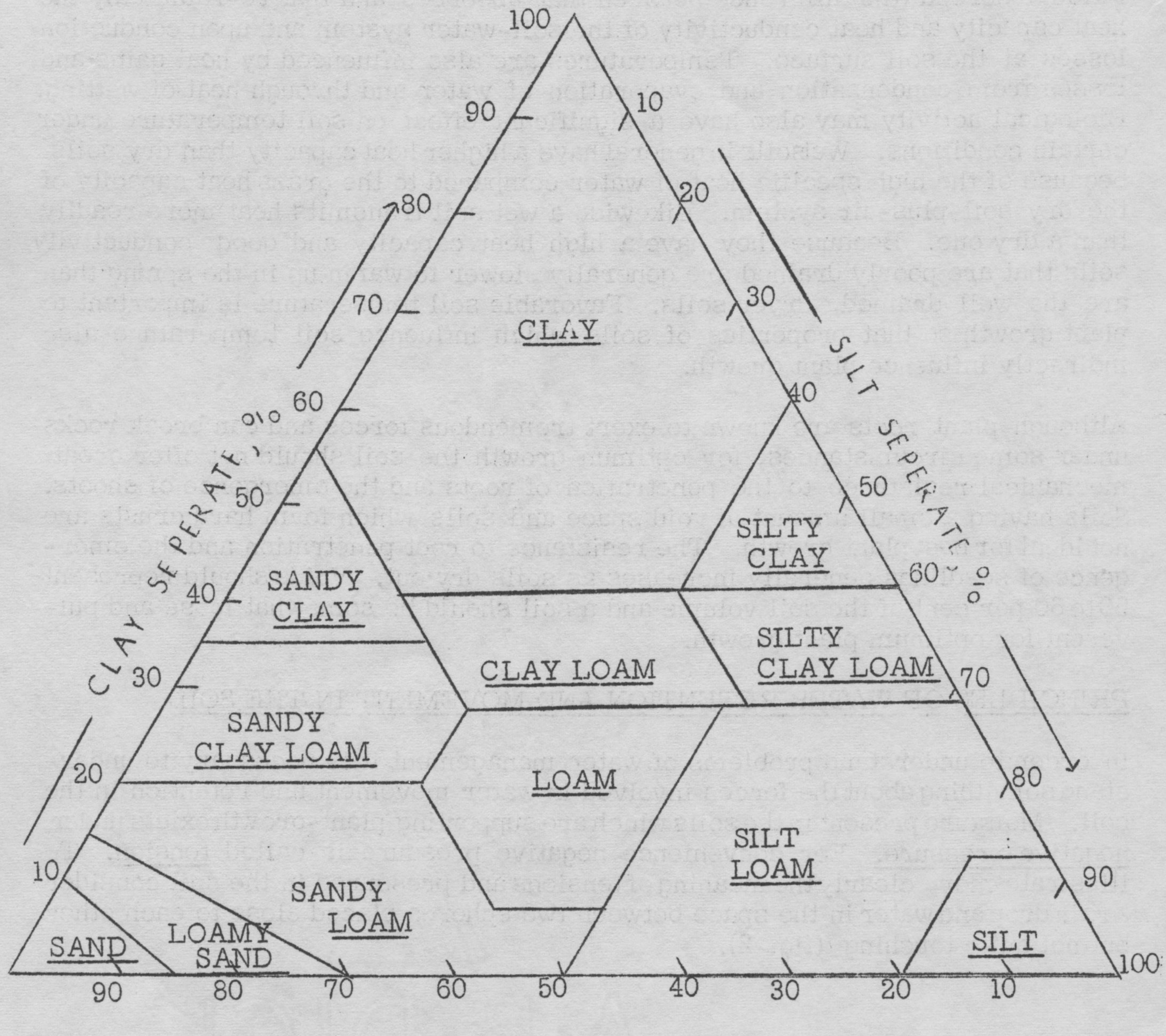

Fig. 1. SOIL TEXTURAL TRIANGLE

Water retention and transmission in the soil depends largely upon the geometry and size of the void spaces. The quantity of air in a soil is inversely proportional to the water content. Aeration and water supply then, depend upon soil texture and soil structure.

The temperature of the soil depends largely upon the net amount of solar radiation absorbed (the difference between that absorbed and that re-radiated), the heat capacity and heat conductivity of the soil-water system and upon conduction losses at the soil surface. Temperatures are also influenced by heat gains and losses from condensation and evaporation of water and through heat of wetting. Biological activity may also have a significant effect on soil temperature under certain conditions. Wetsoils in general have a higher heat capacity than dry soils because of the high specific heat of water compared to the grass heat capacity of the dry soil-plus-air system. Likewise a wet soil transmits heat more readily than a dry one. Because they have a high heat capacity and good conductivity soils that are poorly drained are generally slower to warm up in the spring than are the well drained, dryer soils. Favorable soil temperature is important to plant growth so that properties of soils which influence soil temperature also indirectly influence plant growth.

Although plant roots are known to exert tremendous forces and can break rocks under some circumstances, for optimun growth the soil should not offer great mechanical resistance to the penetration of roots and the emergence of shoots. Soils having a small amount of void space and soils which form hard crusts are not ideal for best plant growth. The resistance to root penetration and the emergence of seedlings generally increases as soils dry out. Voids should represent 50 to 60 per cent of the soil volume and a soil should be somewhat loose and pulverent for optimum plant growth.

PRINCIPLES OF WATER RETENTION AND MOVEMENT IN THE SOIL

In order to understand problems of water management it is necessary to understand something about the forces involved in water movement and retention in the soil. Moisture present in the soils which are supporting plant-growth exists under negative pressure. For convenience negative pressure is called tension. To illustrate more clearly the meaning of tensions and pressures in the soil consider a rain drop and water in the space between two spheres placed close to each other but not quite touching (fig. 2).

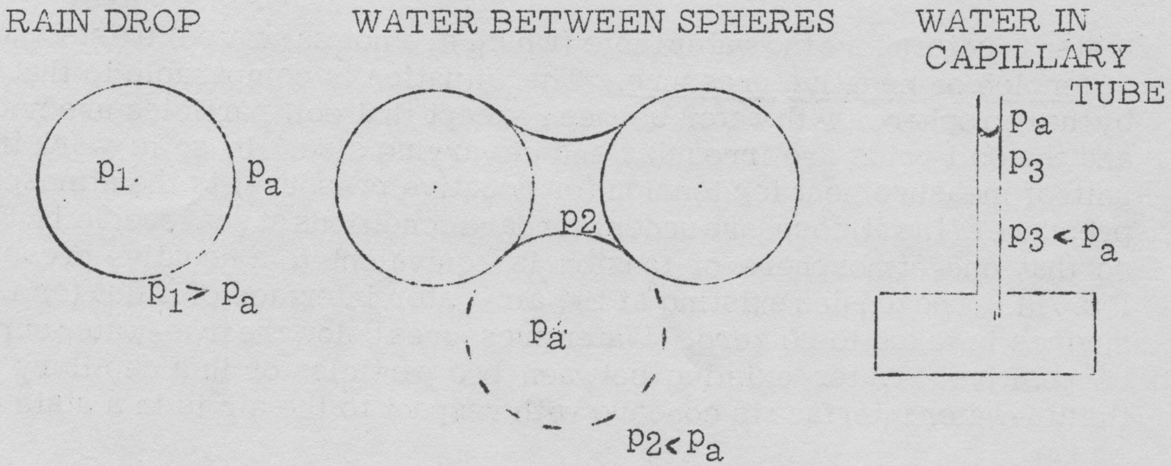

Figure 2. Air-water interfaces for water in a raindrop, between two spheres and in a capillary tube.

Because of surface tension forces, the water in the raindrop tends to assume the distribution giving the minimum surface area (not quite a sphere because of its motion with respect to the air). The pressure of the water inside the drop is greater than the pressure of the atmosphere outside by just enough to compensate for the additional pressure brought about through surface tension forces which act on the water surface. The equation at equilibrium would be $p1 = p_a \, pst$, where p1 is the pressure inside the drop, p_a is the pressure of the atmosphere and pst represents a pressure due to surface tension. Note that the pressure is greatest on the concave side of the air-water interface.

Because of cohesive forces between water molecules and adhesive forces between the solid materials in the surface of the spheres and the water molecules, the water between the two spheres is actually under <u>tension</u> or <u>negative pressure</u> with respect to the atmosphere. The pressure within the water, p_2 is less than the pressure of the atmosphere, p_a. The difference in pressure is again due to surface tension forces--this time arising from the cohesive and adhesive forces associated with water molecules and the solid spheres. The pressure is again the greatest on the concave side of the air-water interface. Capillary rise of water in a small tube is a similar phenomenon.

Water in soils above the water table (which are not saturated) exists under a state of tension or negative pressure. The situation is comparable to that illustrated by the two spheres with water between except that soil particles are not spherical and the soil voids are irregular and of varying size. In soils work the common unit of measurement for tension (or negative pressure) is the atmosphere. The pressure of the atmosphere under standard conditions at sea level is 14.7 lbs./in.^{2} so that one atmosphere of tension is equivalent to a negative pressure of 14.7 lbs./in. The tension existing at the air-water interface of a flat (or free-water) surface is taken to be zero. Water pressures below the free-water surface would be positive. Water existing between two particles or in a capillary tube where the air-water interface is concave with respect to the air is in a state of tension.

It is an experimental fact that when the tension in soil water reaches about 15 atmospheres plants wilt and fail to grow unless water is added to the soil to reduce the tension. When the tension of the soil water approaches zero too much water is normally present and plants suffer because of the existence of poor aeration conditions. Plants normally exist and grow best when the tension in the soil water is greater than zero but less than 15 atmospheres.

The quantity of water in a soil at a particular moisture tension depends upon the size and configuration of the void spaces. The nature of the void spaces, in turn depends upon the textural class and structure of the soil. Sandy soils, because of the kinds and sizes of the voids, tend to have less water in them at particular moisture tension than do silt and clay soils at the same tension. As an example, a particular silt loam soil is known to have 11 per cent moisture present at about 15 atmospheres tension when plants wilt. A particular sandy loam soil is known to have 4 per cent moisture present at 15 atmospheres moisture tension. At a moisture tension of 1/3 atmosphere (the tension which might exist in some soils several days after a rainfall or an irrigation) the silt loam soil would have a moisture content of about 23 per cent whereas the sandy loam soil would have only a moisture content of about 8 per cent. This means that the amount of water which would be available for plant use in a given volume of soil would be greater in the silt loam soil. For successful crop growth the sandy soil might have to be irrigated more frequently.

The above discussion of water availability does not tell the entire story. The rate of movement of water in a soil profile is important and must be considered. Water moves in a soil in response to gravitational forces and to forces due to the cohesion between water molecules and the adhesion of water molecules for soil particle surfaces (surface tension). Under conditions where the soil is not saturated the gravitational forces often are minor compared to the surface tension forces. Surface tension forces are greatest where the changes in moisture tension with distance are greatest. That means that the greatest force tending to move water in unsaturated soils is that which exists at a wetted-front where water is moving into a dry soil. In a homogenous soil water moves along the moisture gradient from regions where the soil is wet to regions of dry soil. Water movement also depends upon the effective channel size. In a wet soil the channel for moisture movement is larger than for the same soil when dry. This is because under unsaturated conditions water must move along the surfaces of particles and through the moisture films between particles. Void spaces occupied by air are not part of the flow channel. The more moisture present in the soil the greater is the size of the flow channel. Under unsaturated conditions sand or gravel adjacent to a wet soil transmits water only very slowly if at all. Only when sand or gravel connects with a source of water at zero or positive pressure will water move into and fill the void spaces. Water from rainfall or irrigation will move rapidly into a soil with large voids and the infiltration of water into such a soil will be rapid but the same soil may transmit water only very slowly when a source of free water is not present.

The ideal soil for turfgrasses will be a soil with sufficient large voids for rapid infiltration of water and for good aeration yet with plentiful small voids for the retention of water. Thus the ideal soil is a soil of such texture and structure as to form a compromise between the high moisture retention of a soil with mostly fine pores and the high porosity of a soil having mostly large pores. Ability to withstand mechanical disturbance is also an important consideration in soils for turfgrasses.

SOIL STRATIFICATION AND ITS EFFECT ON WATER MOVEMENT

Certain types of soil stratification restrict the downward movement of water. Layers of compact soil materials such as are found in hard pans materially reduce the downward movement of water because of the small void spaces present. Because of the low permeability of such materials downward moving water sometimes accumulates above such layers forming what are referred to as perched water tables.

Coarse materials such as sands and gravels may also limit the downward movement of water. Since water in soil above the water table is normally present under tension it is not free to move unless some force is applied to move it. Because of the small surface area of the larger sand and gravel particles compared to that of a normal soil and because the soil voids are large the unsaturated permeability of sands and gravels is low. Hence no appreciable quantity of water can move from a fine-textured soil into sands and gravels until such time as the tension of the water in the soil reaches low values such as that the voids in the sand or gravel can hold water. When this point is reached water can move readily in the pores of sands and gravels.

The phenomenon of water movement into sands and gravels can be demonstrated by means of a pen and blotter. When you touch a pen to a blotter the fine pores in the blotter take ink rapidly from the large capillary of the pen. Even though the blotter were to become nearly covered with ink it would be impossible to get the ink to move back out of the fine pores of the blotter into the large capillary of the pen. Because of this phenomenon a layer of sand or gravel in a finer textured soil will temporarily restrict moisture movement. Such layers of sand are frequently created artifically through application of sand to a turf and subsequent covering with compost. Before water can move through these layers of sand the soil above must become much wetter than normal. This situation is frequently harmful to root systems of turfgrasses because of the poor aeration which exists in wet soils. Also, soil in this wet condition cannot withstand the mechanical impact of foot or vehicle traffic without puddling which further destroys the desirable soil physical conditions.

For maximum drainage under unsaturated conditions a soil should have uniform pore size throughout and slightly beyond the useful root zone. This will prevent the formation of perched water tables. Adequate drainage is also possible under some conditions where the soil pore sizes are large in the surface and diminishing in size with increasing depth. This condition would only hold true where water application rates never exceeded the rate of movement of water in the most restricting zone of the soil profile.

The presence of sand and gravel below the root zone, under some circumstances, is a decided asset. In the Columbia Basin a common soil type consists of 1 to 2 feet of a fine or coarse sandy loam overlying sands and gravels. If the fine or coarse sandy loam soil extended to great depths it would have a very low moisture storage capacity and would need to be irrigated more frequently than practical. Because of the presence of the sands and gravels water does not move readily out of the root zone and the moisture supply available for plant use is consequently increased. Yields of sugar beets of as high as 40 tons/acre have been obtained on this soil with normal irrigation.

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ESTHETIC FACTORS OF PLANTING DESIGN

W. S. SUMMERS
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Esthetic qualities are difficult to define in purely objective terms. One might be able to enjoy his surroundings of fresh air, sunshine, beautiful trees, and refreshing smells without being aware of what he actually sees. Personally, I think that people with different backgrounds and experiences have a different esthetic sense. How else can one describe why some people are homesick for a desert or others for mountains, and still others for masses of vegetation.

Scenery is observed from different extremes. The most common is that of casual observation in which the observer tends to notice only a few details or to see the whole prospect in a vague way. They sense rather than perceive the scene. They accept it as a matter of fact, or may be impressed that it is beautiful, or ugly. What is beauty? We quote from Somerset Maugham. "Beauty is a grave word. It is a word of high import. It is used lightly today--of the weather, of a smile, of a frock or the fit of a shoe, of a bracelet, of a garden; beautiful serves as a snyonym for good or pretty or pleasing or nice or engaging or interesting. But beauty is none of these. It is much more. It is very rare. It is a froce. It is an enravishment. It is not a figure of speech when people say it takes their breath away; in certain cases it may give you the same suffocating shock as when you dive into ice cold water. Andafter that first shock your heart throbs like a prisoner's when the jail gate clangs behind him and he breathes again the clean air of freedom. The impact of beauty is to make you feel greater than you are, so that for a moment you seem to walk on air; and the exhilaration and the release are such that nothing in the world matters any more. You are wrenched out of yourself into a world of pure spirit. It is like falling in love. It <u>is</u> falling in love. It is an ecstasy matching the ecstasy of the mystics." We know that this is true because people accept patterns in fabrics, designs in automobiles and furniture without thought of how they look in other surroundings.

In spite of this the designer must create far beyond his apparent public. It may be left to the trained observer or to designers to induce pleasurable response in the scene. How then are we going to express the esthetic qualities in words. In doing this let's distinguish the main group of elements in this way:

Elements of Pattern in the Scene

1. Sensuous materials (i.e.), affecting the senses

   a. Colors
   b. Lines
   c. Patterns
   d. Textures - lights and shadows
   e. Spaces
   f. Surfaces

2. Natural objects

   a. Trees and other vegetation
   b. Topography - hills, mountains, valleys, meadows, swales.
   c. Water - lakes, streams, ocean
   d. Buildings
   e. Sky - horizon, canopy, clouds.

3. Cooperating factors or phenomena

   a. Tendency of all matter to take on form
   b. Specimens
      Clumps
      Masses (woods, groves, forests)
   c. Perspective
      Atmospheric - grey colors in distance
      Linear - lines with disappearing railroad tracks, fences, etc.

4. Human interests

   a. Religious
   b. Symbolic
   c. Moral
   d. Dramatic
   e. Mental (moods--gay, tragic, sublime)

The planting designer must do more than cover land spaces. He will establish an ideal or theme, purposely or instinctively, based upon distinctive decisions as to colors, shapes, plant groups, and scale relationships in the variation, in transitions between contrasting elements weaving all together into balance and the subordination of the minor to the dominating features.

Trees have special qualities of line and form to which empathic understanding is induced. The soaring, graceful qualities of the American Elm may create a spiritual reaction. The suspended and pendant branches of the weeping willow, the upright cedars, and cypress all have peculiarly physical effects.

Color is another factor which contributes to the esthetic qualities of the landscape.

Remember that color in distance becomes more grey. Sometimes we create the illuision of distance by using bright color in the foreground, followed by dull tones in progressively lighter values, to soft greys in the background. For an example, you can secure great depth if you plant dark green foliage of the red cedar in the foreground, the blue green foliage of the Chinese juniper in the middle ground, and the grey green foliage of the Silver Cedar in the background. OR Rich green foliage of the Austrian Pine in the foreground (coarse needles), dull green foliage of the White Pine in the middleground (finer needles), andsoft green foliage, of the Himalayan Pine in the back ground (fine needles.)

The position from which you observe may be the influencing factor in creating a certain esthetic quality.

A. Far Distance Aspect:

Form or Outline -- is the most apparent quality at a distance. Essentially two dimensional.

B. Far Middle Distance
Masses of Form distinguishable. Edges of form become visible. Texture - contours revealed in light and shade.

C. Near Middle Distance:
Form - modelled in outline and contours - three dimensional. Texture - at its' most interesting setting; texture factors visible. Color - greens of foliage color contrasts and harmonies most effective. Flower most effective, especially in Autumn--Flower color most effective at this distance.

D. Near Position
Form-in general less important, except that details of location and direction of branching may be important. Texture - contributing factors seem near at hand. Color-- most evident in details of foliage, flowers, bark and branches. Here it is individual and personal, while in "C" it is fairly abstract.

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MERION BLUEGRASS

ARDEN JACKLIN
Dishman, Washington

Merion bluegrass is a new type of lawngrass. It is an improved Kentucky bluegrass found on Merion Golf Club course, Ardmore, Pennsylvania about 15 years ago. The USGA promoted it, made studies of it at Beltsville, Maryland. It is a superior type of grass, both as a seed plant and as turf.

Characteristics

Other bluegrasses grow upright, Merion grows sidewise, and forms a dense cover in contrast to more open cover of other types. It requires less mowing. It has disease resistance. Leaf spot is not much of a problem. Invasion by crabgrass is nil. It has weed resistance. There is no dormancy period; it tends to keep on growing throughout the year. Such grasses are low in seed production and this is true of Merion, too. It has a very dark green color. Because of its horizontal habit of growth Merion is low to the ground. Cutting to 1/2 inch is O.K. It is able to compete in mixes.

Shortcomings

1. A very slow starter - takes a long time to get going.

2. No dormancy period - once started wants to keep growing. O.K. if no frost but if a warm interval occurs before spring Merion starts to grow. If frost comes again, grass freezes back and makes a poor appearance.

3. Mowing affects appearance adversely. About three days after mowing, tip of blade shows yellowing. This is true of other lawngrasses, too, but because of Merion's dark green color, the yellowing is more conspicuous.

4. Seed production difficult.

5. Weed control a problem. Merion sustains injury to chemicals used for weed control. You can't go out and spray with 2,4-D in the seedling stage. Later it stands as much as other turf and lawngrass. On the other hand, Merion's tight growth makes it difficult for weeds to get established once the grass has covered.

The Miracle of Merion and the Miseries of Its Production we are well-acquainted with. Jacklin Seed Company has worked with Merion for several years. It was three years after seed was available before any field was established because of difficulty of getting Merion started. The number of growers now can still be counted on your fingers although Merion was released eight years ago.

Things that contribute to making Merion difficult to grow:

1. The period for planting in spring is short.

2. Seed cannot be planted more than 1/2 inch deep nor less than 1/4 inch. Must be planted right depth, have right moisture and fertility conditions.

3. During first month or six weeks, plants are small and weak and offer no competition to weeds. High fertility helps weeds, as well as grass.

4. Crusting or drying of soil for long will kill.

5. Does not stand cultivation until established.

6. Mite infestation troublesome in this area at one time - now controlled by insecticides.

7. Don't know too much about effect of fertilizers.

8. Reproduces asexually, no fertilization. About 1% self-fertilizes.

9. Seed doesn't all mature at one time. Some of it ready now, some two or even three weeks later. Earliest maturing seed dries up and shatters.

10. Harvesting done with combine. Threshed with spiral type of threasher. Seed very fuzzy. Moisture content sometimes as high as 32%. Seed has to be dried to standard amount of moisture. Seed variable in size. Is divided into lots. Germination tests made.

Where grown in Northwest

Eastern Washington, Oregon and Idaho. Western Oregon. Some grown in irrigated areas of Washington. It is not believe that Western Washington area is suited to growing of Merion.

Some Merion is produced on fringes of Palouse area. Foothill area of Mount Spokane, O.K.

Amount of Production

In 1952 about 85,000 pounds; in 1953, 150,000 pounds. In the Pacific Northwest production is about 200 pounds per acre under management.

Factors holding down production

1. Lack of growers with adequate background for growing Merion.

2. Limitations in suitable areas for growing. Not one farmer in 500 able and willing to go through with producing Merion.

Sale of Seed

Last fall 80% sold for use in mixes. This fall 75% sold for straight planting. Demand for seed is very high. Promotion of Merion has been held down because of inadequate supply.

Price situation

Lawn grass seed carries a large percentage of margin and goes through several hands before the consumer receives it. A great deal of the final price is for services, handling, etc. Merion sells at $2.00 to grower $2.30 to major jobber; $3.40 to dealer and retails to public at $4.25.

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TURF FERTILIZER

Paul D. Brown and Lee Fryer
Chas. H. Lilly Company

Objective:

1. The proper amount of fertilizer to apply
2. The lasting quality of each material used
3. What causes burning, if any
4. What causes different shades of green
5. The results of liquid fertilizers
6. The results of new organic materials

Method:

We decided on a method, whereby we would fertilize a series of measured plots at one location. Then after carefully studying the effects of the work of the first location, wewould devise another series of plots at a second location, and so on.

Work was completed, observations made and color pictures taken at three locations and four series of tests:

1. Greenwood Cemetery, near Renton, Washington

2. Foster Golf Course, practice green, near Renton

3. Renton High School Stadium

4. Renton High School Stadium

About 90 test plots, each 3 ft. by 33 1/3 ft., were used with various materials and rates of application.

The calendar period covered was April 16th through Aug. 10th. Observations covered a later date as results were still being checked.

Results:

1. For early spring, (April) the dry fertilizer materials gave better performance than the liquid materials.

2. As the season advanced the liquid fertilizers (liquid fish and chemical solubles) were much more effective.

3. On early spring grass a noticable shock was observed when the rate of application was over 4# per 100 sq. ft. of a 5% N, or 2# of sulphate of ammonia, 2# Nugreen, etc. -- (150# or more of actual N per A.) a powdery white compound was deposited on the leaves of the grass, apparently due to excess of nitrogen in the sap of the plant. The white substance was collected and analyzed by Jerry Freeman of Lauck's Testing Laboratories, and found to be a nitrogen compound similar to urea.

4. Where the plots were fertilized evenly and watered with usual care, there was no burning, even with 10# per 100 sq. ft. of our 5% nitrogen fertilizers (this is over 2 tons per A. and over 200# actual nitrogen).

5. The only materials causing burn are cyanamid on the Cemetery plots and a minor elements blend used on the Foster Golf Course plots. Cyanamid burned at all applications over 1/2# per 100 sq. ft., and when used in mixed fertilizers.

6. An application of 4# per 100 sq. ft. of Organic Morcrop gave approximately as good and rapid performance as applications of 8#. A similar result was obtained for other materials. Four to five pounds per 100 sq. ft. is best for Organic, Lux and other mixed fertilizers containing 5% nitrogen.

7. The best rate of application for Liquid Fish fertilizer, (Marina--10-6-5) is 1/4 to 1/2 pints of concentrated material per 100 sq. ft. applied in diluted form. This figures out in terms of average putting greens at 3 to 4 gallons per green for greens up to 6000 sq. ft.

8. The best application of Flo-Morcrop (15-25-15) was one pound of dry material per 100 sq. ft. applied in diluted form. This figures out to be approximately 500# per A. (75# of actual N per A.) Application of less than this amount did not give satisfactory results in any of the plots, although 1/2# per 100 sq. ft. gave noticable greening and grass growth.

9. Minor elements application at rate of 1 pound per 100 feet gave burning in one instance. No especially beneficial results were obtained from our own minor elements blend, or the new FTE blend, except in one instance for a few days at Foster Golf Course, with the new FTE material. Results with minor elements were inconclusive.

10. Cyanamid, and materials containing cyanamid, produced a grey-green color to the grass.

11. The dry materials containing ammo-phos and/or urea produced dark green grass.

12. Cyanamid burns recovered quickly. Even the severe burns were quite well recovered in three weeks.

13. Magnite (containing 7% nitrogen and 7% magnesium oxide) gave good and lasting results and was quite rapid in performance.

14. Leather meal, a related material, gave very slow results, and not quite as good.

15. Crab meal appeared to be a promising material.

16. Feather meal was outstanding in its performance but owing to lack of uniform grind and mixing qualities does not always flow freely through a spreader.

17. The results with equal applications of sulphate of ammonia, calcium nitrate, ammonium nitrate-lime could not be distinguished from each other.

Recommendations:

1. Feed the grass at the rate of 250 to 300 pounds of nitrogen to the acre during the growing season by giving several applications over a period of six months.

2. Use a complete fertilizer.

3. At least once a year, feed with a fertilizer high in phosphate and potash.

4. Apply lime every other year, in the fall, at the rate of 5# per 100 sq. ft. Gauge the lime application by getting a pH test, and if the soil is quite acid, put on 10# per 100 sq. ft. (Pacific Slope)

5. Always water turf after feeding so that the water soaks down to about six inches. This is equal to about 2 inches of rainfall. This also applied to high concentrate fertilizers applied as a liquid.

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CONTROL OF VEGETATION ON OREGON HIGHWAYS

LESTER ORTON

Salem, Oregon

Control of vegetation involves both the inhibition and promotion of various species depending on their relative merits or values. The former practice involves physical means of control, such as hand grubbing and trimming, use of power mowers, and other special types of equipment. In recent years certain agricultural chemicals have been used to an increasing extent in an effort to increase efficiency and reduce the cost of this work.

An important aspect of the program is the establishment of desirable species along the roadside. These species are generally the adapted perennial grasses, although certain legumes have also been found to be of value. The main purpose of this type of evgetative cover is protection of the exposed soil and subsoil against water and wind erosion. Weed control, too, is simplified by the establishment of a good turf and the rawness of new construction is rapidly healed with desirable vegetation, presenting a pleasing appearance to the travelling public in a relatively short time. Except under more severe conditions this can be accomplished with a combination of seeding and fertilizing. Where the exposed areas exists, a mulch of straw or hay is used in addition to the seeding and fertilizing process to aid in the establishment of turf. Topsoiling is also used under certain extreme conditions but it is relatively much more expensive.

The seeding andfertilizing are accomplished in one operation with three men using a "Floss" spray rig mountedon a truck. This machine consists essentially of a 750 gallon tank equipped with a centrifugal pump, an auxilliary motor, internal mechanical agitator, and the necessary hoses, valves and nozzles. With a mixture of grass and legume seeds and the required amount of complete fertilizer in water, the solution can be sprayed over approximately an acre of ground in from 10 to 15 minutes' time. Using the nozzle mounted on the truck a slope distance of about 75 feet can be reached, and for greater distances a 100-foot hose with nozzle can be carried up or down the longer slopes.

The mulching machine is trailer mounted and towed behind a flatbed truck carrying either hay or straw. Hay is generally used because it is approximately the same price as straw and has certain advantages. After application with the machine it is more resistant than straw to disturbance by wind, and in addition it usually carries some seed which may germinate and produce a satisfactory cover, which sometimes eliminates the additional operation of seeding. This operation is performed by a four or five man crew. Approximately two tons of hay are required per acre. The slope distance reached will vary depending on the wind conditions, but generally it will be between 30 to 40 feet. The machine consists essentially of a blower and exhaust pipe similar to that on a stationary threshing machine. Horizontal and vertical movements of the counterbalanced pipe are manually controlled by one man. Two men cut wires and feed bales while one man drives the truck. Hay is sometimes obtained from highway rights of way, which is a cheap source. The mulching operation thus utilizes the roadside grass which otherwise might not be used.

HIGHLIGHTS OF WEED CONTROL

Weed control along Oregon Highways can be divided into three major categories (1) noxious weeds, (2) weeds not legally declared noxious and yet undesirable from agricultural aspects, and (3) those species which are of special concern from a highway maintenance standpoint. The first two categories will not be discussed here because control measures along the highways are essentially the same as those measures being used by private land owners.

The third category includes some problems unique to highway rights-of-way. One of these is the Lodgepole Pine Situation along Highway 97 between Bend and Klamath Falls. This species is germinating in large numbers in the area disturbed by construction and maintenance. If allowed to continue to grow it will eventually form a dense cover, reducing sight distance, furnishing a hiding place for deer dangerously close to traffic, forming snow traps and other ways interfering with maintenance. In the experimental work to date it has been found that a 1% solution of 2,4-D or 2,4,5-T ester in diesel oil is quite effective as foliage spray. At concentrations as low as .5% 2,4,5-T shows a slight superiority over 2,4-D. In 1954 this work will continue with three separate applications during spring, summer and fall to check the effectiveness of applications at these specific seasons.

Elimination of vegetation along guard rails, sight posts, sign posts, bridge heads and other structures where high visibility is important is accomplished by the use of long-time soil sterilants. These materials are sometimes applied dry and sometimes applied in a water carrier. Speed of application has been greatly increased with the use of a special boom which is designed to straddle the guard rail while spraying a strip 4 to 7 feet wide. This boom is mounted on a dump truck which carries a high volume, low pressure spray rig and is operated by a two-man crew, the truck driver and the operator of the boom who sits adjacent to the driver. Lateral and vertical control are so arranged that the rig can safely travel at speeds from 4 to 5 miles per hour.

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KRILIUM EXPERIMENTS - OREGON

WILLIAM R. BURNETT
Monsanto Chemical Company

In the future Krilium Soil Conditioner is going to play a very important role in the building of new greens and tees and the rebuilding of troublesome greens and tees due to compaction, poor drainage, shallow grass root growth, and ineffective disease control. The first step in proving the value of Krilium was taken at Forest Hills Golf and Country Club, Cornelius, Oregon, William Martin, Owner. Mr. Martin has had trouble with some of his established greens due to the heavy, clay type soil on which his course is constructed. Compaction and poor drainage has made play and care rather difficult in some instances. So when an additional nine holes was to be added to his course he came to us inquiring as to the use of Krilium in rebuilding old and building new greens and we outlined what he could expect from using Krilium.

Application to thirteen greens and thirteen tees was made on September 8th and the following method and depth treatments were used.

The area of the green was marked out and the required amount of Krilium was applied with a Fertilizer Spreader. The rate used was one pound per one hundred square feet. Mr. Martin desired a seven inch treatment on the greens so that when the cup needed changing the plug could be taken out and replaced without worry of getting untreated soil on top. Also a seven inch depth treatment would assure him of a deep root system which is vital to good greens. Thus green application required 2.2 pounds of Krilium per one hundred square feet. After the necessary material was applied the ground was tilled using a 48" Rotary Hoe, run off of the tractor power take-off. Because of the excellent mixing ability of the Rotary Hoe, only one mixing after the application of Krilium was necessary.

If a smaller unit is used two mixings may be required to assure thorough mixing of the Krilium with the soil. After the material had been mixed in, the green was wetted down thoroughly to activate the Krilium and then when the ground was workable the Rotary Hoe was used again to mix the soil to seedbed consistency. On aprons and tees the same procedure was followed except that the soil was treated to a three inch depth.

The results anticipated are as follows: Less compaction, improved drainage, better utilization of fertilizers, a deep healthy root system, probable elimination of aeration or at least less time spent in aerating. Less labor in watering and less water used. The greens will be more buoyant during the dry, hot weather and more firm during the wet weather.

The cost of using Krilium against the cost of using Peat Moss and Sand was 25% less in favor of Krilium. The actual labor costs were not computed, however the handling and application of 50 - 50 pounds drums of material as opposed to the handling of 500 bales of peat moss and innumberable yards of sand would be a substantial factor and saving. The aggregating effect of Krilium in the soil would be a lasting effect.

The use of Krilium in building turf on athletic fields has also proven successful. Multnomah Stadium has received the benefits of Krilium. The heavily abused center section of the playing field was torn up and treated to a three inch depth with Krilium and then replanted. Prior to treatment water would stand on the surface and make play and turf care very difficult. Since the application of Krilium drainage has been effected and care is much easier according to Mr. John Howie, Stadium Superintendent.

These are but two recent applications which will bear close watching. Before long, I feel Krilium will be a standard application in the building of new turf on Golf Courses, Athletic fields, Cemeteries, and in Parks.

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TURF FIELD TRIP -1953

KENNETH PATTERSON
Pullman, Washington

Dry Land Grasses - (areas of 14 inches or less annual rainfall)

1. Sheep Fescue

Planted in 1949. This grass have established quite well on the terrace and is sufficiently aggressive to prevent weed encroachment. This grass does quite well in low rainfall areas of Washington.

2. Hard Fescue

This planting was made in 1943. This grass has been the most successful of any of the dry land grasses for cover and weed control on nursery terraces. It has prevented weed invasion and has supplied excellent cover on both upper and lower terrace areas.

3. Poa ampla - Sherman big bluegrass

This terrace was seeded in 1936. The cover does not meet the requirements of an excellent cover. It produces a somewhat open turf and has been invaded by weeds to a considerable extent.

4. Festuca rubra - red fescue

The terrace seeding was established in 1943. The cover on the channel and upper terrace surface is satisfactory but the lower (droughty) terrace section does not have a satisfactory cover.

5. Poa nevadensis

This terrace planting was made in 1936. It has been invaded by grasses and weeds to considerable extent and provides an unsatisfactory cover for this type of planting.

6. Agropyron inerme - Bluebunch Wheatgrass

The terrace was seeded in 1936. This native bunchgrass has not been able to compete as well with weeds under these relatively favorable conditions.

Merion Bluegrass - Space Planting

Approximately 500 individual plants are space planted to study the variability in Breeder Seed of merion bluegrass. It may be used in a reselection program.

Recommendations for dry land seedings for turf purposes.

No. 1. Fairway Crested Wheatgrass.

This is normally the most easily established of the dry land grasses. Crested wheatgrass also ranks first in resistance to burning which is of high priority around buildings or storage sites.

No. 2. Hard fescue.

Somewhat more difficult to establish but provides an excellent short grass-cover. Very desirable for erosion control and quite aggressive in preventing weed encroachment. It may be seeded with crested wheatgrass.

No. 3. Bulbous bluegrass

Easily established if rodents can be controlled. This grass reseeds itself well but matures and becomes very dry in the early summer. It could become a fire hazard as soon as hot dry weather is encountered.

Merion Bluegrass - Lawn.

Portion of this lawn was seeded in November, 1952, the rest in May, 1953. It has established well and has made an excellent turf. The mainteance problem has been reduced over the red fescue as the mowing required is only about one-half as frequent as that necessary on the creeping red fescue.

Creeping red fescue - Lawn.

This lawn was seeded in May of 1953. It has established an excellent turf which is retarding weed encroachment quite well.

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