1961

Vernon J. Smith
William Tower
Louis Lee Smoot
Ted Hyland
Richard S. Clarke

See next page for additional authors

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Professor Blundell was born February 4, 1897 in Ottumwa, Iowa. He attended Iowa State University and received a B.S. degree upon graduating in 1924.

Shortly after graduation from college, Professor Blundell came to Brookline, Massachusetts, where he was employed by the firm of Olmsted Brothers, Landscape Architects.

He left Olmsted Brothers in the summer of 1932, to start teaching in the Landscape Architecture Department at the University of Massachusetts. Although well versed in all the many facets of the profession, his main subject matter in the department has been the teaching of plant materials.

During his years on the campus he has done a really prodigious amount of work in planning various developments on the grounds of the University, and has planned and supervised the campus gardens and the plantings around the individual buildings.

His abounding enthusiasm and unfailing good-nature has made him popular with both fellow staff members and his students. The Stockbridge School Turf Management Club considers it an honor to dedicate the 1961 Turf Clipping to Professor Blundell who will be retiring from teaching in June.
G.C.S.A. SCHOLARSHIPS AWARDED TO THREE TURF SENIORS

G.C.S.A. scholarship certificates were awarded to Leonard Blodgett, Richard Mitchell and James Wheeler, Stockbridge Turf Seniors.

Presentation of awards were made by Sherwood A. Moore, Vice President of the Golf Course Superintendent Association of America at the University of Massachusetts Annual Turf Conference Banquet.
To form a bond of common interest between the Turf Management Club, the alumni of the Stockbridge and Winter School Turf Majors and all interested friends of the University of Massachusetts Turf Program.

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"MY IDEAL COURSE, UNDERWATER, U.S.A."

By Vernon J. Smith

TYPES OF GRASSES

Greens: Bent, Poa annua, and any other type of grass that will thrive under two inches of seawater. Recommend eel grass.

Trees: Seaweed and other useful plans deposited by high tides.

Fairways: 50% dandelion (yellow), 25% clover (purple), 12.5% field mint (white) and 12.5% other colorful weeds. (Green chairmen's wife likes color and we've got it.)

WEED CONTROL

Greens, tees, and fairways: The weeds controlled themselves perfectly this year. There was no need to plant more.

DISEASE CONTROL

Greens: We sprayed weekly from June 1 to October 15. We used as many fungicides at one time as the salesman would allow. We found that by using large amounts of fungicides in our spray tank, there was less room for water. Result: considerable savings on our water bill.

Tees: Too small to think of this year.

Fairways: Having an industrious crew of mermaids, we removed all snow and ice from the fairways and prevented occurrence of snow mold. After affect of snow removal: winter kill of all species.

INSECT CONTROL

Greens: No hexapoda, however Crustacea aquatic infest at high tides. No spray available as yet. Remove lobsters and shrimp with net.

Tees: Use chlordane at 10 pounds per 1000, dieldrin at 3 pounds per 100 sq. feet. Results unknown -- left job two days later.

Fairways: No action.

GREEN RECONSTRUCTION

1. Make as small as possible, 1000 to 2000 square feet.
Reasons
1. Less disease control.
2. Insects will have to move to other areas.
3. Less chance of ball mark injury.

2. Use no tile drainage.

Reasons
1. Two large electric fans will dry area after rain.
2. Too much work digging trenches.

3. General Hints
1. Use as little sand as possible.
2. Roll area with heavy roller. This causes compaction right away and you won't have to worry about it later.
3. Areas around greens should have as many unplayable lies as possible. Then the members will not notice your other mistakes as they will be too busy thinking about their next shot.

NEW EQUIPMENT

1. 1961 Sports car ------ $3590.95
2. 12 Row boats ------- 1800.00
3. 6 Outboard motors 2106.00
4. 6 Sets of oars --- 24.00
5. 1 Set of Irons --- 165.90
6. 1 Set of woods --- 85.00
7. 1 Golf car ------- 1400.00

Total $9,375.00

MISCELLANEOUS

1. Send Greens Chairman to other courses in the area throughout the playing season. If possible send the members with him.

2. Have all salesmen come to club at one time. The truth will come out, and also bids on necessary items.

3. Have many water holes. Then there will be less grass to cut. Also, your pro will enjoy the booming ball concession.

CONCLUSION

Hold out for an eight week vacation (paid) so you can take a short course in turf management. Everything you do not understand will become clear, and the things you know will be forgotten.
FROM THE EDITOR  
by  
Robert W. Sullivan

Turf Clippings has been growing in size each year. We want to acknowledge the Massachusetts Turf and Lawn Grass Association for their financial assistance which has made this publication possible.

I wish to thank all those individuals whose contributions of articles, time, and ideas that made this printing possible. A great deal of the credit for the publication of this issue should go to Professor Troll and Mr. Waddington for giving their ideas and time. I also want to thank all those seniors who helped make this publication a big success.

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TURF MANAGEMENT CLUB NEWS  
by  
William Tower

This year the Turf Management Club enrolled its largest membership with a total of eighteen seniors and twenty-three freshmen.

1960-1961 Officers  
President ---------------------- John Mulhearn  
Vice President ------------------ John Kasper  
Secretary ------------------------ Everett Wood  
Treasurer ---------------------- William Johnson

Robert Sullivan was elected to edit the "Turf Clippings" for the 1961 Spring Issue. Meetings during the 1960-1961 season were to prepare all data necessary to produce this helpful publication.

Ted Hyland our committee chairman selected a fine group of educational speakers for our meetings during the school year with most of them coming during the eight week Winter School Course which was held from January 16 through March 10.

GUEST SPEAKERS

November 9, 1960 ---------- Sergeant Wiggett, Supt.  
Golf Course  
Westover Air Force Base  
Chicopee, Massachusetts

Subject: Construction and Maintenance
December 7, 1960  Bob St. Thomas, Supt.  
Sunningdale Country Club  
Sunningdale, New York  
Subject: Problems and Responsibilities of a Supt.

The Clapper Co.  
West Newton, Mass.  
Subject: The Toro line of Machinery

American Agricultural Chemical Company  
Subject: Organic Fertilizers

February 8, 1961 Leon St. Pierre, Supt.  
Longmeadow Country Club  
Longmeadow, Massachusetts  
Subject: Drainage Problems at Longmeadow C. C.

February 15, 1961 Frank Merchel  
Winter School Student  
Seekonk, Massachusetts  
Subject: Construction and Drainage

February 23, 1961 Roger Smith  
Fertilizer Research  
Eastern States Farmers Ex.  
Subject: Fertilizer Manufacturing and Technology

Aero-Thatch Co.  
Subject: The New Aero-Thatch Machine

Professor Lawrence S. Dickinson also spoke to the class. His subject was "The Limits of Tolerance of Golf Course Turf".

Professor Joseph Troll was selected to be the advisor for the Turf Management Club for the third straight year.

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QUOTES FROM 1961 SENIORS

Norm Dennehy  "Let's go down the Hatch!"

Bill Tower  "What's the answer, Sully?"

Robert Sullivan  "What did you get?"

Ed Galvin  "Where you sitting, John?"

Joe Graham  "Get off my back!"

--4--
Bill Emerson "Let's go over the mountain and get crooked."

Everett Wood "Let's go down for a few"

Bill Kittler "Think I'll take a nap"

Norm Beauregard "Of course I wrote that letter, Mr. Troll"

Bernie Keohan "You sure there wasn't two tests"

Brad Peterson "I don't know, what's Bernie going to do?"

John Cook "Did they check attendance?"

Len Blodgett "What do we need this course for, we'll never use it."

Dick Mitchell "I'm going back in the Navy!"

Louie Rudinski "Can I borrow your comb, Brad? I'm going up by the clubhouse"

Jim Wheeler "Hey Joe, Got any work for me today?"

John Mulhearn "Samoda-key!"

Dave Mauk "I've got to take a shower!"

Bob Hiltz "But, we had a game Wednesday night, Mr. Troll"

QUOTES FROM THE PROF'S

Mr. Whitney "Do as I say, not as I do"

Mr. Hamilton "So what if it is raining, were going out today!"

Mr. Troll "Remember fellas, this isn't an employment agency"

Mr. King "Now when you guys get up lovers lane-----!"

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THE UNITED STATES MOST WESTERN OWNED GOLF COURSE
ARMED FORCES GOLF COURSE, GUAM
by
Louis Lee Smoot

Fifty-three hundred miles from the West Coast of the United States lies the Island of Guam. It is a tropical island lush in vegetative growth and weather making it ideal for year
around golf. The Armed Forces Golf Course is jointly operated by the services. In addition to the service man and his dependents using the club and its facilities, there are Civil Service personnel and their families who are members.

Our rainfall and temperature runs higher than in the states with a rainfall of 87 inches and an average temperature of 81 degrees. The humidity was 80 per cent for the year. The "girls" visit us starting in June and on through November and December. Each one was named after a letter in the alphabet with the first one of each year starting with "A" as Ann and ending with Nan, the last one for the year 1960. Lola was the most talked of, she blew her top with winds ranging between 70 to 90 knots and left after depositing over 9 inches of rain in a period of 30 hours. However, like all other golf courses we still have the problem of when to water.

For the members' wives wanting to learn golf and the husbands who are eager for them to learn, we hold classes three times a week with one class alternating on Tuesday and Thursday and the other class just on Wednesdays. These classes run for six lessons and there are forty ladies in each class. There are three instructors besides myself.

Newcomers to the course praise the beauty of the surroundings. The Coco Nut Palm is in abundance with the Monkey Pod, Poinciana, Bread Fruit, and the various kinds of citrus growth scattered about to add to the scenery.

We have a regulation 18 hole course that at the present measures 6,525 yards with new tees under construction which will lengthen it to 6,775 yards. In addition to the above, we also have a short par three course. There is no age limit for those who play this course. It offers the chance for the whole family to play together.

Our club house, though not as elaborate as found at the stateside type country club, offers all the facilities. Besides the ladies and mens lockers and shower rooms, we have in the club a snack bar and lounging area. The Pro Shop is also part of the club house and we do say that in sales, we stand second to none in the volume of business. By comparison, we do more sales over a period of time, than all the Pro Shops combined in the state of Hawaii or any three service clubs in the Far East. There is a separate building adjoining the club house for the cleaning and storing of members golfing equipment.

With the temperature causing one to 'give forth' with the sweat, and therefore relinquish the salt content from the body, we have the very concoction for restoring it back to the place from where it came. This is done by the way of the 'Salty Dog' drink. It consists of taking a ten-ounce glass and placing it upside down on the ice, revolving it to moisten the edge and then placing the edge in salt. Turning the glass up-right,
put in a jigger of vodka with ice and then add grapefruit juice to fill the glass. Man! What a restoration.

Guam, it is felt, will soon become a tourist haven.

With the miles of beautiful beaches, a fisherman's paradise, the addition of more golf courses, the arrival and departure of the Trans-Pacific Jet Airlines, how can it miss!

The "Julee" to fill the glass...

What a restoration.

"Urban Gardens," was a success. The entire Curry Hicks Gymnasium at the University of Massachusetts was transformed into a beautiful spectacle. Thirty-foot tall Spruce trees, along with water fountains and many varieties of exquisite flowers, filled the gym. A special feature was the beautiful lawns of Merlon Blue.

Each year the Turf Majors, with the seniors as superintendents and the freshmen their apprentices, cut the specially grown turf and lay it for the show. The freshmen are each given a turn at the power sod cutter, and also roll and load approximately 40,000 square feet of sod.

Two groups of freshmen participated in the 10 by 10 foot projects competition. Ted Hyland, Peter Wisnewski, Terrence Mulligan, and Joseph Stilk won second prize in the Naturalistic Class. Their project with its theme, Altering Nature For Recreation, consisted of two scaled golf holes.

The other group, with Barry Mereul, Paul Banacos, David Barber, and Gary Luccini, entered the Educational Class. Their project, Lawn Diseases, also earned a second prize. Disease symptoms were cleverly produced on turf, and literature explaining each disease's control was placed nearby.

The 48th Annual Horticultural Show with its theme, "Urban Gardens," was a success. The entire Curry Hicks Gymnasium at the University of Massachusetts was transformed into a beautiful spectacle. Thirty-foot tall Spruce trees, along with water fountains and many varieties of exquisite flowers, filled the gym. A special feature was the beautiful lawns of Merlon Blue.

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Everett Wood, a senior majoring in Turf Maintenance, received the Outstanding Football Player Trophy for the 1960 season at the Stockbridge School of Agricultural’s Annual Banquet.

"Woody" is a leader both on and off the football field and was the spark plug of the team. He is known as a fearless competitor in everything he attempts. The Navy veteran is a top ranking student in the school and is also secretary of the Turf Club.
STOCKBRIDGE—MAJORS IN TURF MANAGEMENT


OPPORTUNITY AND EDUCATION

Richard S. Clarke
1961 Winter School Class President

Greenskeeper, Golf Course Superintendent or Course Expert are some of the titles given the men whose business it is to develop and maintain optimum conditions on the golf course.

We are aware of the tremendous growth in popularity of the game and the increase in number of the facilities provided and being provided for its enjoyment. With this growth, we find an increase in the demands made upon the men involved in the construction and maintenance of these facilities.

Fortunately, today we find a healthy trend towards the employment of more qualified and talented designers in these expansion programs. We who are involved with the maintenance of these golf courses are grateful for this trend and hope it will continue. It is quite obvious that the superintendent is at the mercy of the golf course builder.

For economic reasons alone, we appreciate the need for qualified management of these areas. The demands made by increased traffic, greater competition, and closer more critical scrutiny are some of the factors calling for the best efforts of the golf course superintendent.

In many instances, the Superintendent is a combination carpenter, electrician, plumber, mechanic, bookkeeper, and businessman as well as an expert in his field of turf management. With these qualifications, gained through experience and education, he attempts to maintain standards high enough to satisfy himself as well as a group of sometimes overcritical patrons. His progress and security depend upon the satisfaction of this obligation. Whether or not he is successful in his efforts, depends, to a certain degree, upon conditions and circumstances often times beyond his control.

Unfavorable weather, blights, diseases, lack of rainfall, too much rainfall are a few of the many things able to upset even the best of management programs.

The presence of these factors, and being aware of the possibilities of them does not promote any sense of security or comfort for the superintendent. In many respects he is walking a veritable "tight rope" in the pursuance of his duties. However, there are several mental crutches available that are aids in promoting the general welfare of the turf manager.
The formation of the Greens Section of the United States Golf Association, turf organizations, both local and national turf conferences, experimental stations, etc. are all sources of information and latest techniques which are available to the superintendent. Their availability should and does add something to the general welfare of the turf manager.

Relative to the above mediums and their effect on the superintendent, consideration should be given the values of the Winter School for Turf Men. These courses, scheduled at convenient times, are available to certain numbers and play a big role in the promotion of the turf man's general welfare. The opportunity for men of any age or experience, to enroll in these schools and expose themselves to new techniques in their chosen field, is one of great value.

We in the 1961 Turf Winter School recognize this valuable opportunity. We are aware also of the fine reputation of the Stockbridge School at the University of Massachusetts. Our membership is made up of representatives from Boston on the east coast to Guam in the Pacific. Because of this school's fine reputation, we came here expecting a great deal. We leave here feeling we have received even more than we bargained for.

Our sincere thanks to the faculty of this fine school who have impressed us all with their sincerity as well as their ability. May we show our gratitude by the intelligent transference of your imparted knowledge to our field.

"THE MOST OUTSTANDING TURF SENIOR FOR THE YEAR - 1961"

by

William Emerson

Each year the seniors of the Turf Management Club choose a fellow senior as the "Most Outstanding Turf Senior of the Year". The winner is chosen for his scholastic ability, leadership ability and his participation in school activities.

The recipient of the award for 1961 is Everett C. Wood, "Woody", as he is known to his fellow seniors, is an excellent student and was elected treasurer of the Turf Club as a freshman and secretary as a senior. He plans a career as a Golf Course Superintendent.

Our hats are off to you "Woody" for a well earned and well deserved award.
CAN A GOLF PROFESSIONAL’S KNOWLEDGE OF TURF MANAGEMENT IMPROVE RELATIONSHIP WITH THE SUPERINTENDENT

Martin Best
Putnam Country Club
Putnam, Connecticut

My answer to this question is yes. The professional, knowing and understanding some of the problems confronting a superintendent, can help to do many things to ease the burden.

First, he can try to keep the players from starting prior to 8 A.M.; this will enable the superintendent to whip the greens and remove the sprinklers. Also on days the greens are mowed, the first few greens can be completed before the early golfers leave the first tee. The unnecessary waiting would be the result for both the player and the workman. The workman can then be available for additional jobs that will further improve the condition and appearance of the golf course; hence, it increases the member’s pride in his club.

Secondly, the professional, through his pro-shop conversations with the members, can repeatedly bring to their attention the importance of repairing ball-marks on greens, smoothing footprints in traps, replacing divots, and respecting the tee markers. By getting the members to realize the importance and obeying these courtesies of the game of golf, I feel certain that more man-hours would become available for other chores.

Small items that might have been unnoticed by the superintendent or his men could be observed by the professional.

Close relationship between the superintendent and the professional could benefit both the club and its members.

HOW WE PREPARE OUR GREENS BEFORE TOPDRESSING

by

Robert Sullivan

An important factor one must consider when topdressing his greens is to be able to work the topdressing down into the crown area of the turf. In order to do this with the least injury and shock to the turf in hot weather, the greens should be combed with a Delmonte Rake and then spiked just prior to topdressing.
The Delmonte Rake does not tear or rip the turf but merely picks up any runners or stolons which are laying flat and which may cause a mat condition. We suggest that the green be raked twice at right angles to each other and then mowed. This method picks up at least 90 per cent of the runners.

Two men are needed to operate the rake. One man pushes and applies pressure while the other man pulls the rake with a rope. With one man enough pressure and forward movement cannot be applied. We have found that if the greens are raked once during the summer, before our first topdressing, it is sufficient for the remaining times that we topdress. By doing this before our first topdressing, we reduce the amount of mat that may occur during the season and we also 'open up' our greens for the topdressing.

Just prior to topdressing, the greens should be spiked twice at right angles to each other. Now the topdressing can work for us by filling up low spots and leveling off our green without creating more of a problem with mat and thatch. After topdressing we will have a smoother putting surface with less injury and shock to the turf as well as a reduction in mat buildup.

If your method of topdressing hasn't been too successful in the past, try preparing your greens before topdressing as we do.

AN INEXPENSIVE CURE FOR WEEDS AND POA ANNUA

by Pat O'Connor

As you can well imagine, the problem of compaction on a par three golf course is ever present. This is one of the reasons there are so many weeds in the greens.

We had been aerifying about every three weeks, but it was becoming extremely difficult to stop weed encroachment and because of thin turf, Poa annua had taken over one green completely and invaded many others.

The greens were Colonial Bent and since this grass is not very stoloniferous, it wasn't able to combat weeds very well. We were thinking of planting a different type of grass, which was going to be an expensive proposition, not only because of the cost of labor and material, but our greens would be out of commission for most of the playing season.
In the spring of 1958 because of the winter injury that we received, Poa annua had invaded all of the bare spots on the greens. Something had to be done or when the hot weather came, the Poa would go out.

We took a pH reading of the soil and found that it was 5.4. This would favor a Bent grass and give it a chance to fight off the weeds. The only problem was to find a method of introducing the new grass that wouldn't put our greens out of commission for very long.

The owner, after some research, decided to try aerifying and then sprigging the holes with C-1 and C-19 bent, which is strongly stoloniferous and likes a low pH.

The greens averaged 800 sq. feet and the cost of sprigging was $20, a green as compared with $600, per green if we had sodded them. The fact that there was no time lost during the season was also a money saver.

The results of this method were favorable, as the C-1 C-19 rapidly crowded out the weeds and Colonial bent. The only weed we had to remove by hand was Dandelion.

Although it took nearly a year, the savings was more than enough to compensate for the difference compared to sodding.

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WATERING
by
Arthur MacCurrah

Water is by far the most important factor to be considered in the development and maintenance of a satisfactory putting green. The correct use of water depends on the understanding of the requirements of the grasses and the functions of water in plant growth. It is also necessary to understand the conditions of the soil in regards to absorption, storage and release of water for plant growth.

The bent grasses require a great deal more water than do the bluegrass and the fescues. They require even a greater amount when they are maintained at green height of 2/16 - 5/16.
Water is needed for germination, growth and the manufacture of food. It acts as a solvent and carrier of plant food materials. It is also important for good development and activity of the organisms that decompose the grass clippings, dead roots and other organic residues.

The most important factor to be considered in watering is when to water. Water should be applied only when necessary. Watering of greens should never fall into a routine practice because different conditions may exist from green to green. Greens should be checked daily and plugs taken from different sections of the green and examined. Plugs taken from a low section of a green may contain adequate moisture whereas from a higher portion of the green it may be drier and require moisture.

If this occurs, the answer may be in hand watering. This may seem a costly practice but in reality it is not, because it lessens compaction, supplies water to needy areas and it also conserves water.

In properly constructed greens where adequate aeration is present, the top inch and a half may be allowed to dry out slightly. This is beneficial to the grass plant, because it stops certain fungus from becoming active, prevents weed seeds from germinating and activates the deeper roots of the plant. But if the greens have a large amount of Poa in them, they should be kept moist up to and including the top of the soil because the Poa may wilt and die out. The Poa does not have a sufficient root system to reach water at deeper levels; this can be helped slightly by increasing the height of cut from 1/4 to 5/16 of an inch. This may seem only a slight difference but the root development is improved greatly.

Watering in the spring should be considered with care. The soil should be allowed to dry out up to 2 inches. When it becomes necessary to water, the soil should be saturated up to six inches. Grasses develop most of their roots during this period and the drying of this area will encourage deeper root penetration. If during the spring you receive light rainfall and the soil is dry, water should be applied or else the roots will be shallow all through the summer.

Water should be sprayed lightly over sections that become wilted. The main purpose of this is to cool the grass plant.

Watering is mainly a practice that should be governed by common sense. If common sense is used very few problems will arise.
HONORARY MEMBERS OF THE TURF MANAGEMENT CLUB

Honorary membership certificates in the Turf Management Club were presented to Mr. Geoffrey S. Cornish and Mr. Alexander M. Radko at the 1961 University of Massachusetts Fine Turf Conference.

Mr. Geoffrey S. Cornish was born in Winnipeg, Canada. He holds a B.S. degree in Agriculture from the University of British Columbia, graduated from the University of Massachusetts' Winter School in 1938. Later he became an instructor in Agrostology at the University of Massachusetts where he received his Masters Degree in 1952. Since then, Mr. Cornish has become a well-known Golf Course Architect.

Mr. Alexander M. Radko is a native of Yonkers, New York. He received his B.S. degree from the University of Maryland in 1951. He started for the Greens Section in 1947 and in 1955 took over as Eastern Director of the U.S.G.A. Greens Section.
GRADUATES OF WINTER SCHOOL FOR TURF MANAGERS—1961


Third row: Professor E. Pira, Mr. R. Waddington, Mr. A. Allen, V. Smith, F. Merchel, J. Helming, D. Dimarzo.

Fourth row: L. Polidor, J. Martin, M. Best, Professor J. Troll, Dr. Colby, F. Spadafora, J. Reilly.
The various topics are presented for your information as follows:

Welcome Speech by Narry Sperandio .......... A-1
Handle With Care by Dr. Ellsworth H. Wheeler .......... A-2
Current Ideas on Green Construction - Panel Discussion .......... A-4
  Moderator - Alexander M. Radko, Eastern Director,
      Green Section, U.S.G.A.
  Panel - Charles Baskin - Country Club of Waterbury
  Dick Blake - Mount Pleasant Country Club
  William Gordon - Golf Course Architect
  Sherwood Moore - Winged Foot Golf Course
  John O'Connor - Salem Country Club

Automatic Systems for Watering by Robert F. Harper .......... A-14
History of Golf Course Architecture by Geoffrey Cornish .......... A-22
Effect of Nutrition on Turf Diseases by Dr. Houston B. Couch .......... A-31
Turf Disease Control and Use of Fungicides by Dr. R. J. Lukens .......... A-33
Trees and Tree Care by Gordon S. King .......... A-38
Arsenical Toxicity by Dr. C. R. Skogley .......... A-41
Soil Reactions to Arsenical Compounds by Joseph E. Steckel .......... A-45
Brush Control For The Golf Course by Dr. William I. Boyd .......... A-51
Massachusetts Highway Herbicide Program by Joseph L. Beasley .......... A-54

General Turf Session (Alternate Session)
Observations on Highway Turf Establishment & Maintenance
  by E. F. Button .......... A-62

Progress Reports -
  Pre-emerge Chemicals for the Control of Crabgrass
    1. Dr. John R. Havis .......... A-70
    2. Professors John M. Zak & Joseph Troll .......... A-71

Root Growth of Turf Grasses as Affected by Different Heights
  of Cut & Nutrient Levels by Evangel J. Bredakis .......... A-71

The Use of Sod by Daniel Pellegrino .......... A-72
WELCOME SPEECH

By Narry Sperandio

In behalf of the Golf Course Superintendents Association of N. E., it gives me great pleasure in extending our warmest greetings. I would like to commend the University of Massachusetts for sponsoring this conference. Because of some thirty years of experience I am convinced that continued study and practice is absolutely necessary.

This conference like all turf meetings brings together the Golf Course Superintendent and the turf research men, and in so doing, the investment of our time is bringing greater returns every year.

If taxes, labor, materials, and equipment costs, continue to rise, (and there seems to be no end), there is going to be greater demand for more efficient golf course maintenance.

The turf research men at the experiment stations, need the close cooperation of the golf course superintendent, just as much as the superintendent needs the services of the research men. Together the scientists, and the superintendent, must make research, more rapid and extensively useful.

Turf grown at the experiment stations, does not get the abuse of golf traffic, nor is it grown to oblige the demands of golfers, adverse weather does not have the same effect on this turf. So, we, the superintendent, carry out the recommendations of the research men. In so doing we have to consider: what strain of grass are we growing, the turf might be new, or it might be older, it may have a great deal or a little thatch, the soil could be light or heavy, it could be well or poorly drained, what is the air circulation, is the turf grown in a pocket surrounded by hills or trees. What are our maintenance practices, do we normally feed heavy or light, what kind of fertilizers, and when do we feed. Do we water heavy or light, how and when do we water.

Will our findings and recommendations apply to our neighboring superintendent.

The superintendent, if his officials accept his recommendations, will produce, fine turf, have clean sand traps, brooks, rough and landscaping that will be pleasing to the eye.

Now, whether or not the members realize it, the superintendent has to be one of the world's greatest labor relations experts. Otherwise he would not be able to keep help, considering competitive wages, hours, vacations, insurance and other benefits.

He also must be a rapid-fire executive, making an accurate diagnosis of a trouble or emergency and making the right decision immediately. He also must organize and administer the correct action promptly. He must always be set to move the right way in case of sudden changes in weather.
A superintendent in trying to be efficient is constantly trying to place labor where it will not work in the vicinity of players or the result will be unproductive time.

When golfers talk about where they might play golf. They do not talk about the club house, at such and such a country club. They do not talk about the locker rooms, restaurant, or pro shop. They talk about the golf course, is it a nice lay out, but most important it is the condition of the golf course that they are more concerned with. If it is in good condition, they will say, “let's play it, that golf course is in beautiful shape”. So, consequently, that particular country club, because of it's well conditioned golf course will have more activity, in it's various departments, such as restaurant, pro shop, locker room, etc. I have always said, if it wasn't for the fine turf on the golf course, there would not be interest, at the country club.

I have noticed that some superintendents, equipped their men with uniforms. One superintendent not only supplies uniforms for his crew, with names on their pockets, but, he has each tractor, greens mower, and tee mowers, carry score cards, tees, matches, hand towels, and first aid kit, for the convenience of his members.

I understand that, with the approval of your President, Mr. Lederle, there is a possibility of a Par 3 Golf Course here on the campus. Wouldn't it be a step in the right direction to have turf research going on under actual playing conditions. Home owners, landscape gardener's, Park, Cementary and Golf Course, Superintendents, as well as golfers and the recreation program at the College would benefit.

HANDLE WITH CARE

E. H. Wheeler

Chemicals - pesticides - can and do cause injury - even death - to man, other animals and to desirable plants. They would not kill weeds, fungi, insects and other pests if this capability was lacking.

These pesticides - chemicals - are an essential tool for up-to-date turf management. They do the job better and at less cost. You need them.

But! You - and all pesticides users - have an important responsibility; a responsibility to use pesticides
safely, to know what you are doing, to allay the fears of these now frightened by scare publicity about pesticide chemicals.

Remember! It is MISUSE, not the use of pesticides that is dangerous. Pesticides, even the most dangerous ones, can be used safely IF YOU know what you are doing.

And how can you be sure you are using a pesticide in the right way - safely? It's easy! READ and FOLLOW DIRECTIONS on LABELS and in literature enclosed with the package. These directions, precautions and other items on labels are required by law and backed up by research. They mean what they say!

Skulls and crossbones plus the work POISON in red means the material in that container is highly toxic to man and other warm-blooded animals. Only the most dangerous materials carry such a warning; never disregard such plain language!

Along with the red POISON between the skulls and crossbones you will find special precautions, things to avoid, what to do in case of accident, and the antidote. These are important. Knowing this information on the label may save a life - perhaps your own.

Sodium arsenite, a weedkiller, the mercury fungicides, and insecticides such as parathion, TEPP, dieldrin and others are highly toxic - you know it the minute you see a label. But even such materials can be used safely if the directions on the label are followed exactly and completely.

The more you use a toxic material the more dangerous it becomes - we all have a tendency to get careless as things become familiar. Let's not lose our respect for red skulls and crossbones. Twelve years ago people were concerned for their children, pets, birds and themselves when 10 lbs. per acre of asual chlordane was suggested for grub-proofing turf. Now some of those same people are ready to apply 60 to 80 lbs. per acre to check crabgrass!

In 1959 two men died from poisoning by a pesticide. They might have been saved if a label from a package had been carried with them to the hospital. The employer did not know what material his men had been using!

Twelve cattle died from arsenical poisoning following drift on direct application to pastures of...
a weedkiller thought to be relatively harmless in spite of the red skulls and crossbones and POISON.

You are not a friend when you give someone a little pesticide for their backyard or driveway in a beer or coke bottle or any other unlabeled container! This is a perfect set-up for an accident especially for children.

There are only two ways to handle, apply, store, and dispose of pesticides and their containers. One way is RIGHT, the other wrong.

Let's do it the RIGHT way - the safe way. It's all on the label.

Panel Discussion of CURRENT IDEAS ON PUTTING GREEN CONSTRUCTION

MODERATOR: A. M. Radko, Eastern Director, Green Section, USGA

PANEL: Charles Baskin, Supt., Country Club of Waterbury, Waterbury, Connecticut, and is in his 34th year as Superintendent at this club. Mr. Baskin is a graduate of the Ballyhaise Agricultural College, Ireland...in the early 1920's he began working for Donald Ross and then when the opportunity arose he stayed at the Country Club of Waterbury...he is a USGA Green Section Committee Member...a member of the GCSA and the Connecticut Golf Course Superintendents Association...he is a Past President of the latter organization.

Dick Blake, Superintendent Mount Pleasant Country Club, Boylston, Mass...graduate of the Stockbridge School of Agriculture...member of the GCSA...President of the Rhode Island Golf Course Superintendents Association...Editor of the New England GCSA Newsletter.

William Gordon--Architect, President of the William F. Gordon Co...charter member, Past President, and present chairman of the Board of Directors of the American Society of Golf Course Architects...member of the USGA Green Section Committee and the Mid-Atlantic GCSA...has been in golf course construction and design since 1920...from 1920-1923 with Carter's Tested Seed Co., New York City...1923-1942 Partner in the architect firm of Toomey and Flynn...1942 to present formed own Company.
Sherwood Moore, Superintendent, Winged Foot Golf Club, Mamaroneck, New York, Vice President.GCSA...graduate of the Stockbridge School, member USGA Green Section Committee...member of the Metropolitan GCSA...Past President of the New Jersey GCSA.

John O'Connor, Superintendent, Salem Country Club, Peabody, Mass...member GCSA and New England GCSA...began in construction for Donald Ross...worked at Salem for most of active career.

"COMPOSITE" OF ANSWER AND QUESTIONS

(bear in mind that some questions are answered by different panel members - so where answers seem to differ slightly - this is the reason for it.)

QUESTION #1: What procedure do you follow once the decision is made to rebuild a green?

"This would depend greatly on the problems encountered on the green in question, such as: Desire to change type of turf - Inability to maintain turf - Drainage problems - Membership's dislike for present green, etc.

If problems are agronomic alone, the Superintendent can do most of the work needed; he can, if need be, solicit aid from the USGA Green Section's Agronomist, or the Turf Agromonists from Agricultural Stations where turf work is being done.

If it is necessary to change design of the green, then an architect should be consulted...and meetings arranged with green committee, the superintendent, the architect, the contractor should finalize plans...a clay model of proposed revision would be helpful...grade stakes at new project site better enables committee to understand proposed revision.

Begin immediately to provide a good temporary green for play until new green is ready for play.

In every case the club members should be kept informed of project work under way."

QUESTION #2: Are there any special features that you prefer to see in the architecture and/or design of the green?

(a) What are some considerations with regard to size?

"Green should be of sufficient size to receive a
shot that is fairly played to it...size should vary from 4500 to 7500 sq. ft...greens should have at least seven different cupping areas--adequate cupping area with smooth flowing contours--no abrupt or sharp contours.

(b) What is the minimum and maximum specifications for pitch?

"Never more than 1 foot in 35, and never less than 1 foot in 100 feet."

(c) How far should traps be placed from the putting surface?

"There was a difference of opinion on this question--one opinion was that the "traps should be built tight against the putting surface and collar--otherwise the target area is greatly enlarged, and approach shots are uninteresting".

(d) Is there a preference in size of green as dictated by length and relative difficulty of hole?

"Definitely, the size of the green should reflect the difficulty and distance of shot to be played to the green. The contouring of the green also determines size...where more severe contours are desired, the larger the green must be to insure good cupping area."

(e) What if anything in your opinion adds to or detracts from the character of a green?

"The ability of the architect to make good use of natural features such as terrain, trees, streams, etc...also the ability to design the putting surface and bunkering for the precise shot to be played into the green...the ability of the architect to make the green setting appear natural."

QUESTION #3: How far in advance is it best to project a new green construction?

"The farther you can plan ahead, the better...in the northeast all preliminary work such as specifications, orders for materials like sand, tile, seed, stolons, or sod, etc. should be finalized at least one month prior to September 1st...plans should be made at least one year in advance...if you plan to grow your own sod, it should be one year old sod at minimum before transplanting it."
QUESTION #4: When is the preferred time to begin work on a green building project in the Northeast?

"Late August or early September...right after Labor Day if possible...tournaments decrease after Labor Day after which there is still plenty of good weather for construction, turf growth, and time for the soil to settle properly before green is played."

"Just as soon as we can, we establish a temporary green and install an 8" cup in place of the regulation 4½" cup to compensate for the temporary green...our regular maintenance work is reduced at this time and my men look forward to the chance of doing something different, they like construction work."

QUESTION#5: What drainage provisions are important?

(a) With regard to tile drainage requirements the answers were:

"If topsoil mixture is to have a large percentage of sand, tile is a must. Use 4" land or agricultural tile placed at least 12" below finished subgrade. Lay tile on one inch stone or gravel base and fill the balance of the ditch with gravel. Tile drain lines should be placed on 20 foot centers, and allow approximately 300 feet per green or 6,000 sq. ft. in size."

"Experience tells us that regardless of what the subsoil is or the thickness of the stone blanket, tile should be installed at the time of construction. There seems to be no substitute for positive drainage. The tile should be 20 to 36 inches below the finished surface. I always place tile on a bed of gravel and cover it with gravel."

"Four inch tile--Bermico, Orangeburg, or Plastic laid 10" deep in the subsoil...the bottom of this trench should be covered with 1½" crushed stone to a depth of 2"...and the tile laid on the crushed stone...a sheet of tar paper should cover the tile line...and the tile completely covered by gravel."

"Four inch tile placed on gravel in a herringbone pattern at least 14 inches deep."

"The USGA Green Section Staff report (USGA Journal, Sept. 1960) on putting green construction covers drainage very well."

(b) "Surface drainage is vitally important to the maintenance of good putting turf...where possible greens should be drained in 2 or more directions"
to reduce the amount of water discharged through an approach... it must be kept in mind however that on approximately 50% of the greens on any given golf course it is almost impossible to eliminate some drainage to the front entirely... good visibility of the putting surface for the shot being played to the green is important, and as a result on uphill shots to the green must have some degree of fall to the front."

"The surface drainage of greens should be in as many directions as possible—not just one or two or only to the front."

"Two or three directions, and not to the front if possible... there should be no pockets to allow water to stand on the surface... correct contouring can remove surface water in several directions."

(c) Air drainage provisions:

"Air drainage and circulation should be good... it is of utmost importance... do not hesitate to thin wooded areas around greens, leaving only specimen trees, and remove all underbrush... also prune remaining trees high if at all possible... treat stumps so growth is retarded, or remove them if at all possible... keep maintenance requirements in mind—space for gang mowers if any trees are left nearby."

(d) Internal drainage of soil:

"The soil mix should be such that it will permit excessive water to percolate freely and rapidly to a lower level where it can be removed. Yet it should have the ability to retain water and support turf growth over a considerable period of time making frequent applications of water unnecessary."

"With a good sandy loam soil over a good gravel base, deep root structure will be formed rapidly—if the watering program is correct."

"A good soil mix is important. What this mix will be should be determined by the amount of play anticipated, soil conditions, etc... when in doubt and adequate funds are available, my recommendations would be to follow the USGA Green Section's specifications as outlined in their Journal of September, 1960."

"Good internal drainage—percolation of water—is very important... and the topsoil mixture governs the permeability, the percolation rate of water through the soil."
QUESTION #6: How do you determine the topsoil mixture for your greens?

"The mixture that I use is largely determined by experience... the mud pie technique...puddling the soil and checking percolation rates...and by feel... occasionally it is advisable to send samples to the University for mechanical analysis...a sandy loam soil is preferable as a top soil."

(a) How deep do you place the topsoil?

"Preferably 12 inches and this would provide a settled depth of approximately 10 inches...this means 37 cubic yards per 1,000 sq. ft."

(b) Should topsoil be sterilized?

"Yes, with any one of the soil sterilants available depending on the time factor required for each....sterilization of the soil in Spring seeding or stolonizing of greens is a must."

(c) How do you prefer to mix the topsoil?

"Off the site...mix with front-end loader...turn soil 2 or 3 times...and haul to green when ready. The advantage of mixing off the site are:

"(1) accurate mix; (2) no pockets of sand or humus; (3) the correct proportions of sand, humus, and soil; and (4) mixing can be done while other work is in progress."

(d) When do you prefer to add nutrients to the topsoil?

"Apply ground limestone, phosphorus, and potassium as recommended as a result of a chemical analysis of the soil...the nitrogen too(some organic, some inorganic) can be worked into the soil too...to a depth of 3 to 4 inches...about 3/4's of the materials could be worked into the soil...the remainder placed on the surface...grub proof with lead arsenate at this time also...or if you are reasonably sure that insects will be no problem, you can spray with the newer and faster acting insecticides later if necessary."

QUESTION #7: What method of mixing of the topsoil do you prefer?

"Off the green site with a royer shredder...or a front end loader if stone free."

QUESTION #8: How do you prefer to smooth the surface prior to planting?
QUESTION #8: (Continued)

"Alternate raking and rolling and sometimes by dragging with a mat."

"After the cultivation is done, the soil should be raked to the desired contour. A light rolling, preferably by a large diameter hand roller, is followed by another raking. The process of light rolling followed by raking should be repeated. At this time, the soil should be ready for rolling with a heavier roller. It will probably be necessary to roll the soil 4 to 6 times with this roller. After each rolling, the soil should be raked to a depth of about 2 inches. During the raking, always bring the soil to the desired contour.

"It would be preferable to add the topsoil in layers of 3 or 4 inches 'footing' each layer prior to adding the next layer. In this manner the length of time to allow for settling can be shortened. There is no substitute for raking, raking, and reraking in all directions to obtain a smooth surface, and even the use of a leveling board is good practice."

QUESTION #9: How do you guard against compaction in construction?

"Keep all heavy equipment off during construction and do not work soil when excessively wet."

Compaction can be regulated by having a proper traffic pattern at the site. Heavy equipment, such as trucks and tractors, should be kept a few yards off the green. Do not allow people to walk in the same path but have each person take different routes of travel over the green. Any heavily compacted areas should be loosened to the density of the rest of the green."

"Our reason for rebuilding a green is to eliminate compaction. We keep trucks and tractors off the topsoil. We mix our own topsoil, sand loam, etc. to what we think will give us a good porous mixture. I show this mixture to three or more Superintendents in my area to get their reaction. So far our thoughts seem to run along the same line. But, in the final analysis I think a soil mixture test should be made."

"The ideal method is to haul the soil to site and spread by hand but labor costs do not always permit this. Some compaction is necessary to insures a firm and true seedbed. The prevention of over compaction is not always possible but can usually be corrected.
QUESTION #9: (Continued)

by deep cultivation after topsoil is spread. Once the natural physical structure of a soil has been destroyed by mechanical mixing little further damage can be done to it as a result of compaction and cultivation. Concerning soil tests I feel it is imperative that the laboratories be instructed to break soil samples down to their finest structures when making test mixes. This will more nearly duplicate the damage done in field mixing.

QUESTION #10: How long do you allow the soil to settle prior to seeding or stolonizing?

"Experience tells us that any new green should have a period of 2 months to settle, depending on volume of fill...even 12 inches of soil should have a minimum of 6 weeks under natural rainfall or judicious artificial watering to accomplish natural settlement...this time can be shortened by "footing" each and every 3 to 4 inches of soil."

"I don't feel that a waiting period is too important where the topsoil layer is concerned because there are several ways this settling can be speeded up...serious trouble can arise in deep subgrade fill if sufficient time and moisture are not present to settle this material...I therefore recommend applying shallow layers (6 inches) of subgrade fill, and then compact them as each is applied."

(a) Rate of seeding or stolonizing of bentgrass:

"One and one-half to two lbs. per 1,000 sq. ft. except in the case of Penncross which is 1 lb. per 1500 sq. ft...for stolonizing we suggest 5 to 10 bushels per 1,000 sq. ft. depending on quality of stolons and time of year they are planted."

QUESTION #11: How soon after completion is it advisable to open the green for play?

"Just as soon as the green is completely covered with a good stand of turf, and has a firm even surface."

"Depends on whether it was sodded, seeded, or stolonized...sodded greens will be ready first, seeded greens next, and stolonized greens take longest as a rule...the latter require a great deal more topdressing to true and smooth surface."

"Sodded greens could be ready for play in 2 weeks...some may require 3 to 6 weeks...but it depends
QUESTION #11: (Continued)
greatly on the proper preparation of the base."

"The longer you can keep players off, the better."

QUESTION #12: Do you mix any extra topsoil for later use?

"Always plan enough extra topsoil mix to be able to topdress greens with the same soil as used in construction...to maintain a uniform soil with no layering."

QUESTION #13: What apron size or collar do you like to see and are there any special considerations regarding maintenance requirements?

"I prefer a large apron or collar, so that power equipment can be used to full advantage, and safely. There should be no sharp contours where mowers will scalp or water puddle or run across green. These areas should be constructed so that they could if necessary be maintained with gang or triplex mowers."

"Widths should be kept to a minimum and determined by the width of cut of the mower used to maintain them. A thirty inch collar is the minimum width and forty-eight inches the maximum width. The final size is entirely a matter of efficient mower use, the number of trips around the green being kept to a minimum to maintain a width within the limits given above.

"The course of the collar is determined by the original design of the putting surface and should be maintained in this shape so the green does not lose its original character over the years."

"The aprons and collars should blend into the green. Mounds or knolls should add character to the green. Also, a mound or knoll when properly placed can prevent golf balls from going too far astray."

QUESTION #14: If turf is used from a sod nursery what special requirements are important for the nursery soil?

"Sod nursery soils should be as nearly like the final putting green mix as possible...identical...so that no layering takes place when sod is lifted and placed on the new green...sod should be cut thin as possible if soils are not the same...the sod on the new green will have to be aerated sooner and more often if the nursery soil is not identical to that on the new green."
QUESTION #15: How soon do you advise mowing a new green?

"Mow a new green just as soon as there is growth to remove...use a sharp mower and a careful operator...if stolonized, grass could be higher before mowing than for seeded greens...if so gradually reduce the height with each mowing until it is reduced to putting green height...if sodded, then roll the green several times to level the surface prior to mowing."

QUESTION #16: How often do you topdress a new green?

"As often as necessary...depending on growth...also whether seeded, sodded, or stolonized...stolonized greens require more frequent and heavier top dressings to smooth them...possible every second week until open for play."

QUESTION #17: How important is the topsoil mixture to a watering program? If there were some way to provide a margin of safety in water application would you be for it?

"The topsoil mix has become increasingly critical in the maintenance of greens. The number of rounds of golf played per day on any given golf course is increasing steadily. The number of qualified, experienced green superintendents is decreasing due to retirement of our older superintendents and the lack of trained men to fill their jobs and the jobs at the two hundred to three hundred new courses built each year. The increased use of fertilizers, herbicides, insecticides, and fungicides any of which may be capable of building up toxic residues in the soil have added to the problem.

We now find many courses that cannot be maintained through the climatic extremes of any twelve month period.

Our problems could be drastically reduced if we had green preparation and soil mix specifications that could create the following putting green soil characteristics.

1 - Sufficient water retention for plant needs thus requiring minimum irrigation.

2 - Sufficient porosity for rapid passage of excess water and circulation of air.

3 - Ability to hold plant nutrients.

4 - Ability to resist compaction.
QUESTION #17: (Continued)

5 - Ability to hold shots without deep ball pitting or foot marking.

6 - Ability to allow herbicides, fungicides, and insecticides to slowly leach out to prevent possible build up of toxicity due to use of these chemicals.

"If all of the above requirements could be met the critical situation that now exists could be largely eliminated.

The United States Golf Association Greens Section has made an effort to attain the perfection we would like, and I'm sure everyone in the design and construction field hope it may be the answer."

Reprinted here in its entirety is the article referred to many times in the panel discussion...from the USGA Journal & Turf Management. Sept. 1960.

Specifications for a Method of Putting Green Construction by the USGA Green Section Staff.

AUTOMATIC SYSTEMS FOR WATERING

By Robert F. Harper

I have been looking forward with a great deal of pleasure to this afternoon and to the opportunity to discuss with you the application of automatic watering systems, and their application to your golf course.

One of the most dynamic developments in the golf course industry in recent years has been the increasing appreciation and acceptance of a well designed and efficiently operating, permanently installed automatic watering system. Actually, the term automatic is somewhat of a misnomer in that, for the most part, all we are really going to talk about is a remotely controlled irrigation system.

First of all, I would like to say that these systems are not new and that all types have been in existence for many years, though only in recent years in this Northeastern section of the United States. I think the most obvious reason for this recent growth is the existing poor labor situation with which we are all concerned. As far as watering men are concerned, their job generally lasts for a period of only a few months at best, and then they are either dismissed or moved into other jobs on the golf course. As a result
of this situation, they are generally part-time laborers and tend to be quite undependable. It is hard to determine whether they are doing the job correctly, simple as it is generally conceived to be, or whether they are doing just enough to get by. The tendency for the watering man to literally sleep on the job, and to be absent for one reason or another -- most of us have heard the full gamut of excuses -- brings the benefits of automatic watering very vividly into your experience.

The automatic systems are always operated during the night, and once the system has been set up to operate at a given time during the night, no labor is required during the course of the night, moving sprinklers and so forth. The availability of labor to manually operate the system at night, during weekends, and from year to year is becoming increasingly more acute. In some instances college men who are off for the summer months are hired, and do a relatively good job. However, since it is what might be called "just a summer job" the reliability factor here also comes into play. The men do not like to be engaged in a night-time job, nor be involved with a job over the weekends.

In some areas, especially in this immediate area, the local codes require that two men work together at night, so that if one is injured, the other can be of help to him. This obviously increases your costs and your problems in operating a manual system.

I heard a story lately where a man who was out working at night, operating the irrigation system on a golf course -- the golf course in question was Joe Butler's at United Shoe -- thought he "saw" things. All sorts of objects turned up quite unexpectedly, from automobiles to people. Joe Butler informed me that his man was absolutely sure he had seen a group of people crossing the street quite close to where he had been, but upon inspection the next morning, no tracks were found and it was quite obvious that it had all been something that the night watering man had just imagined. The poor labor situation is certainly one reason why the idea of automation in irrigation is gaining in acceptance and in popularity.

Another reason for installing the automatic type system for watering your golf courses is that, as of now, it is a proven fact that you can get a much more efficient and dependable overall operation. Night watering is taken for granted for the most part, and with night watering come several inherent advantages.
In the first place, generally speaking, a low wind condition exists which enables the sprinklers to discharge their water in an even pattern of distribution. This enables your irrigation system to perform efficiently, the way it was designed to do, and the turf does not suffer from lack of water in some areas and too much in other areas.

From the economical standpoint, considerable water is saved when the watering is done at night due to the fact that the evaporation rate is considerably less. Not only is less water lost back into the atmosphere, but as a result, more water is absorbed by the soil giving deeper penetration which is greatly desirable from the standpoint of creating good, sturdy, deep-rooted turf.

Another advantage of automatic night watering, if you are being supplied from a city water distribution system, is that the water pressure at night is generally quite a bit greater, and since a higher pressure is required for the operation of a large golf course irrigation system, it is desirable to have a pressure at least equal to the design pressures of the system. In some areas where a great number of homes have been added to the existing city water distribution systems, the water pressure drops considerably at peak periods of the day, namely in the early morning and late afternoon hours. If the automatic watering system on the golf course is set to turn on at ten o'clock in the evening and turn off at six o'clock in the morning, then the maximum pressure from the city is available and the system is capable of operating at its design efficiency.

As well as being able to water automatically very easily at night, with low wind, low evaporation rate, and higher city pressures available, the undeniable feature of "controlled watering" is very much a reality. This particular term, "controlled watering," arises from the idea that it is possible to operate your system with automatic controls in a way economically impossible with manual controls. In the first place, the irrigation from individual sprinkler heads is not accomplished by manually turning on one sprinkler head and letting it run for an hour and the manually turning it off and moving it to another location. The generally accepted form of operation with a semi-automatic system is to automatically turn a group of sprinkler heads on simultaneously for a period of fifteen minutes, and then turn them off for a period of perhaps two hours, automatically returning to water again for a period of fifteen minutes. Repeating
this type of operation automatically throughout the night, for a total of four complete irrigation periods adequately covers a third of the course. This type of repetitive watering, as it is termed in the industry, accomplishes several things. In areas where you have steep hillsides or slopes, no runoff of the water is possible. This is due to the fact that the low precipitation rate, approximately a half inch during a period of eight hours, is so low that all the water sprinkled on the turf is absorbed into the soil. Even in areas where clay or heavy soils occur, the repetitive watering type of operation will completely eliminate puddling in low spots due to the fact that once again the precipitation rate is so low that it is generally absorbed by these heavy soils. In each case, both in runoff and puddling situations, the water is applied so as to penetrate into the soil and not remain on the surface. If the controls are adjusted correctly for all areas of your course, the "just-right" amount of water will be supplied to each area.

Another reason why these systems have become so popular during the past few years is that the initial investments required to install such a system has been decreased considerably due to wonderful advances in the type of engineering design now offered in general by the industry. Many years ago, the lack of design knowledge required that a particular Club spend considerably more money than they were economically able to justify in the operation of the course. However, at the present time, tremendous advances have been made in the type of designs that can be offered and, as a result, the investment needed to install these systems are available and naturally fall into different price brackets. In areas such as we have here in the Northeastern part of the United States, the most practical type of system is the semi-automatic, individual sprinkler head control system. This system has been installed and is operating successfully at the Rhode Island Country Club in Providence, Rhode Island, the Wampanoag Country Club in West Hartford, Connecticut, and the Weston Country Club, in Weston, Massachusetts. In all three of these systems, the semi-automatic idea, using individual sprinkler head controls, was utilized and has proven to be very practical. Generally speaking, taking all things into consideration, namely rock formations within the course itself, the investments for the systems should run between a low of $50,000 and a possible high of $80,000. Inasmuch as it is generally conceded that a budget of $3,000 is adequate to handle the operation of a manually controlled 18 hole golf course, and inasmuch as a semi-
automatic system generally requires a budget of about $1,500 a season, it can be concluded that $1,500 a season can be actually saved on labor alone by the installation of a semi-automatic watering system. In some areas this is considered to be a very conservative figure, and I have heard that over $3,000 a season can be applied against the additional cost of a semi-automatic system. Obviously, the longer the season, the more advantageous it is to operate a semi-automatic system.

It is interesting to note that only a small additional cost of some eight to fifteen per cent need be added to the original cost of the old-fashioned manual, quick coupling system, where a semi-automatic system has been designed along with it, covering the same areas with the same amount of water per week. It is now past history that these investment figures and percentages are possible, since they have been proven so many times and in so many different places all over the world. Little wonder that good, semi-automatically designed systems are no longer considered "too expensive" but are now a must.

Another type of system, aside from the semi-automatic type, is the fully automatic type systems where sprinkler heads are permanently installed in the ground, connected to permanently installed piping and controls. Systems of this type are highly advantageous, and very practical in areas where watering is essential. However, in areas such as we have here where it is virtually a marginal watering area, the additional cost to install these systems over what would be required for a semi-automatic system makes the installation of these systems almost prohibitive. However, in the very near future, new sprinkler equipment is being designed which will offer a relatively inexpensive fully-automatic type golf course irrigation system.

Up until now, we have been discussing why the automatic watering systems for courses have become so popular, and now you are probably wondering how such a system can be utilized by you at your particular course. As I mentioned indirectly before, basically two types of systems can be employed. First, that of a fully automatic type system, and secondly, that of a semi-automatic system. The automatic type system is one where the sprinkler heads are permanently installed in the ground on permanent piping, and are controlled in one of two ways. The old way was the master valve type control. In this type of system, the master valve is generally located so as to supply water to a group of sprinklers and operate all of them simultaneously. The
latest type of control system, which is actually the ultimate turf sprinkler control system, features an automatic valve under each sprinkler head. This results in economic and functional benefits for the architect, the contractor, and most of all for the owner. As we have discussed, an old-fashioned sprinkler layout is composed of the main line carrying a large amount of water into one open valve at a time, through which the water is divided and redivided through large, medium and small size pipes, until it is dispersed at the end of many small pipes to sprinkler heads at one time.

The ultimate turf sprinkler control system is composed of the same main line carrying a large amount of water, but here it differs from standard sprinkler layouts. A main line has many small lateral mains, each of which supplies several motor sprinkler heads and automatic valve combinations, but only one operates at a time per lateral main. This keeps most of the pipe down to the size necessary to carry water to one individual head. Sprinklers to operate together are determined by inexpensive plastic control tubing, to the remotely controlled automatic valves, rather than by expensive pipe connections. Since all piping is main line, no extra pipe need be installed to carry water to quick couplers or part circle heads around greens and tees. Economically speaking, the savings in the reduction of the large size pipes more than pays for the additional cost of tubing and automatic valves. Supplying an equal quantity of water to an area through smaller pipe is accomplished by using a higher percentage of small pipe continually, rather than a small percentage of large pipe intermittently. This type of systems offers many advantages:

1. The architect or sprinkler consultant will save from 1/3 to 1/2 the time required to size the pipe for the sprinkler system, because there is much less cumulative flow loss computing necessary.

2. The sprinkler contractor will save time and take off because of standard pipe size, fittings and hookups. Higher quantities of standard items reduces the cost per unit, and installation is easier because of the smaller pipe and less variety of materials necessary in the field.

3. The sprinkler head manufacturer appreciates this type of system since no dirt syphonage into the rotors can occur. Another feature is that water cannot gain velocity in empty piping that can cause a sprinkler center to pop right out of the head, since all piping is always full of water.
4. The landscaping contractor will save many hours of extra seeding time around the rotor type sprinkler heads on slopes where draining of the lower heads usually washes away seed, soil and fertilizer.

5. The customer derives the most benefit from this type of sprinkler system, because every benefit previously mentioned reflects on the overall savings of the customer's money and the protection of his interest. A customer will also appreciate the absence of wet, soggy spots in his turf caused by downstream pipe drain-out on gently rolling terrain. Also, the pipe sizes may be reduced considerably since the overall time of a sprinkling cycle may be increased to a point where it is watered a maximum amount of time, using a minimum amount of gallons per minute. Generally speaking, the farthest valve from the source of the system opens first, followed by the next to farthest, etc., which in effect for all intents and purposes, completely eliminates any hydraulic surges or hammers in the piping itself. The reason for this is that the distance between the farthest valve and the next to farthest valve within the system from the source, is the only column of water that is actually being stopped by the closing of the farthest valve. The main body of water, of course, is relieved out through the opening of the second valve.

In a semi-automatic system, the portable sprinkler heads are located at predetermined places throughout the course in the late afternoon or early evening hours, and then at a predetermined time at night are allowed to go into operation. When morning arrives, after the course has been watered thoroughly, the sprinkler heads are then removed and the course is ready for play. Hereagain, two types of systems are available in the semi-automatic variety. One where a large master valve controls a number of sprinkler heads simultaneously, and the other where individual remote control valves control the sprinklers individually. Once again, the individual sprinkler head control system is proving itself to be by far the most practical from both the standpoint of low head drainage from the piping and also from the standpoint of the pipe sizing required to operate such a system. In an individual sprinkler head control system, the linear footage of pipe is almost identical to that of the master valve system. However, the piping is generally smaller in size, due to the fact that a more efficient system can be designed.

Before closing this discussion, I know most of you are quite interested in what types of automatic equipment are used. In the past few years, most of
the companies engaged in supplying the automatic controls for this type of system have been going all out to develop the diaphragm-type remote control valve. Piston type remote control valves are still available, but the trend seems to be going to the diaphragm-type valves. This is due to many reasons, namely, that with a diaphragm, no packing glands or close fitting parts are required, whereas with a piston valve, foreign matter in the water, such as sand, silt, algae, calcium, iron or lime, tend to wear the internal parts and cause the piston valve to fail or malfunction. No orifices or strainers, which might tend to clog and ultimately cause trouble, should be in a valve.

The piston or diaphragm valve can be supplied in either the normally open or normally closed type. The definition of a normally open hydraulic or pneumatic valve is one that is held open by line pressure at the inlet to the valve. A normally closed pneumatic or hydraulic valve is one which is held closed by line pressure at the inlet to the valve. In an electro-hydraulic valve, which is generally termed a solenoid valve, the normally open type is one which opens when its solenoid coil is deenergized. It is generally conceded in the hydraulic or pneumatic diaphragm type valve, that since the design is considerably more simple than the solenoid type, it will be more dependable, especially if foreign or abrasive matter appears in the water.

In the operation of a pneumatic or hydraulic type remote control valve, small polyethylene plastic tubing can be used to operate them from their centrally located automatic controller. In the case of the electric solenoid operated valves, a wire is run from the electric automatic controller to each electric valve. Generally speaking, this wire is of the low voltage type, and as a result, the wires have to be sized accordingly.

If the polyethylene plastic tubing is used in conjunction with water pressure for a completely hydraulic type operation, no precaution need be taken with this tubing as far as freezing is concerned. For many years, this tubing has been used in such places as the Denver Parks Department, the Spokane, Washington, Park Department, and in Canada with no reported rupturing of the tubing being experienced from the expansion of freezing water in the tubing. The hydraulic type system is generally chosen as superior for this particular application due to the fact that inherent in a hydraulic type system, the valves tend to close and open more slowly. This, in
effect, lessens the chance for surges to develop in your underground piping and cause damage to the pipe and fittings.

The straight electric or the combination electro-hydraulic, or electro-pneumatic controls, required to operate the remote control valves, are either located in the areas being watered, or at the source of the water supply. It is just a matter of opinion which is the better location, and in many cases the location is decided from the overall application on the particular golf course. There is no set 'best way' to determine this alternative, and it really doesn't make too much difference.

I can see from my watch that the time has come to bring this talk to an end, and I am sorry that a normal three-hour discussion on the particular subject has to be crowded into a short 45 minute period. However, I enjoyed speaking with you regarding the application of automatic controls in your golf course irrigation systems, and I hope that as time goes on, you will all become proud owners of the semi-automatic type irrigation system, either by installing a new system, or by converting your existing manual system.

HISTORY OF GOLF COURSE ARCHITECTURE

By Geoffrey Cornish

When John Mulhearn on behalf of the Stockbridge Turf Management Club, a few minutes ago so kindly presented Al Radko and me with certificates in recognition of outstanding achievement in the field of fine turf management, I could not help but think that perhaps in any one year I create many more turfgrass problems than I help solve. The thoughtfulness of the Turf Management Club is nevertheless much appreciated, and Mr. Radko's contributions are certainly countless.

My talk tonight is to consist of thirty minutes of talking plus about twenty minutes to show slides. Each slide has been selected to show a milestone in golf course design from the days of the old course at St. Andrews to almost the present. These in fact trace the evolution of modern course design. I have purposely selected slides of courses designed by bygone architects. None are the work of contemporary architects nor does my talk mention any contemporary architects except Bill Gordon who was with us this afternoon, although I will discuss contemporary architecture. I have done this because I could never cover in the time
available all great courses that are being laid out today.

When we consider that several of us in this room knew Charles Blair MacDonald, the Father of American Golf Course Architecture, we can conclude that course design is a young profession. And indeed it is. Even on the other side of the ocean in Scotland where golf has been played for many centuries the history of course design goes back for only a few generations to the mid 1800's.

All the early course in Scotland and also those few located in England and Ireland were situated on "linksland", those sandy grassy areas stretching back from the coast line. When a new course was needed a site was selected that already had a number of attractive hollows of turf, made smooth by sheep and rabbits, and a number of natural hazards which were generally sand dunes, ditches, gorse, whins and heather. It was centuries before it was realized that turf, sandtraps and hollows and plateaus could be artifically created. In short as the noted British golf architect Sir Guy Campbell said in regards to the earliest courses, Nature was the architect and animals the contractor.

The old course at St. Andrews until its revision in the 19th century was in part such a layout and still retains many of the features of a natural course.

The renowned course was primitively in existence when the University of St. Andrews opened in 1414, nearly 80 years before Christopher Columbus discovered America, 200 years before the arrival of English colonists on the Massachusetts coast and more than 500 years before Bob Grant and Mary Sperandio opened the Conference this morning.

It is of interest that several of the deepest traps on St. Andrews started as divots which the ferocious winds and rains of Scotland scoured over the centuries into the terrifying hazards we know today.

These original layouts of Nature on the Eastern Scottish coast hall marked golf as a point game and as Sir Guy Campbell emphasizes, these layouts became the blueprint and pattern for every links and course since constructed throughout the world indeed they remain today as the ideal of all quality and design; and no course design is successful if it departs too radically from the contouring and subtleties inherent in the natural layouts of linksland. This does not, of course, mean slavish imitation of individual holes and greens.

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Many of us from this side of the ocean viewing a Scottish links for the first time admire the beautiful moulding of the greens and sculpturing of the traps. We may well wonder what genius, what artist, what creative intellect conceived such spectacular features. Investigation will often show that this shaping is the work of wind, water, birds and animals and not of man. It is architects outside Scotland who are imitating linksland in building the raised and sculptured, irregularly trapped greens we see on every great course today.

Until very recently it was thought that the Royal Montreal first built in 1873 and St. Andrews on the Hudson established in 1868 were the original golf courses in North America. It has now been proven that courses were in existence in the Thirteen Colonies before the Revolution. All but one of these seemed to die with the Revolution apparently because so many of the golfers of those days were Tories or Loyalists who took off for Canada and the British West Indies after the Revolution. One of these earliest courses was known to be in existence at Charleston, South Carolina. This lingered on until around 1815 and not long ago I read that a rough plan or sketch of this former course came to light in old documents found in South Carolina.

After the rebirth of golf in North America with the establishment of the Royal Montreal and St. Andrews on the Hudson there soon followed Tuxedo Park in New York, the Newport Country Club and Shinnecock Hills. These clubs were followed by The Country Club (at Brookline), Myopia Hunt, Chevy Chase, the Philadelphia Country Club, Essex in Massachusetts, Essex in New Jersey, Baltusrol, Appawamig, Montclair and the Baltimore Country Club. All names familiar to us today because these clubs have survived although not all in their original locations.

These earliest courses were for the most part designed by Scottish architects and professionals who did not take up residence in the United States. Perhaps Willy Dunn was the best known of these men.

The era of American golf course architecture was ushered in by Charles Blair MacDonald. Born in Canada of Scottish parents he was brought up in Chicago until the age of 16 when he was enrolled in the United Colleges of St. Salvador and St. Leonards in St. Andrews. His grandfather who still lived in Scotland was horrified to find that a man of 16 had never played the Royal and Ancient Game and arranged for him to take lessons with old Tom Morris the noted Scottish pro-
fessional and course designer. Apparently he took to the game like a duck takes to water and before graduation four years later he was defeating many Scots at their own game.

Returning to Chicago he endeavored to get a group interested in building a course, but it was many years later when he finally persuaded the Chicago Club to build 18 holes. This was followed by other courses in the Chicago area and then his greatest triumphs, the National Golf Links on Long Island and decades later Yale at New Haven and the Mid Ocean in Bermuda.

MacDonald was a remarkable personality. Herbert Warren Wind the celebrated golf writer and author of that fascinating and comprehensive book "The History of American Golf" says you either liked him intensely or disliked him intensely. There was no middle ground.

MacDonald played a great game of golf, even his enemies admitted. He was officially the winner of our Second National Amateur Championship and according to his friends the winner of the first National Championship. Actually Charlie was the runner up in the first championship but because the United States Golf Association was not formed until the Second Amateur he was considered the authority on golf rules. Charlie not being the retiring type, or so the story goes, had the winner disqualified for some infraction and took the laurels himself. The ensuing argument which raged for a decade or more in golf circles and all the attending publicity apparently did not hurt the game. Some say it hastened the formation of the United States Golf Association the following year, and may have persuaded that fledgling body not to depart too far from the rules of the Royal and Ancient.

According to Warren Wind, MacDonald swung his weight into this and every controversy American Golf experienced in his lifetime.

One reason Charlie made staunch enemies was that he was convinced he had been appointed by God to supervise the spread of the game in America.

Another was that he, a confirmed slicer, felt that all the real troubles on a golf course should be on the hook side. And he designed his course accordingly. From Wind's "History of American Golf" we can deduce that MacDonald had laid out the holes at the Chicago Golf Course clockwise around the perimeter of the property, so that the golfer who unleashed a far sized hook found himself off the course and playing his
second from a cornfield. To appease the hookers, MacDonald had the club adopt an out of bounds rule whereby those out of bounds took their second from the tee. Later MacDonald apparently feeling this did not give the slicers sufficient advantage decreed that the club must adopt the Royal and Ancient's stroke and distance rule. To be sure as Mr. Winn says Charles Blair MacDonald with his chronic slice was never 'out of bounds on this clockwise course.

All Charlie's early courses in the Chicago area and he designed most of them where were designed in this manner. Not too surprisingly he won about every tournament he entered in that city. Perhaps Charlie was considered a bit tiresome in some golfing circles. At any rate one golf season which he spent entirely in England he was the recipient of a telegram from Chicago golfers reading "We hope you are enjoying your holiday. We are."

In later years MacDonald left Chicago and made New York his home. According to Warren Wind he did not mellow with age. If anything his ideas became more fixed, his oaths more explosive and his loyalty to St. Andrews stronger than ever. Whether he was fighting the U.S.G.A. or designing his wonderful courses or replaying old matches in the leather chairs at the links he remained a law unto himself.

In retrospect as we look back it is probable that had it not been for MacDonald's strong personality and his insistence that neither the rules of the Royal and Ancient nor the challenge of courses be greatly compromised, golf would never have taken hold of the American imagination as it has. Certainly as Wind says, "MacDonald contributed more to the advancement of golf in America than any other person of his generation."

Another early architect was Walter Travis, winner of the British Amateur of 1904 and one of the greatest golfers of his time. Travis, Australian born came to this country at an early age but retained his countrymen's inborn dislike for constituted authority.

Walter Travis true to this characteristic of his people was an independent soul. Unlike MacDonald whose domineering personality charmed British golfing circles and who the British regard as an unexpected but welcome ally in their frequent differences of opinion with the newly born U.S.G.A., Travis soon ran afoul of British golfing circles. Prior to the Amateur of 1904 he refused to attend any of the preliminary dinners which were so much a part of British golf in
those days and then later refused to dress in the approved fashion of the day for the match. Much to the chagrin of the British he won their amateur championship.

Returning to the United States he took an active part in promoting golf in this country. It was said of him he was the only man in those days who dared to modify any of the principles Charles MacDonald had decreed for American course design. Running his own independent way, completely unaware by old Charlie and his references to that "upstart", Travis ushered in an era of moderation in course design, quite alien to Charlie, whose hazards meant only to terrify, it is true, more often than not in practice demoralized the golfer completely. It was perhaps fortunate at this stage there was some one on the scene who could stand up to MacDonald. Perhaps to Travis more than any other man we owe the principle in golf course design of not fighting Nature the whole day. In other words in general we use what she provides in the way of contours, modifying them perhaps by not destroying them. This ties in exactly with what the eminent golf course architect Bill Gordon said this afternoon in relation to green sites.

Three examples of Travis' courses in this general area are Round Hill near Greenwich, Yahandois at Utica and in collaboration with Willy Dunn, Ekwanok at Manchester, Vermont.

The years immediately before World War I produced other shots that were heard around the world when in 1913 the 17 year old Francis Ouimet defeated the veteran British golfers Ray and Vardon at the Country Club to become the first American born golfer and an amateur at that to win the United States Open. This did something to golf in this country. Ouimet overnight became the hero of youth everywhere, whose ambitions turned from other channels into the twin objectives of owning a set of clubs and emulating Francis' performance.

Well known architects of the pre World War I period including some famous amateur golfers who designed courses for a hobby were Robert Hunter, James Taylor and the British architect H. S. Colt who worked with George Crump in creating Pine Valley and while here designed quite a number of other courses.

Following World War I and particularly prior
to the depression, a few of the well known architects were Willie Parks, Tillinghast, Toomey and Flinn, Wayne Styles, Devereaux Emmett and Chandler Egan the golfer. Here in Massachusetts and Connecticut the late Orin Smith and Skip Mogan both designed a number of courses. Then there were the big three, Dr. Allister Mackenzie, Donald Ross and Stanley Thompson. Thompson and Ross each designed over 500 courses before their deaths, a record not since equalled. Many of today's architects were formerly associated with Mackenzie, Thompson and Ross and these three men stamped American Architecture with three principles. These were that to be truly great a golf course, individual hole or feature must have golfing value, it must be beautiful, and it must be maintainable.

At this point I would like to comment on contemporary architecture briefly without discussing contemporary architects.

Robert Tyre Jones, Jr. in "Golf is my Game" notes that the net effect of improvements in balls, clubs and above all in the standards of golf course maintenance has made the game easier and in some ways different. For example on holes of the drive and pitch variety placement of the tee shot was of paramount importance 30 years ago, while extra length offered little profit. Today with the deadly pitching wedges on holes of moderate length the long drive can be of definite advantage.

Although it is debatable whether better players today are as good or better than those of 30 years ago, we do know that a tidal wave of newcomers far greater than has ever hit the game before is now flooding our newer courses and those older courses that happen to have vacancies. Many of these people are in the rough more than they are in the fairways. Superintendents have accordingly groomed the roughs. This has a profound influence on placement or other hazard and incidentally has contributed to the influx of newcomers in that the fewer lost balls has a definite appeal to a novice who could easily lose 10 to 15 balls in a round with ungroomed roughs.

It is of interest to read that Mr. Jones has observed the improvement in golf course maintenance standards. Occasionally we hear that greens, fairways, etc. are not what they used to be. Personally I am sure this is on par with the statement that the winters of New England are not as rugged as they used to be.

Social and economic changes on this continent are affecting golf course developments. The revolution in
agriculture is resulting in better land being available for golf and here in New England we see estates and farms everywhere being converted into country clubs and public courses.

Likewise the growth of cities is forcing established clubs to sell their existing courses. At the same time the construction of turnpikes and limited access roads is allowing these clubs to locate conveniently in areas far distant from downtown.

Clubs that were formerly golf clubs are now country clubs, but even these are different from the country club of a few decades ago. Strictly speaking they are family clubs with something for every member of the family and no longer do they serve only as retreats for the senior male of the family.

The well-to-do American family feels that belonging to a country club is part of its way of life - an extension of its standard of living. Moreover, many organizations expect their executives to belong to a country club whether they use the facilities or not. With only 501 courses in the United States and only a little more than half of these private there are no where near enough to satisfy the demand. Many clubs built today have a waiting list before they are even completed, and I know of one new facility that had a waiting list before construction started.

Modern earth moving equipment has revolutionized golf course construction. Mountains can be eroded, deep depressions and swamps filled, lakes built, boulders removed and land cleared and contoured at far less effort and expense than that involved before the invention of these mechanical marvels.

In the shape of things to come I predict a greater understanding between superintendents, research and extension services, and golf course architects. The destinies of the professions of the golf course architect and the golf course superintendent are linked together. My own feeling is that neither can thrive without the goodwill and understanding of the other. In my opinion the paper by Al Radko's Green Section Staff in the September 1960 issue of the U.S.G.A. Journal and Turf Management on methods and specifications for putting green construction marks a milestone in course constructions, and by setting standards should itself help to this better understanding between those in course construction and those in course maintenance.
It has been an anomaly that golf courses were built with the man whose career will be linked with its future taking no part in its construction. Today, however, we see superintendents taking an increasing part in construction of their own courses. They are present in an executive capacity, perhaps as the construction superintendent and they take part in all decisions and also air their views in regards to plans and specifications. Not only does this pay handsome dividends to the club but it gives the superintendent some ideas of the frustrations inherent in any golf course construction project.

One other point before going on to slides is the training of future golf course architects. Since the era of Charles Blair MacDonald there have been periods when golf course architecture almost became a lost art. From 1930 to 1946 other than government sponsored municipal courses there were less than 200 courses constructed in the United States. Young men entering the profession must keep this in mind.

Furthermore they may find that few committees are willing to accept their ideas until they have at least reached their thirties. Hence the period of preparation can be longer for a golf course architect than for a teacher, lawyer or doctor.

Nevertheless, I am sure there is plenty of room for qualified men in golf course architecture in the foreseeable future. And it is my opinion that in many ways it is the most rewarding and interesting of all professions.

Preparation other than knowledge of the mechanics of the game should include college study in both agronomy and landscape architecture, at least five years working with an established course designer, several years on course maintenance and then travel to study famous golf courses abroad and in America. In this regard it has been stated that the nearest thing to an enduring text book on golf course design is the Scottish linksland.

**Conclusion**

T. S. Eliot the poet has stated that this civilization may be known to the future by a hundred golf balls lying in a country stream.

While I personally do not take his pessimistic view of our civilization it is apparent that the Royal and Ancient Game of Golf together with its social aspects occupies a unique position for better or for worse in all advanced democracies of the mid-20th century. This construction boom is not peculiar
to the United States, in that Great Britain, Ireland and other English speaking countries, Italy, Germany, and Japan are building golf courses at a rate somewhat comparable to our own.

Many Universities are following the lead of the Universities of Massachusetts and Rhode Island in increased grants for turfgrass research and teaching. To the young men in Stockbridge and the Winter School I would like to say they have chosen wisely in selecting an occupation related to golf and turfgrass. All of us in this room should feel indebted to both Professor Lawrence S. Dickinson and Dr. Jesse De France for linking New England so closely to this growing profession and to Joe Troll and Dick Skogly in perpetuating their work.

Had it not been for Professor Dickinson none of us would be here tonight and had it not been for he and Dr. De France I feel that all the professions associated with golf and turfgrass would have been much the poorer. I will not attempt to catalogue the contributions of Professor Dickinson and Dr. DeFrance beyond stating that they have been helpful friends and teachers of superintendents and architects too numerous to list.

In this Commonwealth of Massachusetts we are now particularly fortunate in having the energetic and capable Professor Joe Troll and his right hand man Don Waddington handling the turfgrass program in the department of our old friend Dr. Bill Colby. The phenomenal attendance at this turfgrass conference under the worst possible weather conditions testifies to the organizing ability of these men.

EFFECT OF NUTRITION ON TURF DISEASES

By Houston E. Couch

Department of Botany and Plant Pathology, The Pennsylvania State University

Knowledge of the precise role of fertilizer and water management practices in development of turfgrass diseases is of primary importance to management specialist. Research over the past five years at Penn State has shown that the relative severity of Rhizoctonia brown patch, Sclerotinia dollar spot, and Pythium blight can be altered by variations in fertility, pH, and soil moisture.

With Rhizoctonia brown patch, it has been found that disease development is greater at high nitrogen (N)
fertility when phosphorous (P) and potassium (K) levels were normal. When N, P, and K were increased concurrently, however, the added susceptibility of the plants was offset. Under low N with normal P and K, the plants were more resistant to the pathogen. At concurrent low N, P, and K, however, susceptibility was increased. pH had no influence on disease development at low N, but under normal, balanced, nutrition, less disease occurred.

Low balanced nutrition resulted in less severe disease developments with Sclerotinia dollar spot, when compared with high balanced or high N fertility. pH had no influence on disease development, but plants grown at low soil moisture were more susceptible to the pathogen than those held at continuous field capacity.

Pythium blight was found to be more severe under low balanced fertility, and at low calcium levels. In addition disease development was greater at low soil moisture levels.

From the foregoing, it can be seen that response of turfgrasses to these diseases is not a simple, straight line factor. Generalizations relative to plant vigor and disease development can not be made. This is best illustrated with the results of the brown patch studies, where it was found that the combinations, rather than levels, of N, P, and K determined the degrees of plant susceptibility.

Field application of these results lies not in the control of turfgrass diseases through the alteration of the fertility program. Rather, when the fertilizer or irrigation programs are suddenly changed, one should be prepared for the possibility of it being necessary to change the fungicide program (rates and frequency of application) also.

It can not be over emphasized that while relative susceptibility to turfgrass diseases apparently is subject somewhat to fertility and irrigation practices, desirable control is not possible by altering these programs. Adequate disease control can only be accomplished by the proper use of fungicides. Disease outbreaks can not be avoided by certain fertilizer practices. When the turfgrass management specialist manipulates the fertility program to control disease, he may find that the grass growth rate is no longer desirable, and he is certain to find that disease control has not been accomplished.

The program most certain to produce grass of predictable utilitarian and aesthetic qualities, is one in which the management specialist uses fertilizers to grow grass and fungicides to control disease.
TURF DISEASE CONTROL AND USE OF FUNGICIDES

By R. J. Lukens

How can we control turf diseases? Before this question can be answered, we must ask: What is diseased turf? Turf is sick when it isn't growing normally. Sick turf wilts or dies from a slight shortage of water, while healthy turf is not affected. Sick turf fails to respond to fertilizer like healthy turf does. Sick turf dies from slight abuse, while healthy turf can withstand much abuse. The cause of sick turf is generally attack by certain fungi. The specific ailments of turf we recognize by special symptoms and the presence of the pathogen.

What parts of grass plants become diseased? The most evident diseases of turf are those of leaves and crowns: the top parts which we all see. Top-infecting diseases of grasses are Helminthosporial and Curvularia blights, commonly known as melting out, fading out, or leaf spot. Copper spot and dollar spot together with Pythium blight and Rhizoctonia blight, commonly known as brown patch, are top-infecting diseases, too. There are other top-infecting diseases, but they generally do not cause problems in turf.

Grass roots also get fungal diseases. These are lesser and are not usually suspected of causing problems in turf. At time, Pythium will attack roots of bentgrass. Rhizoctonia solani rots away roots of grasses especially turf on putting greens. When the roots rot, the plants cannot get water and the leaves wilt. Turf with short roots requires more care, watering, and fertilizing because it does not have a large reservoir in the soil to draw upon for its needs.

Control by helping the grasses. Now, turf does not always become diseased when the fungal pathogen is in the soil. For disease to develop, the surrounding environment must favor the attacking fungi, and the unfavorable for the grasses. Thrifty turf does not succumb to attacks of fungi as readily as unthrifty turf. So, an important way we can control turf disease is to maintain turf in good vigor. An ounce of prevention is still worth a pound of cure. I admit it is a ticklish problem to maintain healthy turf on putting greens. A person who can master this problem in spite of the heavy demands placed upon fine turf today, is a much sought-after superintendent. Feeding the turf properly is essential for healthy turf. Fertilizing too little or too much may make grasses susceptible to diseases. Healthy turf requires certain soil conditions. If these are not provided, the turf is not thrifty and may easily succumb to disease.
Control by attacking the pathogen. Another way we can control disease is to attack the pathogenic fungi. They, too, must grow and survive in the same environment as the grasses. For fungi to cause trouble, they must be growing vigorously and multiply rapidly. So, we can control turf diseases by preventing a build up of pathogen or by allowing very little fungus to attack the grasses.

The fungi causing disease on fine turf need moisture in order to multiply. They need moisture for a certain length of time to attack grasses. For example, brown patch occurs in humid, warm weather, bluegrass leafspot occurs in wet, cool weather, and Curvularia blight can occur on turf anytime when it is watered daily. All these diseases require abundant moisture. Overwatering or too frequent watering helps fungi cause diseases. Conversely, judicious use of water in growing healthy turf discourages disease.

Other cultural practices that prevent a build up of pathogenic fungi are: (1) use of disease resistant strains of grasses; (2) use of clean seed and stolons; and (3) use of clean top dressing. What I mean by "clean" is plant material and soil free of the pathogenic fungi.

Disease control measures mentioned thus far are part of the successful art of growing fine turf. These are things a superintendent keeps in mind in his management of turf. However, there is still another aid we can use to help control disease. That is chemical control of disease. Even though most of my work lies in fungicides, I consider their use for disease control as an emergency measure when other methods fail.

Many chemicals are toxic to fungi and are nontoxic to grasses. Some of these are available to us for use on turf. These fungicides strike at fungi, helping grasses to win their struggle with their pathogens. Some fungicides may prevent disease from starting and some may cure disease after it has started. Some do both. To use a fungicide most effectively, we must know how it acts.

How fungicides combat disease? First, I will talk about types of fungicides and then consider their use in controlling turf diseases.

Some of the turf fungicides currently used are protectants. They form a protective coating around the plant. That is, they are "painted" onto leaf and stem and poison the spores of pathogenic fungi that land on the protected surfaces. This keeps the spores from germinating preventing the fungus from attacking the plant. Protective fungicides are usually insoluble in water, stick to plant
surfaces, and resist weathering. But when the plant grows, new leaves are formed that need protecting. We can see, then, in a protective spray schedule, fungicides have to be applied often in the growing season - every 7 to 10 days is a compromise for turf.

Other fungicides are direct killers. They eradicate young infections in leaves and stems. The fungicide is sprayed onto the diseased spot and kills the fungus in the tissue directly. Direct killers, or eradicants are generally water soluble. Because they are washed away by sprinkling and rain, the active period for these chemicals is shorter than that for protectants. Therefore, the application of eradicants must be properly timed if they are to be effective. As a practice on turf one application of an eradicant is applied when first symptoms appear or when disease in anticipated, and a second one 5 to 7 days later to catch infection missed by the first.

A few turf fungicides may act systemically. They are taken up inside the plant's system, and are carried throughout the plant. The chemical may kill plants from the inside. This type of fungicidal action is new in plant disease control, and few fungicides have been developed that act systemically. One can appreciate the problems involved. Both grass and fungi are plants. So systemic fungicides must poison the bad plant, the fungus, without poisoning the good plant, the grass. But when suitable systemic fungicides are developed, they should be effective for a longer period of time than protectants or eradicants. Two fungicides with which we are working in Connecticut have a long period of effectiveness. We suspect that they act systemically as well as kill pathogenic fungi in soil.

How do we use fungicides? Fungicides may be applied to the tops of turf as dusts or sprays, or to the roots as drenches, dressings plus watering, or as direct injections. How best to apply a fungicide is determined by how it acts and what disease is to be controlled.

Let us first consider foliar application for controlling leaf disease. This includes most current turf fungicides. Sprays are used in preference to dusts. With foliar sprays, we must wet the leaves and stems or crowns of grass uniformly in order to distribute the chemical evenly on the plant surface. Spraying part run-off may result in less deposits on leaf surfaces. So a limited amount of mixture is sprayed onto turf. Foliar protecting fungicides must be painted onto newly developed surfaces throughout the disease season for best results. They control turf disease well, but are laborious and
expansive in practice. Foliar eradicants or direct killers are used to stop young infections of leaves. Few applications are needed in an eradicating schedule, but catching the disease before damage occurs requires critical timing. However, with close watch on the turf, eradicative spray programs have successfully controlled disease on golf greens. The use of systemic fungicides as foliar sprays for controlling leaf diseases may prove to be successful. The performance of a systemic fungicide is dependent upon its movement into leaves, which in turn is largely dependent upon weather factors such as light, humidity, temperature, and soil moisture. Timing of application of a systemic fungicide would not be as critical as it is with protectants or eradicants.

Foliar sprays do not control root disease of turf. Some of the material from foliar sprays may leach through the sod to act within the root zone, but experience has shown that roots of turf can be diseased even though many foliar sprays have been applied to golf greens. Some control of root diseases may be obtained from foliar sprays of systemic fungicides. However, in the case of putting green turf, constant mowing of the sprayed leaves may prevent the systemic fungicide from moving into the lower parts of the plant.

Applying fungicides to soil for controlling leaf and crown diseases of turf is a relatively new adventure. Most turf pathogens live within the turf environment throughout the year, and only attack grass at certain times during the growing season. If these fungi can be reduced below the necessary level to cause disease at a time when they are merely existing in the turf, effective disease control may be accomplished and we then can choose the time of application. Fungicides normally used as foliar protectants and eradicants may be useful as soil fungicides in this way providing they cause no injury. Soil application of systemic fungicides may prove to be very useful for controlling leaf and crown diseases. If the chemical is not tied up, a reservoir of fungicide may be formed in the soil for the plant to draw upon throughout the season to ward off disease. The systemic fungicide may also poison the pathogens in the soil as do other fungicides.

Soil application of fungicides is the best chemical way to control root diseases of turf. The toxic chemicals are made directly available to root surfaces to kill the pathogens. Results may be as immediate as a foliage spray of an eradicant fungicide to stop leaf disease.

How do we use soil fungicides? How do we apply fungicides to get them distributed throughout the sod and root zone of grass? There are several ways in which to do this. We can drench the sod with dilute fungicide using
a pint to a quart of water per square foot. We can drill in a mixture of fungicide and sand or topdressing, followed by heavy watering to wash it into the sod. There is yet a better way.

We have had our best results by injecting dilute fungicide into turf with a tree feeding injector. The injector is inserted 8 to 12 inches into turf and the fungicide is pumped into the soil at 200 psi for 5 to 7 seconds. The injector is reinserted every 4 to 5 feet. The fungicide appears to be evenly distributed through the sod. We are studying distribution of fungicide in more detail.

A side benefit arises from injecting turf with liquid under pressure. The treatment breaks up a compaction layer of soil several inches below the surface enabling roots to penetrate deeper. Destruction of the compaction may soften the surface of putting greens helping approach shots to stick to greens, and putts to roll true.

What have we covered? Turf diseases attack leaves, stems, and roots of grass plants. Keeping turf vigorous helps it fight off attacks by fungi. Disease can also be prevented by stopping the build up of pathogenic fungi. This can be done by proper cultural practices or the use of fungicides. Foliar sprays of protecting and eradicating fungicides control leaf infecting diseases, but requires frequent applications. Foliar sprays do not control root infecting diseases. Systemic fungicides, by acting within the plant, may prove to be practical for controlling turf diseases. Drenching or injecting fungicides into turf controls root infecting diseases. Systemic fungicides and soil applications of fungicides are new ideas in turf disease control, and are still in experimental stages of development.

What's in the future? We at The Connecticut Agricultural Experiment Station are concerned with several aspects for controlling turf diseases. We are also seeking the answers to several riddles. Why does Curvularia blight occur in open sun and not in shade? Why do different strains of bluegrass differ in disease susceptibility? Bluegrass leaf spot is severe on turf of Kentucky bluegrass, but is not a problem on Merion bluegrass. Rust and powdery mildew are severe on Merion bluegrass turf, but are not a problem on Kentucky bluegrass. Kentucky bluegrass lawn succumbs to bluegrass leafspot disease, while Kentucky bluegrass pasture is subject to powdery mildew. What is the connection between these observations? Finding the answers to these questions will help us understand these diseases better, and may give us clues to better control of disease.
Objective: The purpose of this brief talk is to stimulate interest in trees and tree care on golf courses and to guide greenskeepers to an intelligent tree program. A good reference book is "Tree Maintenance" by P. P. Pirone: 1959: Oxford Press, New York, and should be referred to since this talk merely covers a few of the highlights of tree care.

I. DEFINITION: A tree is a woody perennial plant having a single main stem, commonly exceeding ten feet in height.

II. IMPORTANCE OF TREES ON GOLF COURSES

A. Trees have a definite esthetic value in providing form, texture, color and shade to the landscape.

1. They may be planted as
   a. A single specimen tree
   b. Group plantings
   c. Mass plantings

B. Trees may be used for

   1. Screening undesirable sights, such as housing developments or railroad right-of-ways.
   2. Framing desirable vistas or views
   3. Separating fairways
   4. Reducing mowing areas
   5. Preventing soil erosion on steep banks
   6. Climate control

III. HOW A TREE GROWS

For proper tree care one should understand how a tree grows.

A. Metabolism is the sum of all the processes that occur in a tree and have direct bearing on the health of the tree. These same processes occur in grass plants which you all are familiar with.

1. Anabolic - building up of plant tissue
   a. Photosynthesis
   b. Cell division - growth
   c. Food synthesis
2. Catabolic - tearing down
   a. Respiration
   b. Fermentation
   c. Digestion

3. All plant growth is affected by the following factors which may alter the metabolism of trees.
   a. Genetic factors which are inherited will not be discussed here.
   b. Environment factors or outside factors that may have a direct relation to the welfare of the tree.

1'. Grade changes and soil compaction
2'. Water table changes
3'. Planting too deep
4'. Temperature of soil and air
5'. pH
6'. Nutrients
7'. Chemicals, etc., etc.
8'. Fungi attacking
   a'. Foliage
   b'. Vascular system
   c'. Roots
   d'. Cambium

9'. Bacteria
10'. Virus
11'. Insects
12'. Other agencies, such as man, fire, etc.

IV. RECOGNITION, IDENTIFICATION, AND CONTROL OF VARIOUS FACTORS OR AGENTS THAT MAY ALTER THE METABOLISM OF PLANTS.

A. Make use of:

1. County agents
2. State entomologists
3. State plant pathologists
4. Shade tree laboratories
5. Forest Research Laboratories, U.S.D.A. for factual information

B. Factors may often be interacting and difficult to diagnose

1. Beware of sure cures for diseases, such as zinc coated nails, zinc chloride, or iodine crystals combined with wettable sulfur to cure an elm of the Dutch Elm Disease.
C. Obtain the services of a reputable certified, licensed or qualified arborist.

D. You may use your own employees for tree fertilizing, planting small trees, and brush control.

E. Do not use your golf course employees to do tree work that involves climbing a ladder or working in the tree. Your Workmen's Compensation rate for ground work is not based on aerial type of work.

V. A SUCCESSFUL PLANTING PROGRAM ON A GOLF COURSE DEPENDS ON THREE MAIN ITEMS

A. Selection of proper species

1. Vary family, genera and species of trees for disease control.
2. Vary size, shape, color and texture
3. Flowering characteristics
4. Make sure the tree you plant will be an asset and not a liability when it reaches maturity.

B. Good Growing Conditions

1. Plant the tree the same depth as it was previously.
2. Fill the hole with good loam mixed with peat or decomposed organic material.
3. Have the hole larger than the spread of the roots.
4. Good drainage is important. Break through any hardpan that might be at the bottom of the hole.
5. Water thoroughly and tamp soil so there are no air pockets around roots.
6. Place several inches of mulch on surface of ground to reduce loss of moisture.
7. Wrap trunk and stake tree if necessary.
8. Prune back crown of tree about 1/3 to compensate for root loss due to planting.
9. Smaller trees are less expensive to move and adjust quicker to transplanting than larger trees.

C. Maintenance

1. Water soil to a depth of several feet, for several years, during dry periods.
2. Prune dead and undesirable branches.
TIMELY TOPIC

Western Massachusetts Tree Wardens' and Moth Superintendents' Association

April 1961

RECOMMENDED STANDARDS FOR EVALUATING CHEMICAL TREATMENT
AS A CURE FOR DUTCH ELM DISEASE

(Quoted with the permission of Dr. Richard Campana, Professor of Botany, University of Maine, and Chairman, Nomenclature and Standards Committee, National Shade Tree Conference, from his publication dated February 15, 1961)

1. Trees tested must be known to be infected with the Dutch Elm disease fungus. If the trees become infected naturally the fungus should be cultured and identified by a professionally trained mycologist or plant pathologist before treatment. If the trees are artificially inoculated before or after treatment, the fungus must be recovered from parts of inoculated but untreated trees remote from the site of inoculation.

2. The evidence indicating cure should show significant differences in results between diseased trees treated and those remaining untreated (controls). Differences in results should be directly comparable in symptoms expressed between treated and control trees, and should be correlated with positive presence or absence of the fungus.

3. Tests should be carried on over a period of two or more years.

4. Tests should involve a sufficiently large number of trees to have statistical significance (ordinarily several hundred trees).

5. Data presented to substantiate claims for cure should be specific in how they were obtained, so that the work may be duplicated and verified by others.

ARSENCICAL TOXICITY

By C. R. Skogley

Arsenic is an element feared by man over all other elements. It has been for centuries yet its primary use to-date has been to do good for humanity - by helping to
combat disease, to destroy insects, to eradicate weeds and to perform many other constructive technological tasks. In recent years this country alone has been consuming annually more than 15,000 tons of raw arsenic, arsenic trioxide, for these important purposes.

Despite the useful nature of arsenic people still shy from its use. It is probable that this fear is psychological rather than factual. Probably arsenic is a reputed villain because it has been easy to acquire. Back in the 17th century women took small internal doses to brighten their color. And because they had it on hand, it became the accepted method of unobtrusively disposing of rivals, unwanted husbands and friends.

The play "Arsenic and Old Lace" and the persistent use of this element for fictitious murder on radio and television continue to instill fear of arsenic in the public's mind.

Being realistic, however, I am sure you would disqualify arsenic even as a second-best instrument for the perfect murder. Any alert or suspicious doctor can detect arsenic poisoning promptly -- and usually looks for it under questionable circumstances.

There are numerous chemicals or compounds used regularly in our trade that are much more lethal than arsenic -- they just haven't had the publicity.

Don't think for a moment that arsenic isn't dangerous. It is a poison and must be handled properly -- just as all poisons should be. Keep in mind also that when properly used it can be most useful and helpful.

A little history about arsenic. First, the element was named "Arsenicum" by the early Greek. The word meant "male" or "strong one". It is extremely widely diffused in nature but is not an abundant element. It is found as an impurity or in trace amounts in many minerals on every continent. Most of our supplies of arsenic come from the smelting of iron, copper, cobalt and silver where arsenic is removed as an impurity.

Arsenic was discovered sometime over 2000 years ago. Arsenic trioxide was prepared in the 5th century A.D. Not until about 1200 A.D. was elemental arsenic recognized.

Historically, the first use of arsenic was as a paint pigment. In the 19th century arsenic became very important in the dye industry and in glass making. In the late 18th century the first successful arsenic drug appeared. For many years thereafter the arsenicals were important in the field
of medicine. It was through medical research that many of the organic arsenicals were formulated. It was here also that differences in toxic tolerance to arsenic, between forms of living organisms, was first observed. You might be interested to know that arsenic exceeds all of the metals in the number of its known organic derivatives with over 9000 compounds.

The history of arsenicals in agriculture goes back several hundred years also. The first significant arsenical pesticide was Paris green and shortly thereafter London purple. Although they were good insecticides they were somewhat injurious to plants. About 1890, and shortly thereafter researches in Iowa, New Hampshire and Vermont made some valuable findings. They found that the water insoluble calcium and lead arsenates retained full insecticidal powers without phytotoxicity. They also found that the water soluble sodium arsenite was a very capable herbicide and soil sterilant. For a number of years the arsenicals played a big role in the field of insecticides and herbicides but within the past 15 years they have been replaced in large by numerous organic pesticides.

Why the continuing interest in arsenicals? Perhaps there are several reasons. Often when some of the newer organic pesticides fail, for instance, when certain insects build up resistance against them or tolerance to them we find we can still rely on the old standby, arsenic. Another reason is the cost. Many of the arsenicals are quite inexpensive. A third reason is that they have some abilities not yet matched by any of the new organics. They can be used to kill vegetation without sterilizing the soil -- or they can be used as very good soil sterilants. Certain of them are used for selective weed control as DSMA, AMA, calcium and lead arsenate, and even sodium arsenite.

In Agriculture here are some of the specific uses for the arsenicals: Chemical debarking of trees for use in making fence posts or lumber. Arsenic is still one of the best materials for the control of aquatic vegetation. It can be used to kill rooted vegetation without killing fish and other desirable pond life. Sodium arsenite can be used for selective control of crabgrass, chickweed, Poa annua and other tough weeds in fairway or extensive turf areas where cost is a problem. It can also be used in renovation -- the scorched earth method -- where kill is desired without soil sterilization.

Many new organic arsenicals are appearing and will continue to appear for various purposes. The new calcium propyl arsonate, which is being marketed for the
first time this year, reportedly will do these things: Prevent crabgrass germination or kill young crabgrass seedlings, if applied after they have germinated, and not interfere to any extent with seed or seedlings of perennial grasses. Calcium acid methyl arsenate, also recently marketed, may prove to be a superior post-emergence crabgrass killer.

If we are to continue using the arsenicals we should familiarize ourselves with how they kill plants, how and when to apply them, which ones to use, and soil factors that effect their use. Most of this information is available in the literature.

I would like to review a few of these items for you. First, what is the action of calcium or lead arsenate on seed in the soil.

Very extensive studies were conducted at several locations in the country starting in the 1930's to learn about the action of the arsenates. These studies clearly indicated that these chemicals do not effect the seedlings or the plants themselves. The arsenates must be applied well ahead of seed germination where the chemical is absorbed or imbibed by the seed and the embryo is killed. There are many factors that effect the degree of success with these chemicals. You will hear more about this.

The usual rates suggested for calcium arsenate are 12 to 16 lbs. per 1000 square feet and 20 to 30 lbs. for lead arsenate. Although a better crabgrass killer, calcium arsenate must be used with greater caution than lead arsenate. Also, grass injury may not be apparent for 1 or 2 years after the application of these materials.

One thing that might cause you to wonder about using these chemicals -- they have been around for many years, have been tried, promoted and discussed -- yet they have never received official recommendation except locally. Have we been missing a bet or has accumulated experience been so variable that we can't trust the chemicals? Evidently we still don't know. There is yet much to be learned about the arsenicals.

The killing action of the water soluble arsenicals, such as sodium arsenite, depends upon its absorption into the circulatory system of the plant, where its toxic effect is in preventing the formulation of the products of photosynthesis. With heavy applications the tissue covered with the application is killed
rapidly...so rapidly that the arsenic may not enter the circulatory system of the plant. In this event the plant may recover from the basal protected portions. Light, repeat applications appear to give a more complete and selective control at least of annual grasses and certain broad-leaved weeds. Used in this fashion as little as 2-3 lbs. per acre can satisfactorily control crabgrass and chickweed. A single application at several times this rate will normally be most less effective.

Toxicity of the soluble arsenicals is dependent on temperature, being more active at higher temperatures, and on the rate of growth of the plants. A plant hardened by hot, dry weather is harder to kill than one making active growth.

A rather unusual feature of the soluble arsenicals -- perennial grasses sprayed at rates sufficient to burn the leaves but not to kill -- usually resume growth in a very healthy state. It is almost as if the arsenic accelerated the growth.

I would suggest that those involved in turf management should become familiar with the various arsenicals. There are many of them, they are versatile, many of them are inexpensive and dual purpose, they are readily available, and they are hot as lethal to man as we have been told.

Undoubtedly there will be new and better compounds of arsenic for the various weed killing jobs. Additional basic information, much of it missing now, will be obtained in the future to enable us to use arsenic in a dependable and efficient manner.

SOIL REACTION TO ARSENICAL COMPOUNDS

By Joseph E. Stockel

The use of arsenate compounds to kill crabgrass depends on the greater sensitivity of crabgrass seedlings than other established grasses to arsenic. Established bluegrass or bentgrass also may be killed by over-doses of these arsenate compounds. The pre-emerge practice involves the application of arsenates to the soil at a rate which will supply a lethal amount of arsenate to crabgrass but non-lethal amounts to blue or bentgrass. Complete success of the pre-emerge practice is dependent on the availability of arsenate in the soil. Arsenate behaves chemically in a manner quite similar to phosphate. The soil chemistry of arsenates
Calcium arsenate added and phosphates is quite similar but not identical (2). We know that some soils fix large amounts of phosphate and that fertilizer phosphate applications must be large in order to feed adequately the growing plant. A high phosphate fixing soil will be also a high arsenate fixing soil. Low phosphate fixing soils respond to small amounts of phosphate fertilizer. So also the low phosphate fixing soil will be a low arsenate fixer. These are essentially statements of fact. Translated into practice, larger applications of arsenate are necessary to kill crabgrass germinating on high arsenate fixing soils than on low arsenate fixing soils.

The effect of arsenate on crop growth is shown in Table 1 taken from Williams and Whetstone (3). These data show that increased applications of calcium arsenate decrease the growth of the millet and increase the concentration of arsenic in the crop material. In addition, from these data we conclude that with increased concentration of arsenic in a crop we can expect a decrease in the amount of crop growth until ultimately the crop is killed and zero growth will result. Obviously, the availability of arsenate in the soil (in a manner similar to phosphate availability) will determine the amount of arsenate uptake by the crop and the ultimate control of the undesirable specie.

Table 1
Millet Growth and Arsenic Content from Calcium Arsenate Applications
(Williams and Whetstone)

<table>
<thead>
<tr>
<th>Calcium Arsenate Added</th>
<th>R o o t i n g M e d i u m</th>
<th>Millet Weight</th>
<th>Arsenic in Millet</th>
<th>Millet Weight</th>
<th>Arsenic in Millet</th>
<th>Millet Weight</th>
<th>Arsenic in Millet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Sand</td>
<td>5.2</td>
<td>13</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Sand + 25 Soil</td>
<td>3.3</td>
<td>22</td>
<td>9.6</td>
<td>12</td>
<td>6.6</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Sand + 50 Soil Colloid</td>
<td>-</td>
<td>-</td>
<td>6.1</td>
<td>21</td>
<td>6.6</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Sand + 50 Soil Colloid</td>
<td>1.3</td>
<td>53</td>
<td>3.5</td>
<td>27</td>
<td>-</td>
<td>-</td>
</tr>
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</table>

In 1936 Gile (1) reported the growth response of millet to arsenate applications. Crabgrass will respond
in a manner but at lower arsenate application rates. Figure 1 shows the relative growth of millet to calcium arsenate applications on five different soil-sand combinations. On Barnes soil one unit of arsenate reduced millet growth to 30% of the zero arsenate treatment. However, on Clarksville soil, 8 times as much arsenate was found necessary to reduce the millet growth to 30%. Intermediate amounts of arsenate on the other three soils reduced millet growth to 30%. These data show a different arsenate application for each of the soils to produce equal growth reduction of millet by arsenic. Obviously, Clarksville soil is a high arsenate fixing soil and larger applications are required in order to supply the arsenate to the millet root system. Barnes soil is a low arsenate fixer and smaller applications will supply arsenic to the millet root system with growth reduction equal to that on the Clarksville soil.

The results in Figure 1 were obtained when using equal amounts of soil colloids in each sand-soil mixture. The influence of the amount of soil colloid on arsenate toxicity is shown in Figure 2 taken from Gile. Three units of calcium arsenate added to Kirvin soil-sand with 25 units of colloid reduced millet growth by 50%. However, when 100 units of Kirvin colloid were present, 7 units of arsenate were necessary to reduce the millet growth 50%. Similar comparisons were made on Nacogdoches and Marshall soils. On each soil as the amount of colloid was increased, increasing amounts were required in order to produce equal growth reduction and presumably nearly equal arsenic content in the millet. From the practical viewpoint, two golf greens on one course may have quite different colloid content if reasonable care is not exercised in construction. Moreover, the soil source for construction may be quite different.

Several factors are important in the arsenic toxicity concept of crabgrass control:

1. Difference in arsenic toxicity between the plant species,
2. Availability of arsenate in the soil.

Arsenate availability is dependent on the kind of arsenate material (low or higher solubility) used and arsenate fixation in the soil as influenced by organic matter, soil colloid, active aluminum and iron content of the soil.

In summary, the control of crabgrass by pre-emerge arsenate applications is dependent on establishing in the soil in available form, an amount of arsenate which
Figure 1. Effects of increasing quantities of calcium arsenate on the growth of millet in soil-quartz sand mixtures.

Figure 2. Quantity of calcium arsenate required to reduce yield one-half, as affected by quantity of colloid.
will produce a toxic and lethal concentration in crabgrass but non-lethal and a low toxicity in the desired grass species.


BRUSH CONTROL FOR THE GOLF COURSE

By William I. Boyd

Brush control in the Northeast presents many problems and situations which are applicable only to this region. The ideas and facts, based on experience, which are indicated in the following outline must be judged solely on their application to this section of the country.

Golf course superintendents have become accustomed to using a variety of chemicals for control of weeds on greens, tees, and fairways. It is the main purpose of this discussion to consider a similar approach to brush control.

I. TYPES OF BRUSH PROBLEMS

A. Mixed species of woody plants as often grow along property lines or fences and along drainage ditches.

B. Poison ivy.

C. Individual trees or bushes that may not be wanted.

D. Resprouting from stumps of cut trees or brush.

II. CHEMICALS THAT MAY BE USED

A. Ammonium sulfamate (sold as "Ammate" X weed and brush killer).

B. Hormone brush killers -- 2,4-D and 2,4,5-T used alone or in combination.

C. Fenuron pellets (sold as "Dybar" fenuron weed and brush killer.

D. Amino triazole -- Chiefly recommended for poison ivy control.

III. METHODS OF TREATMENT

A. Foliage Sprays -- applied after leaves become mature and until frost, or until fall foliage starts to develop. (Usually early June to early September in New England.)
1. "Ammate" X weed and brush killer. Recommended at 60 pounds in 100 gallons of water with six ounces of Spreader-Sticker, for control of most woody species, particularly oak, hickory, ash, maple, conifers, and poison ivy. Non-volatile, so vapor drift is not a problem. Cost about $15 for 100 gallons of spray, depending on quantity purchased.

2. "Ammate" X Oil Emulsion -- for control of same species as above, at somewhat lower rates of "Ammate". Mix 40 to 50 pounds of "Ammate" X in about 25 gallons of water. Add four gallons of light oil containing about two-thirds pint of Emulsifying Agent A. Fill tank with water to 100 gallons with good agitation. Add six ounces of Spreader-Sticker. Cost $10 to $12 per 100 gallons of spray. With the oil, equipment corrosion is not a serious problem.

3. Commonly available combinations of 2,4-D and 2,4,5-T, containing a total of four pounds of acid per gallon, are usually recommended at one to one and one-half gallons per 100 gallons of water, for control of birch, cherry, beech, willow, popular, alder, brambles, etc., but are less effective on conifers, oak, maple, hickory, ash, and on poison ivy growing in the shade. Users report costs of $4 to $10 per 100 gallons of spray.

4. Ester or amine formulations of 2,4,5-T alone commonly contain four pounds acid per gallon and are usually recommended at three to four quarts per 100 gallons of water. They are more effective than 2,4-D 2,4,5-T combinations on resistant species. Users report costs of $6.75 to $10 per 100 gallons of spray. (To reduce possibility of injury from 2,4-D or 2,4,5-T to desirable plants adjacent to sprayed areas, manufacturers recommend amine or low volatile formulations.)

5. "Ammate" X in mist blowers -- dissolve 400 pounds "Ammate" X weed and brush killer in 100 gallons of water with a quart of Spreader-Sticker. Apply a light covering to all foliage. Mist blower application of "Ammate"
has equaled hydraulic application, at 10 to 20 per cent less cost and no increase in drift danger.

B. Stem Sprays

1. Basal stem treatment with 2,4,5-T or the "D and T" combination is a common practice. Suggested dosage is three gallons of product in 97 gallons of No. 2 fuel oil for power equipment, or four gallons in 96 gallons of oil for knapsack spraying. Experience shows it is important to soak 12 to 15 inches of stem, down to the bud zone or root collar of the plant. New England users have found this treatment very effective on all species of hardwood in New England, but more costly and more time consuming than other methods.

2. Spraying the full stem, or lower two-thirds, has become known as "cane spraying" in this area, to distinguish it from the familiar basal stem treatment. "Dormant cane" spraying is treatment of the entire stem of woody plants, during the dormant season, with a mixture of one and one-half gallons (six pounds acid) 2,4,5-T ester in 100 gallons of oil. Users have found it effective on most species, but relatively costly. "Summer cane spraying" is the practice of spraying the lower two-thirds of the stem with a mixture of one and one-half gallons 2,4,5-T ester in 10 to 15 gallons of oil enough water to make 100 gallons.

C. Stump Treatment

1. "Ammate" X weed and brush killer may be used for stump treatment either as dry crystals or in a concentrated solution. The dry crystals are applied at about one ounce (one tablespoonful) to each three inches of stump diameter. For greater economy, four pounds of "Ammate" X may be dissolved in one gallon of water, with half a teaspoonful of Spreader-Sticker, and applied to fresh-cut stump surfaces. Applied within a few days after cutting, this method is very effective, and quite economical.

2. Another method of stump treatment is to use the same 2,4,5-T mixture recommended for basal stem application, and apply it the same
way, wetting the entire stump base from 12 to 15 inches above the bud zone down to the bud zone itself.

D. Tree Killing

To kill individual unwanted trees, "Ammate" X many be used in crystals or solution (stump treatment mixture). Cut notches at six inch intervals around the tree trunk, and put the crystals or solution in the notches. (If desired, commercially available oil soluble or water soluble dye, depending on carrier, may be used in stump and tree treatment solutions, for marking treated growth.)

E. Ground or Soil Application

This is the newest approach to brush control. "Dybar" fenuron weed and brush killer pellets are recommended for this application, to control most woody plants, including maple, oak, and conifers. New England experience has shown the following rates of "Dybar" to be effective: (a) one teaspoonful per woody plant if the plants are less than four feet apart, or one tablespoon per bush if they are more than four feet apart; (b) one teaspoonful every three feet on a gird pattern; (c) broadcast at the rate of 50 pounds per acre. "Dybar" may be applied at any time except when the ground is frozen, with late winter or early spring the most effective. Since the chemical works through the root system, and woody plants that have roots under the spot where "Dybar" fenuron weed and brush killer is placed may be damaged.

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MASSACHUSETTS HIGHWAY HERBICIDE PROGRAM

By Joseph L. Beasley

Weed control is important in all categories of Roadside Maintenance. Along a secondary highway, or "country road," we generally like to keep the roadside as close to its natural state as possible, consistent with safety and efficient maintenance. In direct contrast is the industrial or commercial highway where beauty competes with utility and efficiency. The state highways of Massachusetts fall in between these two extremes. The people of Massachusetts insist on well-groomed highways, in keeping with the three-century tradition of having a village green in the middle of every town. But at the same time, their Yankee thrift demands that this scenic beauty be achieved at the lowest possible cost.

A-54
Since 1951, Massachusetts has been using and experimenting with chemical weed killers in an effort to reduce mowing and maintenance costs. We have used 2,4-D, 2,4-D+2,4,5-T, Maleic Hydrazide, Telvar D.W., Diuron, Ureabor and Urox. All have been used with varying degrees of success. We have learned that each has its place in maintenance as a useful tool. Herbicides in themselves are not a "cure-all" for road sides maintenance problems. When properly used, however, in combination with other roadside operations, the result is a more pleasing roadside appearance at a considerable saving financially.

Spraying For The Eradication of Poison Ivy and The Control of Undesirable Brush

Our first use of chemicals along our roadsides was directed against poison ivy, at the time an extremely serious problem. Through the use of 2,4,-D and 2,4,5-T, this problem has been practically eliminated. This fact not only has been reassuring to the 3,000,000 people who enjoyed our 325 roadside rest areas last season, but greatly reduced the lost "man hours" of our department employees who are engaged in roadside work.

The Massachusetts Department of Public Works has been making valuable contributions to highway safety with the aid of chemicals, (2,4,-D and 2,4,5-T, 50-50 concentrates combination low volatile esters) by making a concerted effort to increase sight distance on our highways. These herbicides also assist in controlling brush at our roadside rest areas and vistas, behind guard rails and in our selective clearing program.

Not only has the general appearance of our roadsides been greatly improved, but we feel that clean roadsides are a major factor in highway safety.

Roadside Chemical and Fertilization Spray

In our program of selective control of other weeds, we have experimented with 2,4,-D and M-H-40 as part of our constant effort to reduce the number of annual mowings. Unfortunately, we haven't found any chemical lawn mowers as yet. But we have found that some weeds grow a good deal faster than grass, particularly in dry years.

We must then control these weeds and insure a uniform growth of grass, which, even though above normal in height, will still present a satisfactory appearance.

Through a combination of applying 2,4-D to eliminate dandelions ragweed and other succulent weed growth from
maintained turf areas, and by revising our specifications for contract mowing, we have been able to reduce the number of mowings of lawn type mowing from 15 cuttings per year to 11.

In 1961 for this, the third year, 2,4-D is being applied in combination with Urea 45% nitrogen as fertilizer to certain turf areas requiring rejuvenation. This two-in-one combined application is very economical.

It is noteworthy that Massachusetts, in addition, to being the first State to do all roadside mowing by contract, is among the first to apply fertilizer in combination with 2,4-D spray.

Soil Sterilant Treatment

Our state highway system has approximately 900 miles of guard rail. One hand-trimming along a mile of guard rail may take eight man-hours, and the job may have to be done five times per season. With this chemical program, we can go along the guard rail with a power sprayer covering a band two feet wide at a rate of one and one-half to two miles per hour. A two-foot band a mile long is about a quarter of an acre, so four miles of guard rail means an acre of spraying. In other words, one hour of soil sterilant spraying, at two miles per hour, eliminates eighty hours of hand trimming, and the job is done once for the whole season. Our present program calls for treating a two-foot strip along all our guard rails in this way, with a follow-up treatment where needed a year or two after the first application.

Experimental use of this material began in 1953 with such promising results that today all guard rail areas have been so treated.

The soil sterilant program has been so successful on guard rails that we are adopting the same kind of treatment to eliminate hand trimming around poles, ledges, delineators, curbing, piers, abutments and other structures. We are also trying this approach for weed control in waterways, drainage ditches, gravel sidewalks and along fences.

We have learned that soil sterilants of the liquid and granular type can play a very important role in a roadside development program.

However, we must not overlook the possible hazards involved in the use of chemical weed killers. We have to remember that these compounds are intended to kill plant life, and that we must observe the proper precautions to be sure that we kill only the plant life of which we want to be rid. In treating nearly 900 miles
of guard rail areas in Massachusetts with soil sterilant type herbicides, I am happy to say that through the proper use of this material we have experienced no serious mishaps. In other words, this program is being carried on whenever chemical control can be properly employed without hazard to trees or desirable plantings.

We have confidence in chemical weed killers, and it is significant that they are very effective. However, we must be careful with them.

We have held many meetings in our various districts to instruct engineers and foremen in the proper use of these materials, and to exercise proper precautions in applying them. We want them to accept chemical weed killers as a tool for them to use in its proper place in highway maintenance—just as they use sand, salt, patching materials, or snow plows for their proper purpose.

Following is a reprint of a Paper presented at the meeting of the Northeastern Weed Control Conference in New York in January 1961:

"MASSACHUSETTS PROGRESS REPORT ON RESEARCH WITH MALEIC HYDRAZIDE"

By Joseph L. Beasley

The grassed areas of the 2,400 miles of State highway in Massachusetts present a continuous mowing problem to the personnel charged with the responsibility of their maintenance.

Experience has taught us that there is no single phase of our roadside development operations that can be termed a "cure all" for a reduction in mowing costs. It is rather a well planned combination of:

(1) Planting and mulching
(2) Contract mowing
(3) The use of Maleic Hydrazide (MH-30) as a grass growth inhibitor

Planting and Mulching

Since we are not interested in growing areas, the planting of seedlings, vines, prostrate shrubs and natural growth sod takes place on new roads immediately after the completion of the prime contract for the construction of the highway itself.

In all areas where ground cover is practical, this second contract for planting and mulching removes such areas from the necessity of future mowing.
Contract Mowing:

The second phase in our war against increasing costs is the practice of mowing grass by contract.

Massachusetts is a pioneer in the field of mowing grass by contract. After a number of trials and revisions, it is felt that we have the most practical mowing specifications in the country. When you consider that the grass on each and every mile of our State highway system is mowed annually, and that our contract mowing cost per acre are as low as any State in the country (with comparable standards), our maintenance personnel may be justified in feeling proud of themselves.

1 Highway Landscape supervisor, Massachusetts Department of Public Works.

Currently, the number of cuts per year vary with the type of grass to be mowed.

Lawn type mowing requires eleven (11) cuts per season; roadside hay mowing five (5) annual cuts while hay mowing is confined to one (1) seasonal cut.

The Use of Maleic Hydrazide (MH-30)

The third, and by no means, least important phase in reducing mowing costs is the application of certain chemicals to retard the growth of grass, which will automatically reduce the number of mowings required at present.

Since 1953, Massachusetts has been experimenting with chemicals in this area, and it now appears that the most effective method of obtaining a uniform growth of grass is by the proper application of the following spray solution:

100 gallons of water
1 gallon of 2,4,-D
4 ounces Spreader Sticker
2 2/3 gallons of MH-30

Since the solution is being applied at the rate of 75 gallons per acre, it is estimated that two gallons of MH-30 per acre is the minimum quantity to insure proper coverage. While this ratio is higher than that recommended by the manufacturer, it guarantees that sufficient MH-30 is delivered to the grass.
Application

While the combination of MH-30 for inhibiting grass growth plus 2,4-D for eliminating succulent weed growth is unquestionably the correct solution, neither of the two will accomplish the desired results unless they are properly applied. Here we reach the as yet unsolved problem of designing the correct spraying equipment to be manned by competent and conscientious operators.

Since the cost of the material is considerable, it is felt that the manufacturers have given too little thought to the application of the spray solution on a large-scale basis. The recent experimental field work indicates that the correct amount of MH-30 (as determined in the laboratory) is not always delivered to the grass. As we have agreed that the material will control the growth of grass if correctly applied, the fault must lie with the equipment and operators.

Again, since the solution is rather expensive, in order that there be neither overlapping, nor omission during spraying, some means must be devised to identify what area has been covered. Some thought has been given to equipping the vehicle with a separate nozzle for pouring a colored liquid dye to outline the outside edge of each spray pass.

Suggested Equipment Units for Applying Solution

For median strips up to 40 feet, roadsides, outside edges of interchanges, and narrow dividing islands:

One (1) 1,000 gallon tank truck with extender arm type boom, hydraulically operated, a minimum of 20 feet in length.

For wide median strips and dividing islands (over 40 feet), lobes and bowl areas of interchanges and other "hard to reach areas":

(a) Two (2) jeeps or equivalent vehicles (4-Wheel Drive) with dual tires on rear.

(b) One (1) 250 gallon tank.

(c) Fixed horizontal boom.

(d) Mast type boom.

(e) Hand operated boom with hose attachment for manual spraying of slopes, around trees and shrubbery, and other inaccessible areas.
In addition, a 2,000 gallon tank truck to be used to supply water to mix new batches of solution in the tanks of the above-mentioned spraying vehicles.

**History of Inhibitor Experimentation on Grassed Areas**

Massachusetts' research in this field began with MH-40 in 1953 with twelve (12) half-acre plots on Route #1 in Danvers, with encouraging results.

The following year selected areas on a much larger mileage scale were treated on a state-wide basis. While results in certain instances were desirable, other areas, because of poor application, were none too conclusive.

In 1960, the advent of MH-30 influenced the Department to further research in an effort to sabotage the rising mowing costs.

Approximately 75 acres embracing all types of grassed terrain were treated in the Springfield area. In addition, throughout the State, eight miles of median strip, roadsides, and a large bowl area received applications of the solution. This large scale experiment has indicated that the correct application will produce the desired results.

MH-30 will receive a stern test in Massachusetts, since our contract mowing costs per acre are low, while our standards are high. If MH-30 can reduce the costs per acre even further and still maintain our well-groomed grassed areas, it will prove that "chemical mowing" is here to stay.

Research in recent years indicates that this material (properly applied) will insure a uniform growth of grass (5" to 7") that will require only a minimum number of cuts per season. It is not necessary to have a "golf course" appearance to our grassed areas.

In the spring of 1961, Massachusetts plans to treat three (3) of its contract mowing areas in their entirety with MH-30. These three projects total about 65 miles.

Route #9 - Brookline to Worcester (2 contracts)
Route #128 - From Route #9, Wellesley to Route #1, Westwood (1 contract).

The Special Provisions for the above mowing contracts for these areas will call for a reduced number of lawn type mowings from eleven (11) to four (4) and those of the roadside hay cuts from five (5) to two (2).

In the fall of 1961 we also plan to apply this solution to other grassed areas. In the spring of 1962,
it is expected that the number of mowing cuts ordinarily required in these areas will be reduced exactly as described above.

The fall application is being considered for two reasons:

(1) the amount of rainfall during these months is generally less than any other potential spraying period of the year.

(2) the MH-30 will be applied just prior to the time when the grass becomes dormant, and therefore will be present to inhibit before the grass begins to grow in the spring.

Statistics

In 1959, the low bids for our mowing contracts totalled about $580,000.00. The breakdown is as follows:

<table>
<thead>
<tr>
<th>Type</th>
<th>Cost</th>
<th>Percentage of Whole</th>
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<tbody>
<tr>
<td>Lawn Mowing</td>
<td>$134,000</td>
<td>23%</td>
</tr>
<tr>
<td>Roadside Hay Mowing</td>
<td>$296,000</td>
<td>68%</td>
</tr>
<tr>
<td>Other Hay Mowing</td>
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Contrary to popular belief, these figures indicate that mowing costs for grassed areas on road-sides and interchanges are about three times those for median strips.

In 1961, our estimated mowing costs for 85 contracts will be about $628,000.00. The increase is directly attributable to the increased acreage to be mowed.

However, it is expected that, in the foreseeable future, that the combination of (1) planting and mulching, (2) mowing by contract and (3) the use of MH-30 inhibitor will reveal a savings of $100,000.00 per person in mowing costs.

A further analysis of our mowing statistics indicates that $300.00 per mile per season are expended to mow grassed areas on double-barrelled and limited access highways. When our three-fold plan is coordinated, this cost will be substantially reduced.

Summary

Massachusetts, as well as other states, is facing a tremendous task in order to reduce mowing costs.
While planting and mulching will eventually cut down the grass acreage, there will still be large areas where the correct application of the MH-30 solution appears to be a life-saver in the sea of rising costs.

In conclusion, let me say that without the use of chemicals our roadsides maintenance costs would be increased by about $500,000 per year, which money in man-hours could well be used on other more productive maintenance operations.

The problems of management of vegetation along present-day thruways, freeways, parkways, turnpikes and interstate highways are far greater than formerly and must be handled more efficiently on a scale larger than the average person can visualize.

Rights-of-way have become wider, increasing from the 50 feet of 20 years ago to our present 400 feet and more. Instead of mowing two acres per mile as in 1940, we are today faced with the problem of managing as many as thirty acres per mile.

Thus, from a maintenance standpoint, we must learn to live with this growing giant-in-breasth so necessary to erosion control. Appropriations have not been keeping pace with maintenance requirements. Therefore, we must devise new methods of control and improvise on the old, since increased efficiency is the only way to extend the overburdened maintenance dollar.

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OBSERVATIONS ON HIGHWAY TURF ESTABLISHMENT AND MAINTENANCE

By E. F. Button

PREFACE

The importance and magnitude of highway vegetation management -- including turf establishment and maintenance are not difficult for those engaged outside the highway field to comprehend. The fundamental objectives are erosion control and water infiltration into the soil for the long-term protection of the paved-way. There is no more economical nor efficient method of affording this protection than by providing and maintaining a healthy vegetative mantle. Each State now has thousands of acres of roadside vegetation. Each new mile of modern highway brings with it from 13 to 30 more acres of roadsides.

There will soon be 900,000 more roadsides acres to maintain! This is a conservative estimate of part of the "package" given by the much publicized Interstate
Highway System to the highway departments of the nation. In Connecticut, for example, it is expected that more than 200 miles of highway will be built under this system, the additional roadside acres will exceed 4,000 acres.

The maintenance through out the years of these additional acres, as well as of the rest of the roadway, will be a necessary burden assumed by each individual State. It is a burden which will without doubt increase the present and complex technical and financial problems of maintenance. Most Highway departments have been diligently striving to obtain more value per maintenance dollar expended -- an effort not only commendable but mandatory in view of the constantly raising costs of labor and materials, coupled with the specter of an ever-shrinking portion of the tax-dollar available for highways roadside maintenance.

The Concept that roadsides are an integral and functional part of the "complete highway" is generally accepted with few reservations by those engaged in the highway field. The steady and intense publicity focused upon the decreasing acreage of "open land" and "productive land", and the increasing amount of land being utilized in the highway right-of-way has been fostered by the energetic and persistent efforts of many "influential" organizations such as garden clubs, nature, conservation, and wildlife groups. The result so far has been the evolution of a concept that roadside acres are also a valuable part of the natural resource of every adjoining community. This increasing awareness of the public will serve to stimulate the highways to set higher standards for turf maintenance, functional plantings, and for "rest areas". The task of roadside development already taxed by the limitations mentioned shall not only increase in extent, but in complexity.

The progress made in highway vegetation management technology since the early 40's has been phenomenal. Hydraulic fertilizing, air-blasting of granular or pelleted materials, the employment of single-nutrient fertilizers, the utilization of herbicides, the evolution of more efficient grass-cutting machinery, the development of chemical-mowing, are but a few of the new techniques now available for the highway maintainer. We do not have time, however, to bask in the glow of past accomplishments. The pressures of our rapidly expanding highway system, the expectations of the public, and the shrinking portion of the available maintenance dollar make it imperative to increase the tempo of the search for better materials and methods for the total job.
INTRODUCTION

The quality and permanence of an effective turf cover is related to fertilizer usage. It is safe to say that the "Coming of Age" of the modern highway roadside is at least partially reflected in the statistics of fertilizer consumption by highway departments.

Arnold L. Mehring, a leading authority on fertilizer statistics has written (5) that total consumption of fertilizer by State Highway Departments in the nation in 1940 was estimated at 7,733 tons at a cost of $185,276. He further estimated that in 1956 only 26 State Highway Departments indicated fertilizer usage with a total of 21,868. He also stated that the Interstate System (on the basis of the 1956 rate) would require at least 186,300 tons of fertilizer for initial turf establishment. I would be inclined to feel that this estimated tonnage will prove to fall short by at least 100,000 tons! Mehring's estimate at $40 per ton would mean an expenditure of $7,440,000. I think the cost will be in excess of $11,440,000. Estimates of seed, soil amendments, and insecticides would also proved to be quite large.

Numbers in parentheses refer to literature cited.

A glance at some of the Connecticut State Highway Department's expenditures may be of interest to those concerned with, or about, present or potential roadside developmental operations (3).

<table>
<thead>
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<th>FISCAL YEAR</th>
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<th>HERBICIDES</th>
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<th>TOTAL</th>
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<td>460</td>
</tr>
<tr>
<td>1958-59</td>
<td>103</td>
<td>749</td>
<td>852</td>
</tr>
</tbody>
</table>

* Such as: urea, treblesuperphosphate, muriate of potash, etc.

Note: All pesticides and herbicides are not used for turf establishment but include other roadside operations.
A significant increase of plant food per dollar or per application dollar could be shown when one realizes that 85% of the 1958-59 tonnage purchased was of single carrier nutrients (6).

The above figures cover total fertilizer tonnage used for both establishment and maintenance of roadside vegetation. The figures do not include the increasing acreage of turf which is being established by Contractors.

In a small state the size of Connecticut there are over 18,000 acres of roadside cover. To stay within the realm of practicality and economy only a relatively small portion of this acreage can be top-dressed each year...and the amount of plant food distributed to each acre must be modest. An analysis of some operations in one of our four Districts in 1959 shows that over 1,100 acres of turf were top-dressed with nitrogen. Topdressing progressed at the rate of 10 acres per day at a total cost of $18.02 per acre, that is, $9.20 for the cost of application and $8.82 for the fertilizer. In this same District new turf was established on 250 acres and about 100 acres of old, thin turf acres were rejuvenated with N-P-K.

This work consumed about 140 working days, and was performed along with the many other necessary duties of general highway maintenance...thus you can readily see that time and the labor-force are also criteria which must be considered in any roadside turf establishment and maintenance program.

**HIGHWAY TURF ESTABLISHMENT**

There are two general types of Turf Establishment recognized in our operations...in larger states, and states with larger areas of radically differing terrain and soil conditions, many more types of turf establishments would have to be recognized.

Type I includes all loamed areas, that is, areas such as median strips, interchanges, service areas which are destined for intensive mowing.

Type II covers unloamed areas which are in most cases cut and fill slopes or other areas off the shoulder of the pavement.

In cases where new turf is established by Contractors particular specifications covering soil preparations, liming, seeding, fertilizing and mulching, must be followed. Where such areas are seeded
on contract, prior soil testing by the Department determines the amount of limestone required to adjust the soil reaction to as near pH 6.0 as possible. The Contractor is required to apply 1,000 lbs. per acre of a commercial 10-10-10, and to use from 50 to 65 pounds of the specified seed mixture per acre depending upon the method of seeding employed.

Blaser and Ward (1) of Virginia, found that 1,000 lbs./acre of a 10-10-10 fertilizer rapidly established excellent sod, but that half this amount has not been satisfactory. Higher rates caused burning of seedlings in some cases. Light applications of asphalt-straw mulch improved germination and the rate of seedling growth. In Connecticut we have found that about 1-1/2 tons of mulch per acre affords ample protection and that more than 2 tons per acre is apt to be detrimental.

The primary purpose of roadside turf, particularly on unloamed slopes, is soil stabilization. A requisite, is the establishment of an erosion resistant sod as rapidly and as economically as possible. Thus the highway turf supervisor needs to keep in mind a few of the facts that may pertain to fertilizer shortly after it is applied to the soil...I refer mainly to the undesirable factors of leaching and volatility losses that may occur from nitrogen, and the leaching losses from potash.

Some of these factors are adequately listed by Hunter (4) in an excellent article in Better Crops.

The Department has attempted to apply the optimum amount of N-P-K per acre for turf establishment with a minimum leaching hazard by employing the following fertilizer application on areas seeded by its own forces: When an area is seeded (the hydraulic method is used (2) by Departmental forces) 54 lbs. of N, 147 lbs. of P2O5, and 30 lbs. of K2O are applied per acre. The first season after seeding, that is, in the fall after a spring seeding, or in the spring after a fall seeding, 45 lbs. of N, 55 lbs. of P2O5, and 15 lbs. of K2O are applied per acre. Although urea, treblesuperphosphate and muriate of potash are used, the total amounts of plant food applied would approximate an application of about 1,000 lbs. per acre of a 16-20-5. The object is to provide the more leachable materials after the seedlings have root systems capable of utilizing them. This method appears to have merit, particularly on sandy and gravely fill slopes.

Limestone is applied to areas where prior soil tests indicate the need for lime, and Dieldrin is applied to areas which will be intensively mowed.
for grub protection. Mulch is applied on all unloamed areas, it is applied on loamed areas only when such areas are seeded out-of-season.

**HIGHWAY TURF MAINTENANCE**

The Departmental policy at the present time is to apply 60 to 70 lbs of N/acre about every third year...in practice this application has often been reduced to about 30 to 50 lbs. per acre.

The application of N-P-K to an area is made whenever turf growth and soil tests indicate the desirability of complete fertilization. Dieldrin is applied to roadside areas that exhibit a rank growth of the fine-leaved fescues for protection against serious infestations of the sod-webworm.

It should be mentioned that the Department has in the past depended upon the fine-leaved fescues as the dominant turf species...it should also be mentioned that one seed mixture is used for all types of seeding.

At the present time we are relying upon a seed mixture comprised of 30% Creeping red fescue, 35% K-31 Tall fescue, 20% Kentucky bluegrass, 5% Alsike clover, and 10% Domestic ryegrass...it is felt that this mixture will in general be more suitable for the range of seeding environment encountered.

Several species of grasses have shown some advantages for slope stabilization in limited field trials.

**Field Bromegrass** grows rapidly on sandy and gravelly sloped and may produce a very extensive root-system in comparison to the fescues and ryegrass the first season. It does not usually persist in competition with the fescues after the first season.

**Reed Canarygrass** does well on sandy or gravelly slopes and does persist with the fine leaved fescues, however, it has the disadvantage of a tall and coarse appearance.

**Crown Vetch** alegume, shows promise when seeded with grasses such as Tall fescue, Reed Canary grass, or Ryegrass, it does not compete effectively when seeded with the fine-leaved fescues...unless the fescue seeding rate is greatly reduced. It takes Crown Vetch about three years to become reasonable established, but it grows and spreads rapidly thereafter. It is susceptible to the commonly used herbicides.
Birdsfoot Trefoil has shown most of the characteristics mentioned for Crown Vetch, except that it can display various deficiency symptoms on the droughty sand or gravel sites where Crown Vetch appears to have normal color.

**WEED CONTROL**

Turf areas are usually treated in April - May with about 1 quart of 2,4-D (amine of 1,1,1-ester) per acre. All intensively mowed areas are treated, but only 8 to 15 feet of the roadsides are sprayed. A second application is often made in July for the control of ragweed and other annual weeds. It is not desirable to apply herbicides to the bulk of the slopes, other than the 8 to 15 foot strip parallel to the roadway, since the Department desires a natural ecological succession of native shrubs on such areas.

Canada thistle and Milkweed are controlled with 1 pound of Amino-triazole in 10 gallons of water applied with a handboom. Japanese bamboo (Mexican Fleece) can be controlled by thoroughly wetting the plant and the soil under the plant with a mixture of 1 gallon of Baron in 4 gallons of water... needless to say, this treatment will sterilize the soil for about two years.

Weed infestations are usually correlated to the vigor and health of the turf. Proper fertilization is the first important step in obtaining a weed-free turf, herbicides, though valuable and necessary in over-all turf maintenance, can not encourage the growth of desirable turf species in a soil devoid of the necessary nutrients.

**MOWING**

The number of mowings per year vary from State to State. In general the roadsides are mowed from 2 to six times a year, usually with a cutter-bar type mower at a 4 inch height of cut. It is desirable to mow often enough to eliminate the need of raking.

Intensively mowed areas are mowed from 6 to 18 times per year, usually at a 2 to 2-1/2 inch height of cut. Rotary and reel-type mowers are employed, multiple unit mowers are the most economical on areas large enough to accommodate them.

Improper cutting height on intensively mowed areas can result in the loss of a desirable turf species, will increase weed infestation, will discourage optimum root
development, and may encourage brown-out during dry weather. Cutting height and frequency of mowing should be adjusted for the dominant desirable species and for the recovery of the turf during dry weather.

**CHEMICAL MOWING**

Scarcity of labor and time in roadside maintenance, necessitates the continual search for labor-saving methods. The development of maleic hydrazide for chemical mowing has provided highway maintenance forces with an invaluable tool. Maleic hydrazide, when properly applied to sound, vigorous turf, will reduce mowing requirements substantially for an entire growing season. There are some problems still to be solved in connection with its use; however, the possible advantages outweigh the disadvantages on difficult-to-mow areas.

**CONCLUSION**

The broad subject of highway turf establishment and maintenance has of necessity been broached lightly and briefly in this address; however, in parting, I shall fervently stress that co-operation -- and the willingness for open-minded exchange of ideas -- among people in the agricultural industries, the turf professions, the landscape professions, the agricultural research institutions, and the highway departments, are of significant importance in attacking the many problems associated with highway turf establishment and maintenance. Much good work has been done, but much more is required.

I am deeply honored to have appeared on the program of this Conference and I hope and trust that we may all learn a little more, and perhaps gain a little insight into the intricacies and problems associated with practical turf management.

**Literature References**


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PREPARED FOR THE ANNUAL FINE TURF CONFERENCE

University of Massachusetts

at the

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Northampton, Massachusetts

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PROGRESS REPORT

PRE-EMERGE CHEMICALS OF THE CONTROL OF CRABGRASS

Experiments to determine the effectiveness of various pre-emergence chemicals for crabgrass control

Results - 1960 Test of Chemicals for Crabgrass Control at Waltham Field Station by Dr. J. R. Havas

Chlordane - A 23 percent material, applied at 60 pounds of actual per acre, gave very poor control. There was no indication of injury to the basic grasses.

Tricalcium arsenate and a Complex Arsenical - Both materials, applied at their respective recommended rates, did not show a high degree of crabgrass control. The latter chemical gave the least control of all chemicals tested.
**Dacthal** - Estimated control of crabgrass was 94 to 97 percent. It appeared to cause a slight thinning of the permanent grasses.

**Zytron** - gave the highest degree of control of crabgrass in the trial. The general appearance of basic grasses was excellent.

Papers on the control of crabgrass presented at the Northeast Weed Control Conference were reviewed by Dr. J. R. Havis. A reprint of this review can be obtained from the Massachusetts Turf and Lawn Grass Association.

**Results** - 1960 Pre-emergence Control of Crabgrass with Chemicals at University of Massachusetts by Professors J. Zak & J. Troll

Chlordane at the rate of 80 pounds of actual per acre gave reasonably good control. No injury was noted.

Tricalcium arsenate and a Complex Arsenical - Both showed some degree of control but did not measure up to the newer chemicals. The tricalcium arsenate injured annual chickweed.

Zytron Emulsion controlled the crabgrass but it both injured and retarded the basic grasses. Retardation appeared to continue until late June and evidence of retardation still appeared in September.

Dacthal gave excellent control estimated at 98 percent. It did not appear to injure any of the bluegrasses present in the plots.

Zytron Dry - Excellent control was also obtained, estimated at 1 to 2 percent below Dacthal. It too did not injure the bluegrass. Since very little fescue and bent were growing in all test plots, injury to them was not noted.

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**ROOT GROWTH OF TURF GRASSES AS AFFECTED BY DIFFERENT HEIGHTS OF CUT AND NUTRIENT LEVELS**

By Evangel J. Bredakis

Continuous accumulation of organic compounds characterizes plant life. The organic compounds are synthesized in the body of the plant itself from simpler substances taken by the plants from its surroundings. Roots and leaves are the absorbing organs of the plant. The grass leaf manufacturers food by utilizing energy from the sun and nutrients from the air and soil. So the manner in which the leaf surface is removed determines the efficiency of this manufacturing process. The functions of the root system are the absorption of water and minerals, the anchorage of the plant and finally the
storage of root reserves. These functions are vitally important to any living plant and have given emphasis to the value of having accurate and complete information and best procedures for encouraging root penetration.

Interest in factors affecting the development and maintenance of root systems of grass species has been intense for many years. In this article we shall try to concentrate some of our observations from our research work on root growth of turf grasses as affected by different heights of cut and nutrient levels.

Root response to nutrient treatments indicated that low nitrogen treatments stimulated greatest root growth at the start of the treatment run. Under optimum level treatments the rate of root growth was maintained at the same slow rate throughout the experiment. Low phosphorus-potassium treatments produced significantly fewer roots throughout the experiment regardless of height of cut. Low nitrogen treated plants produced roots which were low quality in contrast with the optimum level which produced a good quality root system.

Root response to height-of-cut treatments indicated the increasing defoliation has a pronounced effect on restricting root development varying in response according to species and varieties of turf grasses. While clipping reduces root development, it stimulates the production of rhizomes and stolons and tends to encourage sod formation. There is, however, a definite limit in the closeness to which individual species or variety may be clipped without scalping or such severe defoliation that production of stolons or rhizomes is also reduced. Merion bluegrass for example, showed a satisfactory root development at one inch height-of-cut in contrast with Kentucky bluegrass which at the same height of cut showed unsatisfactory root development.

We can conclude that variations occur in root response with different species and strains but as in height of cut of the grasses is lowered the requirements for a complete nutrient supply are increased and in order to best maintain the several desirable types of turf grasses it is imperative to maintain careful and proper management.

THE USE OF SOD

By Daniel Pellegrino

My topic for this afternoon is "The Use of Sod". Sodding plays an important role in the field of land-
scaping and I feel that in the future it will even play a greater role.

Sodding has been said to be the most expensive method of turf establishment, yet I feel that on many occasions this cost is justified. It involves the cost of sod plus a large amount of labor necessary in the sodding operation. The success of this operation depends on the preparation of the soil, the quality of the sod, and the skill and care taken in laying.

Sod should be cut 12 inches or 18 inches in width and not more than three feet long. Larger pieces will stretch and are difficult to lay evenly. Bent turf should be cut 1/2 or 3/4 of an inch in thickness, while Blue grasses and Fescues will require a somewhat thicker cut. If sod isn't layed immediately, it should be stored in a cool place, grass side up, and kept moist to prevent weakening and yellowing. Sodding is best done late spring and early fall until at least three weeks prior to the ground freezing, however, it may be done successfully through the summer wherever water is available.

In the rebuilding or construction of roads many banks, ditch slopes and drainage ditches have been created by the cuts or fills necessary in the changes of grades and the raising of turf on these areas is done by either seeding or sodding. On the banks along roads sodding has been found to be the best method of preventing washouts. There is no question that sodded slopes hold against erosion better than those which are seeded. In a number of localities, however, seeded slopes have been successful. Ditch slopes higher than three feet should, as a rule, be sodded. The sodding of these ditch slopes over the entire length of a road is rather impractical, although in some localities it may be desirable. The result of seeding any steep grade will not be a smooth job but rather a rough one in places, especially if rain occurs before the grass starts to germinate. Reseeding of these areas is almost always necessary. In general, a very economical procedure is to sod all banks three feet or more high. A great deal of labor and time is expended in repairing washouts if this isn't done.

In cases where roads pass over or under a railroad, high fills or deep cuts are made. In order to prevent the banks from washing and the road-drains from filling, the slopes should be sodded or retaining walls built. The actual cost of sloping these banks and sodding, amounts to approximately 1/20th of the cost necessary to construct concrete retaining walls. In addition to this, the sodded slopes, in my estimation, greatly improve the appearance of the entire structure.
Sodding may be used to great advantage in the maintenance of cemeteries. In the springtime many winter graves are in need of repair. This not being the ideal seeding season, the use of sod may be the solution to make these areas presentable for the visitors on the memorable days ahead.

On our golf courses and athletic fields again sodding enters the landscaping picture. Here these areas must be open for play during the growing seasons and I feel there is no other solution other than sodding to produce a good playing turf quickly. Ordinarily on golf courses sodding is limited to greens and tees, or other areas where the need for turf in the shortest possible time justifies its use, or should I say its cost.

In the landscaping of estates and private homes, I find that one of our greatest problems is the seeding of new lawn areas. Nature's havoc and customer education play a major role in our problems in this field. Clients tend to be impatient in the establishment of turf areas and aren't willing to wait for the ideal time for seeding, yet they are unwilling to assume responsibility for seeding during improper seasons. Being impatient for results they don't consider the time element involved in raising an established lawn.

On private estates sod is desirable for edging planting beds, walks, drives, and for covering slopes difficult to raise seed. Sod is particularly valuable for securing quick effects, especially in summer and late fall when it would be impossible to start grass seed, and for giving a neat finish to a place newly graded.

As I have stated previously, sodding has been claimed to be the most expensive method of turf establishment, yet I have found through our operations that this doesn't always hold true. The same amount of labor is involved in the preparation for sodded areas as is for seeded grades. The difference in cost arises from the cost of sod and the labor of laying. Good sod in the New England area may be purchased for as little as $ .15 per foot tailboard delivery. The cost of handling sod from this point to the finished product ranges from $ .03 to $ .07 per foot, depending on the volume of sod to be laid. Seeding costs have ranged from $ .01½ to $ .05½ per foot, with no allowance made for weed control or repairs from washouts.

In general sodding is more expensive than seeding, but before I decide the final costs, I take the following into consideration:
a) the desirability of an immediate lawn
b) the size of the area involved
c) the season of the year
d) the contour of the land

In conclusion I would like to say that on many of our seeding contracts could I have anticipated the additional cost of weed control and the labor involved in repairing damage, I would have used sod at less expense.