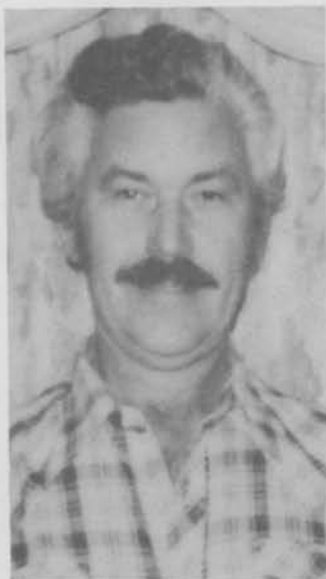


The President's Corner



By Joe Pottenger

I would like to say "Hi" again to all the members of the NTA and send a special welcome to our new members. I guess the ground is all thawed from the cold winter and all the broken pipes repaired. We are all busy on our jobs keeping everyone happy going 8 to 16 hours per day. Wait just a minute! Just don't get too busy and forget the Turf Field Day on June 26 at Puyallup. We need to go and see what has been done and is ongoing for our benefit.

I hope everyone is trying to sign up new members for the Turfgrass Association. You know there is a prize being given again this year for the person who signs up the most new members.

Don't forget the NTA conference coming up September 25, 26 and 27, 1979. There will be some great things happening at Port Ludlow and I am sure you will profit tremendously by attending.

The Northwest Association of Golf Course Superintendents on the Coast is trying to generate new money for turfgrass research through a car raffle. All of the golf courses in the state will participate in selling tickets for this raffle and whenever you are asked to buy, be generous and help to support a worthy cause.

I wish everyone well and hope you have a good summer.

PESTICIDES AND CANCER

ED.NOTE: There are too many instances today where scientific facts are ignored because of uninformed people and the lapping up of hysterical propaganda. You and I will talk to each other about the safety of materials, but we often do not talk to the right people to get their attention. It is about time that each of us speaks out to influential ears who will listen with regard to these issues. Not a single one of us would wish to use materials in the environment that would harm our fellow human beings knowingly or to pollute this environment that could possibly make our stay and generations to follow on this Earth short-lived.

Just recently silvex and 2,4,5-T have been suspended from use by the Environmental Protection Agency. The horrible tragedy of two good herbicides has occurred through the manipulation of phony statistics and is another "amino triazole cranberry situation" conjured up by EPA to satisfy a few brash politicians and environmental activists who want to abolish all pesticides in sight. I think if you will read carefully the following article which is a transcript of a speech which was delivered by Dr. Richard Ellerby, MD, Physician and Surgeon of Internal Medicine and Oncology on May 24 of last year, it will help to explain some of the

(Continued on p. 4, col. 1)

MEMBERSHIP IS THE KEY TO AN ORGANIZATION'S SUCCESS

Without membership, organizations would not exist. There are many benefits in belonging to the NTA and you too can help advance the technology and recognition of the turfgrass industry. A valuable prize will be awarded the individual who brings in the most new members in 1979. Use the blank below to sign up your new member. Additional application forms can be obtained from John Monson or the Editor.

MEMBERSHIP APPLICATION FORM

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Dues include: 1) reduced conference registration, 2) Turfgrass Topics, and other mailings.

APPLICATION OF AQUATIC PESTICIDES

The Washington State Department of Agriculture has approved an administrative order restricting the use of pesticides labelled for application onto or into water. The amended regulations are a result of recent hearings where testimony indicated increasing concern over possible misuse of aquatic pesticides.

The order that will be effective May 10 will restrict the use of all pesticide formulations labelled for application onto or into water to control pests in or on water, except those labelled only for use in swimming pools; wholly impounded ornamental pools and fountains; aquariums; closed plumbing and sewage systems; enclosed food processing systems; air conditioners and humidifiers; and cooling towers. The restricted use pesticides can now only be sold by licensed pesticide dealers and may be purchased and applied only by certified applicators.

Readers of Turfgrass Topics residing outside of the State of Washington should immediately contact your State Department of Agriculture to determine your status on aquatic pesticide application.

The Washington State University Cooperative Extension Service will be conducting two aquatic weed control seminars in May. The aquatics examination will be given by Washington State Department of Agriculture personnel following the seminar.

The program, to be presented by Roland Portman and Bob Parker, will consist of three parts: 1) definition of terms used in aquatic weed control; 2) weed identification problems and chemical control; and 3) mosquitoes, swimmer's itch, etc.

The two seminars will be conducted as follows: May 7, Moses Lake, Big Bend Community College - 8:00 a.m. to 5 p.m. No registration fee. May 8, Everett Holiday Inn, 101-128th St. (Take Exit 186 from I-5). There will be a registration fee for the Everett seminar. To pre-register, send a check for \$5.00 to the Conference Office, Cooperative Extension Service, 323 Ag Service Building, Washington State University, Pullman, WA 99164. Registrations will be accepted at the door from 8:00 a.m. to 8:45 a.m. only at a cost of \$7.50.

Those of you who are concerned with the use of aquatic pesticides in any of your areas should take advantage of either of these two seminars.

Water And Its Uses

By Roy L. Goss

The short water situation two years ago brought into focus more clearly the problems that face us in the future with regard to available water. According to Dr. J.R. Watson, only 1% of the Earth's water is available for use. The rest is tied up in polar ice caps and with the oceans and seas which is not considered immediately usable. To more clearly bring the water situation into focus Herb Schulbach and Tom Aldrich from the University of California published in the Fall, 1978 edition of *Soil and Water* the water necessary to produce food. Part of the table is reproduced below to give you an idea of what is required for food production:

**Estimated Crop Water Requirements
to Produce Quantities of Selected Foods**

Crop	Yield lb/Acre	Water Use Acre Ft/Acre	Gal/Water per lb/Food
Beans, Green	10,000	3	98
Cabbage	25,000	3	39
Carrots	30,000	3	33
Celery	60,000	4	22
Corn (ear)	8,000	3	122
Cucumbers	25,000	3	39
Lettuce	28,000	2	23
Onions	40,000	2	16
Potatoes	40,000	3	24
Spinach	16,000	3	61
Tomatoes (process)	50,000	3.5	23
Apples	20,000	3	49
Apricot	12,000	3.5	95
Cantaloupe	16,000	2.5	51
Cherries	5,000	3.5	358
Grapefruit	25,000	4	52
Oranges	20,000	4	65
Prunes, Dried	4,000	3.5	285
Watermelon	20,000	3	49
Grapes	14,000	3	70
Corn	6,000	3	163
Wheat Bread	4,000	1.5	122
Rice	4,000	3.5	285
Beans, Dry	2,000	2	326
Almonds (meats)	1,500	3	188
Walnuts (meats)	2,000	4	325
Margarine	400	4	2962
Sugar (Beets)	9,000	3.5	127
Milk	10,000	4	130
Beef (Live)	500	4	
(Dressed)	250	4	5214
Pork			1630
Bacon			1630
Chicken			815
Egg			544

Further information presented by these writers indicated that it requires 4,533 gallons of water to grow the daily food requirements for one person. For one year this is equal to 1,641,405 gallons, or 5.08 acre feet. This is in addition to each individual's average daily needs of 223 gallons, so you can see this adds to a whopping water situation. And, you can imagine that with each additional person that consumes water and food, someone has to come up with that additional 5 acre feet of water per year. It appears, then, that

(Continued on p. 9, col. 2)



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WINTER DAMAGE SEVERE THROUGHOUT PACIFIC NORTHWEST

Prolonged cold weather throughout the Pacific Northwest during the winter of 1978-1979 caused severe damage to many turfgrass areas. The damage ranked from minor to severe. The chief damage was caused to playfields and golf courses where play was permitted on frozen ground during the freezeup. I have examined some golf courses which have putting greens with as little as 5% green grass on them following the spring greenup. Damage to eastern Washington golf courses was only moderate and was caused chiefly by ice damage. In most areas, however, some areas in the Columbia Basin experienced severe desiccation losses where snow cover was blown from the putting greens.

In western Washington there was no snow cover essentially most of the time during the extreme freezeup and due to desiccating winds and low temperatures, extensive loss of *Poa annua* occurred. It is interesting to note that little or no bentgrass was lost at all during the winter of 1978-1979 in western Washington. The loss was *Poa annua*. I have made this observation from British Columbia throughout western Washington that the bentgrasses got by with little or no damage whereas the *Poa annua* was badly burned. I would think with the tools that we have today and the knowledge that we have that concerted efforts would be tackled by anyone to convert putting greens especially to bentgrasses to help protect themselves during winters such as we have experienced.

Now what can we do to prevent such occurrences again? First of all, the plants need water. The soil is frozen, no water can be translocated from the roots to the crown tissue and leaves; hence, those portions dry out and die. Without snow cover there is no moisture. The only viable solution is to find water in any manner that you can. It would appear unreasonable in many instances to charge up an entire irrigation system to put a small amount of water (ice cover) over grass surfaces. This could result in severe economic losses from damaged pipe, valves, etc. It would appear to be more reasonable to use large sprayers and spray up to 10 gallons of water per 1000 sq. ft. per application on these surfaces to add moisture and even a very thin ice layer to help protect crowns and leaves. Certainly plastic covers would do the job but there is considerable expense and time involved there as well and the problem of keeping the plastic on the grass surfaces.

I am sure that all of you who have experienced this severe desiccation are vigorously aerifying, verticutting, spiking, overseeding and topdressing to hasten the recovery of these greens as fast as possible.

I have recommended to a number of golf courses to use a mixture of turf-type perennial ryegrass and your choice of bentgrass for overseeding badly damaged greens and tees. The ryegrass should germinate at lower temperatures and make some early growth and help to protect the less vigorous bentgrass seedlings while the greens are being played. Of course, the best technique is to take the greens out of play until a satisfactory cover has developed. This is not always practical nor allowed, hence the ryegrasses will give some protection. Mowing heights should be raised at least 1/16 inch to allow satisfactory establishment for the seedlings. This, of course, will make the greens putt slower, but when there is little or no grass, the speed should be there anyway.

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Some of the damage in both eastern and western parts of the Pacific Northwest was caused by winter diseases including *Typhula* snowmold and *Fusarium* patch disease and in some cases, both. The areas west of the Cascade Mountains experienced more loss from *Fusarium* patch than usual and it can be assumed that infected areas that would normally recover died due to winter stress while the grass was in a weakened condition from disease attack.

I would recommend that any time the soil and grass is frozen hard for a period of more than 4 to 5 days without snow cover and desiccating conditions that some water be added to these areas. We cannot wait for a warm spell nor be sure when it will happen. This year it was nearly two months in western Washington and of course much longer in eastern; hence, the extensive damage.

I hope that all of your turfgrass areas can be recovered quickly and that you have the best conditions for this year.

(Continued from p. 1, col. 1)

bumbling that is being perpetrated on us by selected few who have the power.

Dr. Ellerby is president of the Oregon Society of Clinical Oncology, member of the Oregon Cancer Society's Education committee, chairman of Multnomah County Cancer Society's Education Committee and clinical instructor of medicine at the University of Oregon Medical School. This article further has been borrowed from Pest Control Progress, February, 1979.

Phenoxy herbicides are not new. They were invented back in the '40's and licensed in 1948. There have been over 50,000 papers written on the various aspects of phenoxy herbicides. I think estimates in some of the literature are that you have at least 5 million pounds produced per year 2,4,5-T and only about one-tenth of that is used on the forest. For a comparable example comparing the 50,000 pounds in the forest there are over 2,000,000 pounds used on rice alone in the southeast part of the country. So they're used directly on food crops. Internationally, it's mainly used on food crops rather than on forests. There are over 400 registered products containing the phenoxy herbicides and we have many comparable chemicals that are quite similar chemically to the phenoxy herbicide. You take things like Phisohex soap that we use in our surgical detergents, acne preparations, etc, so the number of products that are indeed related are infinite.

The controversy really has been over the interpretation of data of toxicology studies. I don't want to get into them in great detail other than to say that our toxicology studies are performed on all chemicals and we give the chemical compound to the animal until it becomes toxic, obviously. We can compute from that the amounts that are needed to kill half the animals, 10 per cent, whatever. Autopsy studies are done on all the animals and the results are derived on that one specific animal. The key point is that the results are valuable for that one specific animal and that one specific animal only. We cannot extrapolate from a CH3-up mouse to any other mouse because the result in another mouse likely will be different. And in fact, we have found in our studies, that the variance between species can be by a factor of 10 to the 15th, which is ten with 14 other zeroes after it, in dosages between like species. So some species may be totally insensitive to the same compound.

This is where we get into problems basically, I think, in most of our controversies we have seen. And that is when people try to extrapolate from one animal to the human and this is where our FDA gets into trouble, because time and time again they've made announcements based on extrapolations. I recently returned from a Stanford meeting in which one of the scientists there stated, and had slides to prove, that every single announcement the FDA has made in the last decade has been incorrect. Every single one. He listed them and put them on slides and went all the way back to one that we saw here. I remember at the medical school when the FDA announced and they first got their indubitable privileges that cranberries cause cancer in the state of Oregon. I think most of you will remember that. That kind of faded away and nobody heard anything about it except for all those cranberry farmers who went bankrupt that year. They've announced things recently like reserpine, a high blood pressure medicine, causes breast cancer. They had to be told that a group of patients with breast cancer commonly are hypertensive, therefore commonly treated with reserpine—not a cause and effect, not at all. They said oral antidiabetic agents caused heart attacks and that they

wanted them taken off the market. They had to be told that patients with diabetes have heart disease. And the FDA said female hormones cause cancer—most people still think that female hormones cause cancer. The British have shown on 10,000 patients on female hormones that they have a lower incidence of cancer. The FDA study was on seven patients, not 10,000! Cyclamates and saccharin are another example. FDA took one animal species and made a determination. Seven international studies have shown a lower than average incidence of bladder cancer in humans taking cyclamates in saccharin. Therefore, if you can go by the human studies, you would mandatorily require all humans to take cyclamates in saccharin by the same FDA law.

We get into one problem after another in testing our hair dyes, artificial dyes—one thing with different animals extrapolated all the way to the human the public gets confused. They hear our federal government telling us one thing and our scientists sitting there with their mouths hanging open with no access to the press. For example, there was a recent comment of April 12 by the EPA on an RPAR comment on 2,4,5-T and in that they quoted a study on two different mice, The C3HF and the 17G mouse, which we raised specifically because they develop tumors. And as a classic example in the 17G male mouse on this study who had received nothing, 78 percent of them developed tumors. When they received 2,4,5-T, 75 per cent developed tumors which was 3 percent less. Of the female mice that developed it, when they developed the tumor their average survival was 641 days. If they didn't develop a tumor, their average survival was 569 days. You can't make a conclusion from this animal species. In fact, those of us who dealt with these species in our own studies in the field of medical oncology, which is where I am and where I've done years of research, were beginning to doubt the use of this animal species because it has such a high tumor incidence. But the key there is a tumor does not mean cancer. Many of these are benign tumors—not harmful. The animal lives with these and has a whole variety of them. And when we see a variety of tumors resulting in animals when they're treated with a chemical, this means likely that the chemical is not carcinogenic or cancer-causing. It is likely a co-carcinogen, which means it will potentiate the development of an already erratic species. Ten per cent of the chemicals we test are co-carcinogenic. All of our vitamins can be classified as such, so we cannot extrapolate that kind of data and get any kind of result at all other than an erratic one. In humans, toxicology studies are done on every single drug that we have administered. This goes all the way back to simple old table salt right on the table. In our own serum we have 0.9 per cent sodium chloride or table salt. If you increase that by one tenth of one per cent, we'd all have seizures and die. We cannot tolerate a higher level of sodium chloride.

Another classic example in humans is a chemical compound developed by the Germans around the World War I era. It has the same gross effect on Toxicology studies as does rat poison and it will cause hemorrhage and the rat will die. In animals, it will cause malformations and abortions, so again, a very common thing. It is oncogenic, the animals will develop tumors when treated by this chemical. In humans it's the number one killer of all time, it's far beyond strychnine, arsenic and botulism. It aggravates heart disease, brain disease, kidney disease and lung disease. If you place it on the lining of the mouth it can cause an erosion of the mouth. If you swallow it, it can cause an erosion and perforation of the esophagus, stomach, small bowel. Many people do indeed, die of perforations of their

(Continued on p. 7, col. 1)



THOUGHT OF THE MONTH

"The great sin, fear.
The greatest mistake, giving up.
The most satisfying experience, doing your duty first.
The best action, keeping the mind clear and the judgment good.
The greatest blessing, good health.
The biggest fool, the man who lies to himself.
The greatest gamble, substituting hope for facts.
The most certain thing in life, change.
The greatest job, being needed.
The greatest opportunity, the next one.
The greatest victory, victory over self.
The best play, successful work.
The greatest handicap, egotism.
The most expensive indulgence, hate.
The greatest loss, loss of self-confidence."

(Borrowed from the March GCSAA Chapter Newsletter)



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CORRECTION:

Excuse our oversight for not listing
Jacklin Seed Co., Post Falls, Idaho in
the December issue of Turfgrass
Topics.,

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5. Self- Respect - The need to be treated as an individual, not a "hired hand" or a number on the payroll.

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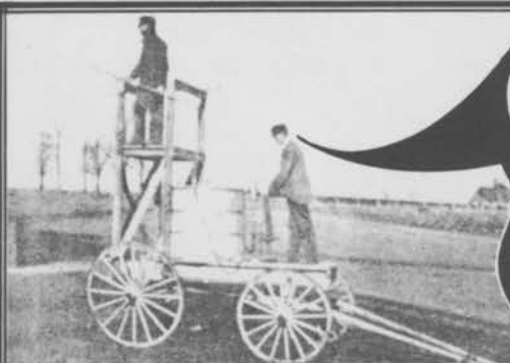
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(Continued from p. 4, col 2)

intestines from it. Children, when they take this drug, can develop a rather agonizing helpless respiration leading to seizures, coma, loss of bowel and bladder control and death. The chemical compound is now manufactured at 100 times in tons the volume of dioxin and its compound is known as acetylsalicylic acid or aspirin.

When you take toxicology studies like this and results like this, if you are to try to pass this currently through our FDA, you would not get aspirin licensed for use on humans.

The key is ratio. A ratio of the amount we can give versus the toxicity of the drug. Common drugs like digitalis that we give to the elderly people to strengthen their heart, has a therapeutic ratio of 2 to 1. Double the dose — kill the patient. That's all. This is not very safe, though when controlled, it is very safe if you know how to use it.

Most of our anti-cancer drugs that I deal with in treating cancer patients cause cancer in animals. So even though we use them to treat cancer in humans, they still can cause cancer in animals.

The dosages of chemicals that are used in the forests are a different matter. The Lane County Medical Society asked the OMA for an opinion on the herbicides and the OMA Subcommittee on herbicides felt the risk was acceptable.

Now, does this mean that the doctors are sadistic fellows who feel that we are to be exposed to toxic chemicals? To defend such chemicals, against public and an emotional issue is a rather hard thing to do. People indeed feel that you are doing them a disservice by speaking. And it is hard to explain to them when they see toxicology studies of rats and mice and monkeys dying why some doctor is defending those compounds. The reason basically, is that TCDD or dioxin is the questionable compound here. And it is a toxic chemical, a by-product of the manufacture of the phenoxy herbicides. It's present now in about one three hundredths to one sixth hundredth or less of what it use to be back in the Vietnamese War. And if indeed we use one pound of 2,4,5-T on an acre, we end up with 0.00000004 milligrams, a milligram is a thousandth of a gram, of TCDD on a cubic yard. That would be one millionth of the amount needed to cause a change in an embryo of the most sensitive animal.

The New Zealand Department of Health computed on sprayed water supplies, which we don't do, but if they were done, the person would have to drink between 43 thousand to 71 thousand liters per day to achieve a lethal dose for the most sensitive animal which is a guinea pig. So it's just identical to the artificial sweetener thing where essentially a person would have to drink a tankcar load of artificial sweeteners per day for their entire life. Yet we're talking about a rat and that's the problem, because we do not know what the toxic levels are for humans on these compounds.

We know that there have been industrial exposures to

tremendous degrees for many years when there were no environmental health industrial medicine people to protect our population. We know that there were workers who worked purely in the dust and the bagging of these chemicals before they were dissolved into liquids to make the solutions of them spray over acres. These people worked for years with dusty clothing and breathing in the concentrated chemical. The only side effect we've seen in them is chloracne—it's a rash on the skin the same seen in chlorine manufacturing. We've seen it in chlorine workers as well. So it's not specific to phenoxy herbicides.

We know that human levels have actually been drawn on oral dosages, feeding people with the herbicides, and computations have been made on chronic dosages. For example, 136 patients Dow Chemical employed for over 30 years they have seen no evidence of any cancer yet. And one would expect, in following 136 people, to see cancer in a 30 year period. But eventually they will, because one out of every four of us will develop cancer in our lifetime.

The thing that we see really sporadic reports of human toxicology that often are non-documented. What we need really are documented cases and when such are done we often find no evidence of damage from the herbicides. Dr. Barry Rumack, the director of the Rocky Mountain Poison Control Center stated that he has yet to see a case of toxicity from standard use of the phenoxy herbicides.

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Assessing The Value of Ornamental Trees and Shrubs

The question is frequently asked to a number of us what the value of a shade tree or an ornamental plant which has either been damaged or removed through rights-of-way, LID's, etc. which may have been the cause of the removal of the tree or the death of it due to these operations. It is extremely difficult to assess the value of such a tree or shrub but there are ways of doing it.

Valuable trees and shrubs should have good records of the age and value at the time of purchase and occasionally the value should be appraised by a competent nurseryman or arboriculturist.

Bruce Webster, urban forester for the Nebraska Forest Service, in Lincoln, reported in the Nov. 1978 issue of the *Journal of Arboriculture* a point system for judging the condition of shade trees. His formula utilizes five factors: 1) trunk growth rate, 2) structure, 3) insects and diseases, 4) crown development, and 5) life expectancy. Each factor which is shown below is assigned a point value and these are added together for an overall condition rating.

GUIDE FOR JUDGING THE CONDITION OF A SHADE TREE

A. Trunk condition

Sound & Solid	Sections of bark missing	Extensive decay & hollow
5	3	1

B. Growth rate (consider species)

more than 6" twig elongation	2-6" twig elongation	less than 2" twig elongation
3	2	1

C. Structure

Sound	one major/several minor limbs dead, broken, missing	2 or more major limbs broken, dead, missing
5	3	1

ASSESSING THE VALUE OF ORNAMENTAL TREES AND SHRUBS

D. Insect and Disease

No pests present	1 pest present	2 or more pests present
3	2	1

E. Crown development

Full and balanced	full but unbalanced	unbalanced and lacking a full crown
5	3	1

F. Life Expectancy

Over 30 years	15-20 years	less than 5 years
5	3	1
Condition Class:	Percent	Rating
Excellent	80-100%	26-23
Good	60-80%	22-19
Fair	40-60%	18-14
Poor	20-40%	13-10
Very Poor	0-20%	9-6

The percent figure (center column above) can be used for the condition percentage in the standard appraisal equation for nontransplantable trees.



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September 25, 26, 27, 1979

NORTHWEST TURFGRASS ASSOCIATION CAR RAFFLE

The Northwest Association of Golf Course Superintendents is sponsoring a car raffle for the Northwest Turfgrass Association's Special Research Fund. A new car will be given away at the Northwest Turfgrass Conference from a drawing of all tickets sold between now and September 20. Many of you will be contacted for ticket sales and for purchasing tickets as well. The Superintendents are hoping to sell 15,000 tickets for this raffle at \$1.00 each. Those who wish to buy a number of chances will find it worthwhile as an income tax deduction as a donation to a non-profit corporation.

Mr. Larry Gilhuly, Seattle Golf and Country Club, is heading up this campaign along with several committee members. Larry and his committee have done a great deal of hard footwork at this time in order to obtain the necessary permits from the State and all of the arrangements for the car. The car will be a 1979 Ford Mustang Ghia - well-equipped - so it should be well worth your time to sell tickets and to buy some as well.

The proceeds from this raffle will be placed in a Special Research and Scholarship Fund of the Northwest Turfgrass Association to be used to help support both research projects and scholarship and educational needs. This is a most worthwhile effort and I think we should all get behind it 100%.

TURFGRASS FIELD DAYS

Don't forget to mark your calendars again for the Turfgrass Field Days. A special field day for golf course superintendents or those closely allied with the golf course industry will be held on Tuesday, June 26, 1979. The field day will begin at 10:00 a.m. at Farm 5, 6 miles east of the Research Station and will conclude at approximately 1:00 p.m.

All research that is ongoing will be viewed by all in attendance at that time.

Bring along any friends, administrators, club officials or anyone else you wish to bring to the field day with you.

A public turfgrass field day will be held on June 27, Wednesday, for all other segments of the turfgrass industry including homeowners, parks, cemeteries, schools, etc. The program will be slightly different for this group since more emphasis will be given to lawn-type turf.

The field days have been set ahead a little later this year to accommodate those of you who hire extra summer help allowing you to have these people at work so you can take the time off from your schedules. We'll see you on June 26 and June 27.



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(Continued from p. 2, col. 2)

water will become one of our most precious resources and one of the most critical. It has already become that critical in certain areas. Without question, deep wells have to be sunk deeper and from all indications ground water levels are dropping. Commissions have been established to study the water situation and to come up with guidelines for future survival.

The crux of this whole dissertation with regard to human water needs is that we, as turfgrass managers, must do a much better job of managing water in the future. One of the alternatives, of course, is to use recyclable water such as sewage effluent or to use water from sources of runoff, impoundment, where we can trap runoff water annually.

Water is probably one of the most abused factors on nearly all managed turfgrass areas where water is "usually plentiful." The price hasn't caught up with us yet but I have no doubt that someday it will. We should learn to judiciously apply water and only when it is necessary. This means that there will need to be a great deal of education among ourselves individually to settle for a little less quality in certain areas while maintaining an acceptable level of aesthetics.

Since excessive water can be very harmful to turfgrass production and maintenance, it hardly seems necessary to delve into all of the points in detail but among them would include an increase in soil structural deterioration, soil compaction, reduced soil oxygen, shallow rooting characteristics, nutrient leaching, and oxygen exclusion from the soil profile.

I believe it is time that the professional turfgrass manager must begin an educational program with his clientele to convince them that we must do with a little less.

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