1967

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David King

William W. Wollinger

Thomas Caputi

Charles Lane

Ronald Hodgkinson

See next page for additional authors

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G.C.S.A.A. SCHOLARSHIP AWARDS

Mr. Richard Blake, a Director of the National G.C.S.A.A. (second from right), presenting the G.C.S.A.A. scholarships to (left to right): Robert Dill, two-year student; Edward Horton, two-year student; Gerald Peters, four-year student; Oliver Leach, two-year student; James Fitzroy, two-year student; Gregory Gimblette, two-year student; Mr. Richard Blake; and Dr. Joseph Troll, Associate Professor of Turf Management.
TURF MANAGEMENT SENIORS

Row 1  (left to right) P. Barratt, D. Frigo, D. Lamson, R. Francis, J. Hunt, J. James, B. Pollard, S. Humphreys, R. Hansen
Row 2  B. McCarthy, J. G. Lagergren, J. Smith, G. Flood, P. Houle, O. Leach, J. Jones, R. Demetropoulos
Row 3  J. Brown, J. R. Lagergren, E. Grey, K. Gendall, J. Fitzroy, R. Kervian, R. Craib, G. Gimblette
Row 4  R. Dill, P. White, J. Blue, D. Dunlavey, D. Allaire, E. Horton
Row 5  J. Green, C. Perelle, J. Black

TURF MANAGEMENT FRESHMEN

Row 1  (left to right) C. Lane, A. Miller, T. Pula, W. Stevens, A. Lanoie, J. Damian, A. Gregory
Row 2  J. Mathews, D. Roule, P. Consolati, A. Hall, R. Hodgkinson, D. Brainerd
TURF CLIPPINGS
Published By
The Stockbridge Turf Management Club
of the University of Massachusetts

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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Department of Plant and
Soil Sciences
University of Massachusetts
Amherst, Massachusetts

Editors: Ted Horton
Greg Gimblette

Advisor:
Dr. Joseph Troll

Contents

Picture - G.C.S.A.A. Scholarship Awards
Picture - Turf Management Seniors and Freshmen

Title Page and Contents

A Poem by David King .............................................. 1
Dedication by William W. Wollinger ............................ 1
Keeping the Golfer Informed by Thomas Caputi ............ 2
Tips on Keeping Your Help by Charles Lane ................. 2
Control of Helminthosporium Diseases by Ronald Hodgkinson .......... 4
Early History of Golf by Louis F. Facy ......................... 4
Modern Products for Modern Living by Rod Hermitage ....... 6
Class Will of '67 .................................................... 7

Picture - Winter School 1967
Picture - A Group of Turf Majors

Conference Proceedings - Table of Contents
A POEM

David King

"Who's the stranger, Mother Dear?
Look! He knows us! Ain't he queer?"

"Hush, My Own! Don't talk so wild;
That's your father, dearest child."

"That's my father? No such thing!
Father died, you know, last spring."

"Father didn't die, you dumb!
Father joined a golfing club.

"But they closed the club, so he
Had no place to go, you see --

"No place left for him to roam
That's why now he's coming home ....

"Kiss him, he won't bite you, Child!
All those golfing guys look wild."

----------------------------------

DEDICATION

William W. Wollinger

Managing a golf course today takes a well trained and dedicated man. The training can be obtained here at the Stockbridge School of Agriculture. But, no matter how good the training is, to be a good Superintendent a man must display a serious interest in turf management. A good Superintendent must have a strong feeling of pride in his work, and above all, dedication.

Dedication is necessary in everything. But running a golf course takes full dedication of knowledge and personal interest. The job of Superintendent can no be measured in the amount of hours worked. He does not hold a nine to five job. I feel that running a golf course is a sort of challenge. Nature challenges you with all her power. She does everything she can to stop you from growing that grass. You must meet her challenge, not only with your knowledge (anybody can read Musser's book), but with a dedication that sets a good Superintendent apart from a bad one. When nature strikes, there's no waiting until tomorrow. The grass may be dead tomorrow; it must be done immediately. There is no stop whistle on a golf course. The only good job is a job done.

This dedication must be a full time thing. Not just an interest that leaves after Labor Day. True, today a Superintendent is more of a manager than a laborer, but I feel he should be managing all the time somebody is laboring on his course. As long as there is a chance that something might go wrong, he
must be available. There is no summer vacation or weekends at the beach for a truly dedicated Superintendent. I don't think he could sleep nights while his course was in the hands of an assistant who might ruin everything the Superintendent has been trying to do since the snow melted.

Agrostology is becoming more and more scientific every year. To be a good Superintendent, with a good course, a man must not only be aware of innovations, but also, I believe, that he must have a serious dedication.

----------------------------------

KEEPING THE GOLFER INFORMED

Thomas Caputi

The superintendent is not only responsible for the upkeep of the golf course, but he is also liable for knowing the game of golf and the principles of golf course design. With this knowledge he should make an attempt to appeal to the interest of the golfer, keeping him informed of landscape developments and changes by reminding him where poor turf conditions are developing, where weak areas exist, and where reconstruction and new construction is taking place.

As an effective means of informing the golfers the superintendent can make use of posters or signs.

Signs are ideal for illustrating existing conditions, planned maintenance operations, and points of interest that would prove to be worth while.

Signs such as: ANNOUNCING: opening of new redesigned 13th hole, and TODAY: insect control treatment on all fairways, or TOMORROW: seventh, eighth, and ninth greens to be aerified, or LOOK: all temporary greens will be used during the coming week, would confirm that the use of signs are used in the interest of the golfer and also to show the responsibilities that fall under the superintendent's jurisdiction.

These signs should be displayed in some convenient place where they are easily seen. A suitable place would be in an area near the first tee or near the pro shop when appropriate to keep members informed.

In the interest and concern of the golfer, the superintendent should make an attempt to plan ahead in an effort to keep the golfer informed of turf management operations.

----------------------------------

TIPS ON KEEPING YOUR HELP

Charles Lane

During the past few years the golf course superintendent has become increasingly aware of the difficulty involved in acquiring and holding skilled labor.
Three reasons for this are: 1) Most work on golf courses is seasonal. Many men prefer a steady year-round income to being unemployed during the winter months. 2) Poor labor management. Repeatedly you hear of experienced men quitting because they "couldn't stand to work for the man." 3) Low wages. Occasionally there just isn't enough money in the budget to afford the men any more than is necessary to subsist on.

Since the superintendent's hands are somewhat, or altogether, tied when it comes to salary and seasonal work, he would be wise to concentrate on good labor management practices to make up for other deficiencies. There are a number of ways a superintendent can do this.

1) Low pay loses more men than anything else. We are all well aware of the fact that money talks. So don't be skimp on the portion of your budget that is allocated for salaries. If you pay well enough, you'll have skilled men beating a path to your door.

If you are paying all you can, try to set up some fringe benefits for your men. See if you can't arrange for the club members to bear the cost of a group medical insurance plan or something similar. Are there unoccupied living accommodations, owned by the club, that could be used by your men to supplement low wages? Give your men a mid-morning coffee break. It won't cost too many man-hours and it's amazing what it does for morale. If you've got a couple of bags of sample fertilizer that is unsatisfactory for the golf course, don't throw it away - give it to one of the men. Fifty or one hundred pounds of fertilizer may be a drop in the bucket to you but it may keep your watering boy's lawn green all summer. At a course where I once worked my best "fringe benefit" was being allowed to use the maintenance barn to repair my automobile. It means a lot to the weekend mechanic on your crew to be able to work on his car in a warm, dry place.

Many of these suggestions are impractical in some cases, but most can be arranged with little trouble or cost. They may mean a great deal to your crew.

2) Respect advice or suggestions from experienced members of the crew. This is especially important if you are the new superintendent at a course. This doesn't mean that you have to take every suggestion to heart, but nine times out of ten the men know more about the overall "mechanics" of the course than you do. These men cover the entire course daily and can provide helpful bits of information, like: The dead spot on the third tee was caused by spilled fertilizer and not some exotic fungus; or the third, sixth and ninth greens always seem to be the first ones to wilt. So if you are new on a course, listen to your men. They may be able to help you more than you think.

3) Know each man's abilities and the jobs best suited to them. Discuss with each man the jobs he likes best and if possible let him do them. If a man is doing something he likes, he's happier and he'll do a better job. Be careful, though, not to let a man concentrate too much on one routine job. He may soon become bored and you risk narrowing the variety of his experience.

4) Try to instill interest and pride in each member of the crew. This is sometimes difficult during the playing season because most of the work is routine
and monotonous. Perhaps the best way to do this is to show that you are interested in your job by being on time in the morning and being around during the day to cope with emergencies or answer questions from your crew. Show interest in their work, and don't be afraid to praise a job well done; if you do, he'll do the job well again.

The four steps above aren't guaranteed to insure that you won't lose your help, but they are a step in the right direction. They will, in all probability, produce a crew that is dedicated (to an extent), interested and proud to say they work for you.

-----------------------------------------------

CONTROL OF HELMINTHOSPORIUM DISEASES

Ronald Hodgkinson

To speed up the recovery of severely diseased turf areas, one should apply a fertilizer containing readily available nitrogen. In Kentucky bluegrass, mowing at one-and-a-half inches or higher, will reduce disease damages caused by melting-out. Frequent or close clipping should be avoided during periods of outbreaks of the crown and root rot phases of these diseases.

Recovery from these diseases can be aided by: opening the area around the crown of the plant by hand raking or use of a vertical mower; mowing the turf area at a satisfactory height; keeping the soil moist enough for vigorous grass growth; applying a quick acting nitrogen fertilizer to the turf. Also, an effective fungicide should be applied to the turf area to control the disease.

Merion bluegrass is a very useful variety where problems such as melting-out occur. It is resistant to melting-out. It grows horizontally enabling it to be clipped closely. It is also resistant to heavy traffic.

The infections caused by leaf spot can be controlled by the use of fungicides. In the cool wet weather group, applications of fungicides should begin early in the spring and should be continued at one to two week intervals. For the warm wet weather Helminthosporium group, control of leaf spot should begin in late spring and be continued at one to two week intervals as long as the weather is favorable for leaf infection.

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EARLY HISTORY OF GOLF

Louis E. Tacy

As far as we know at the present time, the game of golf goes back to the early 1400's when it was first played in Scotland.

The first golf club on record was the Royal Blackheath Golf Club formed by
an Englishman around 1600 in London. Scotland, the original land of golf, organized its first club in 1735. This was known as the Royal Burgess Golf Club and was located in Edinburgh. Out of this club a society called the Company of Gentlemen Golfers, later called the Honorable Company of Edinburgh Golfers, was founded. This society is responsible for the first set of written rules. They established them in 1745, just one year after their formation.

Another club was formed in Scotland, called the Ancient Golf Club of St. Andrews. They formed in 1754. This club was made up of 22 avid golfers who adapted the same set of rules which had been set up by the Edinburgh club.

After about 170 years, the two Scottish clubs combined and became the Royal and Ancient Golf Club. They established and managed the British Open and Amateur Championships in 1919.

The first ladies' club was established in 1810 and was named the Musselburgh Golf Club. This club laid the foundation of another club which came into being in 1872 at St. Andrews. The first ladies' union was organized in 1893. This union, known as the Ladies Golf Union, governed all women golfers.

Golf came to the United States in 1885 with the establishment of the golf course and club at Foxburg, Pennsylvania. Joseph M. Fox, the founder, learned the game while in Scotland and upon his return to Pennsylvania built a course and organized a club with his friends. In 1889, the second course in the United States was built; this was located at Middletown, Kentucky. It was built and run by a group of English immigrants.

The Amateur Golf Association was established in the United States on December 22, 1894. Five clubs were represented in this organization and were responsible for its foundation. The clubs involved were: St. Andrews of New York, Newport of Rhode Island, Shannecock Hills of New York, Country Club of Brookline in New York, and the Chicago Golf Club.

From the Amateur Golf Association came the United States Golf Association, which is now comprised of over 2,300 clubs and courses across the United States.

When golf became a well established game in the United States, the Professional Golf Association was formed. This took place in 1916. The main reasons for its formation were: (1) to arouse more interest in the game, (2) to set up standards of play, and (3) to insure the welfare of the golfers. There are now well over 3,000 members in the Professional Golf Association.

In 1917, a man by the name of Horace L. Hotchiss, established the United States Senior Golf Association. Mr. Hotchiss was a man of 60 years old, and it was his belief that golf was not only a young man's game as most people at that time thought. So, in 1917, in Rye, New York, he formed this Association with some of his "old timers." At the present time there are over 900 members in the Association.
"MODERN PRODUCTS FOR MODERN LIVING"

Rod Hermitage

In every facet of the business world, companies try to follow the above mentioned motto. Very few people realize that fertilizer companies must follow the same trend. In this article I would like to trace some of the advancements in the fertilizer trade during the last decade.

1. Soil Samples
   This is probably the greatest single improvement in the fertilizer business. In the past, consumers worked on a hit and miss basis, however, now with the addition of soil testing, good results for acidity, organic matter, phosphorus, potash, magnesium and calcium can be obtained. Providing good sampling procedures are taken, a good idea of the soil's deficiencies can be determined. Results and recommendations are sent to the customers stating the best analysis of the various fertilizers to use, replacing deficient soil nutrients at the cheapest cost to the consumer in order to produce the highest crop yield. Soil sample analyses are done by reputable fertilizer companies free of charge and is a very important service in selling fertilizer.

2. Increased Concentrations
   A few years ago the following types of analyses were popular: 2-12-10, 2-16-6, 6-12-12, and 10-10-10. Now these analyses, in most parts of the country, are being replaced by 4-24-20, 4-32-12, 8-16-16 and 15-15-15. It is quite understandable when one knows the reasons why. Let's assume a customer receives an analyses report where he is supposed to apply 600 lb. of 2-12-10 per acre. It stands to reason if he used 4-24-20, the following facts come into effect.

   A. He would apply 300 lb. per acre, with considerable time saved in spreading.
   B. He is saving money on the transportation of the fertilizer because he needs one half the number of tons with a 4-24-20 than with a 2-12-10.
   C. He is saving money on the cost of one ton of 4-24-20 as compared to two tons of 2-12-10.

3. Textures and Bulk
   Several years ago marked the advent of a new centrifugal fertilizer spreader. The available texture of fertilizer at the time was fine and made it virtually impracticable. Again the fertilizer industry had a problem of how to produce a granulated fertilizer. Once more research laboratories proved their worth and came up with a method of manufacturing granulated fertilizers.

   This resulted in a new concept for fertilizer distribution, "Bulk." Again, with the consumers' best interest in mind, here is another method of saving money. Let's assume the customer purchases his fertilizer needs in bulk. He automatically saves on the cost of bags, however, he must pay for the spreading in the bulk form. These two usually cancel each other. As a result, his fertilizer is spread rather than piled up in one corner of the field and at no additional cost.

   In summing up, I would like to mention that reputable companies always have their customers in mind, as a satisfied customer is a happy one. He is the one that returns the following year to repeat his order. One further point, if a
company does wrong at one customer's expense, try and figure out how much business he might lose in subsequent years. Remember, good news as well as bad news travels fast. Finally, the company must always (1) produce good products, (2) guarantee his products, (3) service his customers, and last, but not least, (4) Live Modern.

CLASS WILL OF '67

Ted Horton - leaves his marks to A.T.G.
Greg Gimblette - leaves his placement report to Tom Pula.
Ray Kervian - leaves his perfect attendance.
Charlie Perelle - leaves his skis to Dr. Troll.
Jim Fitzroy - leaves his empty Scotch bottle to Lennie Gregory.
Earl Grey - leaves his 1961 Comet to Dr. Troll.
Bob Moyer - leaves his hair to the girl next door.
John Smith - leaves, if he is lucky.
John Hunt - leaves turf to take up his duties at the lighthouse.
Pete Houle - leaves his many trips to the judiciary.
Brian McCarthy - leaves his marks to whomever wants them.
Jerry Flood - leaves his beard to Frank.
Norm Bartlett - leaves all his scholarships to Dr. Troll.
Ken Gendall - leaves his golf ability to Al Lanoie.
Dave Thompson - leaves all his golf trophies to Al Lanoie.
Paul White - leaves his Flag to Ted Horton in the hope that some day he will remember.
Dina Frigo - leaves all his cut classes.
Bill Teece - leaves his clothes??
Brad Webber - leaves his bar stool at the Rustic to the next Turf Club Pres.
Joel Lagergren - leaves turf for the cartoons.
Bruce Pollard - leaves his bus tickets to Pete Consolati and Pete Salinetti.
Jim Lagergren - leaves his clothes in Washington!
Ron Mooney - leaves all his thoughts below his belt!
Dave Dunlavey - leaves for Arbor and Park Management.
Richard Craib - leaves Mt. Pleasant for the Factory.
Don Allaire - leaves a little weight to whomever needs it.
Ron Hansen - leaves his $26.00 case of beer.
Bob Clark - leaves his irrigation report to the Freshmen Class.
Oliver Leach - leaves a hit record called "I've been laughing".
Bob Dostal - "Tex" leaves to go back to the farm.
Steve Humphreys - leaves his Flip Toy Chain to Tom Caputi.
Roy Demetropoulos - leaves his "go-go" girls.
WINTER SCHOOL STUDENTS

Row 1  (left to right)  H. Ellis, J. Doyle, D. Colpitts, H. Cerep, K. Pierce, T. Angelo, W. Fraser, G. Marco, L. Fischer, K. Knobloch, F. Krenzel.
Row 3  E. Tarbox, D. Winkelman, D. Mann, L. Brown, R. Meek, F. Rodgers, H. Weatherhead, Albert Allen, R. Williams.
Row 4  E. Couitt, J. Mahoney, R. Mathews.
A GROUP OF TURF MAJORS

Row 1  (left to right) C. Lane, A. Miller, T. Pula, W. Stevens, A. Lanoie, J. Damian, A. Gregory.
Row 3  P. White, S. Humphreys, D. Lamson, J. Fitzroy, P. Houle.
Row 4  R. Dostal, D. Dunlavey, J. Lagergren, Joel Lagergren, J. Hunt.
The various topics are presented for your information as follows:

Soil Acidity and Liming by F. E. Hutchinson .......... A-1
History of Poa annua by John C. Harper II .......... A-2
Irrigation Practices on Poa annua by Joseph R. Flaherty .......... A-9
From Poa annua to Bluegrass by Charles H. Tadge .......... A-10
Renovation - Timing and Nutrients by Lee Record .......... A-13
Poa annua Panel - Questions and Answers by Alexander M. Radko .......... A-16
The Green Section Specifications for a Putting Green by James L. Holmes A-19
Soil Modification and Results of Further Testing by D.V. Waddington A-25
Water in the Right Amount in the Right Place at the Right Time for Turf
By Eliot C. Roberts A-31
That's Not What I Said! by Frank Gallagher .......... A-39
Growing and Distribution of Sod by Ben Warren .......... A-43
Post Management of Sod by George F. Stewart .......... A-44
Sod Certification by Henry W. Indyk .......... A-45
Management of Various Park and Turf Gardens by Robert W. Sharkey A-47
SOIL ACIDITY AND LIMING

F. E. Hutchinson
University of Maine

The topic I have been assigned today concerns soil acidity and its solution — liming. Therefore, in the next few minutes we will attempt to define the nature of the problem (soil acidity) and then we will consider methods employed to correct the situation.

There are several definitions which can be used to describe an acid, but for our discussion let us agree that an acid system is one where the hydrogen ions (H+) outnumber the hydroxyl (OH−) ions. The greater the differential between the two ions, the greater the acidity or, in other words, the lower the pH value. Many years ago, a man by the name of Sorenson proposed the pH scale as a means of expressing this relative acidity, alkalinity or neutrality of any solution. You will note on the slide that the values range from 0 to 14, with pH 7 being a neutral system where hydrogen and hydroxyl ions are equal.

In the Northeastern section of the United States our soils tend to be acid because of the relatively high rainfall and the original presence of coniferous (softwood) vegetation. In the next two slides you will note the formation of podzol soils under these conditions because of the presence of a considerable amount of water moving downward through the soil and also a pH of 3.5 resulting from the organic acids released from the coniferous litter. Thus, we see that acid soils are normal in this part of the country because of the inter-relationship of rainfall and vegetation.

Our interest in soil acidity is more than academic because it has a very definite effect on soil fertility. Each of the 16 elements which are essential for plant growth is effected by the pH level of the solution in which it is dissolved. Therefore, it is important that we maintain a soil pH level which is most favorable to nutrient availability. This can easily be seen on this slide of the nutrient availability chart, where the width of band for each element indicates its relative availability at any specific pH value.

After viewing the nutrient availability chart one concludes that a pH level near neutrality (6.5-7.0) is ideal for most of the macro-nutrients. For example, nitrogen, phosphorus, potassium calcium and magnesium. However, for several of the minor (trace) elements availability is low in this range and therefore they do have to be supplemented in some instances.

One of the major fertility problems in an acid soil is caused by the fixation of phosphorus by iron and aluminum ions which are extremely soluble at low pH values. This problem is easily solved or avoided by maintaining the soil pH level about 5.5, which is the upper limit for the soluble range for the ions which cause the fixation.

If at this point, we can agree that soil acidity is undesirable, then we must next ask ourselves how to overcome it. I am sure you are way ahead of me on this one and that you know lime can be applied to soils to raise
the pH level. Materials commonly used for this purpose are calcium oxide (CaO), calcium hydroxide (Ca(OH)₂) and calcium carbonate (CaCO₃). These are equally good for correcting soil acidity if they are applied in equivalent amounts.

When lime is applied to an acid soil the hydrogen (H⁺) ions surrounding the colloidal particles are replaced by calcium (Ca²⁺) ions, and the hydrogen ions then tie-up with the carbonate (CO₃²⁻) ions to form carbonic acid. The acid then breaks down to water and carbon dioxide, leaving the soil less acid than it was initially. This occurs as follows:

\[ \text{H-clay} + \text{CaCO}_3 \rightarrow \text{Ca-clay} + \text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2 \]

Frequently the addition of lime to a soil does not result in the expected pH rise. This is caused by some buffering system present in the soil which may be related to type and amount of clay and/or to the presence of a large amount of aluminum ions. For such soils the lime requirement may be quite high, but eventually the pH will rise if enough lime is applied.

In considering soil acidity it is important to note that most fertilizers manufactured today are acid-forming when applied to soils. However, the extent to which any given fertilizer will lower the soil pH level is directly related to the nature of the salts which are used to manufacture it. I would like to show you the equivalent acidity data for the fertilizers produced by one north-eastern fertilizer supplier. They are as follows:

<table>
<thead>
<tr>
<th>Fertilizer Grade</th>
<th># of limestone to neutralize 1 ton</th>
</tr>
</thead>
<tbody>
<tr>
<td>15-10-10</td>
<td>1237</td>
</tr>
<tr>
<td>10-10-10</td>
<td>323</td>
</tr>
<tr>
<td>8-12-12</td>
<td>400</td>
</tr>
<tr>
<td>0-15-30</td>
<td>0</td>
</tr>
</tbody>
</table>

In summary, we can conclude that soil acidity is a natural condition in our region and that it should be continually combated if we wish to grow healthy plants in our soils. The problem is easily solved by the application of a lime material, but the amount of lime required will vary, depending upon the nature of the soil in question.

HISTORY OF POA ANNUA

John C. Harper II
The Pennsylvania State University

Poa annua probably has been cussed and discussed more than any other single species of grass over the years. Numerous articles with titles such as "Poa annua Pros and Cons" or "Poa annua - Friend or Foe" have appeared in popular publications. Until very recently there has been a great deal of talk about this plant, but little basic research on the ecology and morphology of Poa annua.
Dr. Fred V. Grau, in a United States Golf Association Greens Section article, prepared in 1948, pointed out that Poa annua can be a friend because (1) it withstands close mowing and is relatively easy to cut, (2) it grows on compacted soils, (3) it has an attractive color when in a solid stand, (4) it grows in shade or sun and under wet conditions, (5) it has world-wide adaptability in cool-season grass areas, and (6) it has good playing qualities, except when in the seeding stage. On the other hand, it can be a foe because (1) it is highly competitive with the more desirable grasses especially in the early spring, and (2) in most areas, it does not persist year round especially under hot, dry, or hot, humid conditions.

In annual bluegrass we have a species which on one hand invades and dominates many turfgrass areas, while on the other hand it cannot be depended upon to form an acceptable turf throughout the year.

Origin and Distribution. Annual bluegrass has a world-wide distribution. Hitchcock in the USDA publication, "Manual of Grasses of the United States," states that Poa annua is found in open ground, lawns, pastures, waste places and openings in woods from Newfoundland and Labrador to Alaska, South to Florida and California, and at high altitudes in Tropical America. He further states that in the warmer parts of the United States, the species survive in the winter, in intermediate latitudes it is a troublesome weed in turf, growing luxuriantly in spring, dying in summer, and often persisting for a year or more in more northerly latitudes. Hitchcock also indicates that it is commonly found in flooded areas and along stream banks. In Europe annual bluegrass is often referred to as "six weeks grass," "annual meadow grass," or "low spear grass."

It is universally agreed that the origin of Poa annua is Europe. There is some disagreement regarding its introduction into the United States. Hovin reports that it was introduced to America by the early Spanish explorers. Others contend that it was introduced much later by the colonists for use in pastures.

Description. Poa annua has shorter, broader leaves than other bluegrass, and is considerably lighter green in color. It has a boat tipped folded leaf, typical of the bluegrass species, and the familiar light transparent lines on each side of and paralleling the leaf midrib. Unlike Kentucky bluegrass, Poa annua does not produce rhizomes, and although it may develop short, prostrate, rooting stems on the soil surface, it is not considered to be stoloniferous. The entire plant is smooth and the leaves are shiny on the underside. It has no auricles, but does have a well developed ligule.

Poa annua is generally considered a short lived plant, completing its life cycle in one growing season or less. Goss of Washington, however, reports that annual bluegrass lives as a perennial, provided no climatic extremes beyond the survival point of the grass are encountered. He indicates that the West Coast area, from San Francisco to Vancouver, is a region of Poa annua Utopia because of the mild summer and winter conditions. Daniel also states that Poa annua may act as a perennial until killed by disease or wilting. McCullough reports that Poa annua is biennial in the Alberta region of Canada.

Germination of Poa annua normally takes place in late summer or early
fall, although in some areas of the country there may also be considerable spring germination. Daniel has reported that Poa annua may go through the whole cycle of germination, maturation, and seed production, and germination of the seed produced, in a period of two months. He indicates that spring germinated plants normally produce seed that in turf germinates by late summer or early fall.

Seedling Poa annua plants develop quite rapidly, branching freely at the soil surface to produce erect, dense, leafy tufts. Thick, dense stands develop despite the lack of creeping stems. Poa annua will continue to grow into the late fall and winter as long as the soil remains unfrozen, and normally is the first of the grasses to resume growth in early spring.

Seed development of Poa annua is unlike any other cool-season grass. Although seed production is greatest during the period April through June, seed stalks may be produced at any season of the year. Youngner points out that flowering is not governed by day length as in many plants, and is only slightly affected by temperatures within the range of 50 to 80 degrees F. Therefore, flowering and seed production may occur at virtually anytime that the plant is actively growing. No other cool-season grass can produce seed stalks under regular mowing, regardless of the height of cut. Even at putting green heights of 3/16 of an inch, seeding may be so profuse that the green will show a white cast. Seed may be disseminated by wind, water, maintenance equipment or on the shoes of persons using the turf.

Sprague and Burton report that under favorable conditions of mild temperatures and abundant moisture, Poa annua plants may continue thrifty growth after producing seed but that it is most common for the species to die rather suddenly in periods of high temperature or moisture shortage that often occurs in July and August in the northeastern United States. As death occurs the plants turn a reddish brown color which fades in a few days to a light straw color. Areas heavily covered with Poa annua may become almost completely bare in less than 10 days. Unfortunately or fortunately, depending how you look at it, when conditions become conducive to germination in late summer or early fall, the area will become heavily reinfested in a short time.

Variations. Hovin, in a Ph.D. study at UCLA found great variations in Poa annua plants. Considerable differences in longevity of plants was attributed to (1) the ability to form new shoots from the upper nodes, and (2) the amount of tillers produced. Typical short lived plants have a very upright growth with few shoots being formed from the upper nodes of the flowering culms. These plants also produce few tillers. In contrast, plants with a more spreading habit of growth are capable of producing new shoots from the upper nodes. Some of these shoots have the ability to form roots at the nodes, thus spreading the plant in a stoloniferous manner. In addition, these plants produce many tillers and tend to be more perennial than other plants.

There has been considerable speculation as to why annual bluegrass is not completely annual. Hovin's work indicates that Poa annua originated by hybridization between an annual species, Poa infirma and a perennial species, Poa supina.

As a result, Poa annua has segregated out types which resemble one or the other of the parent species as well as intermediate ones. Due to a high degree of self-pollination and good seed fertility, various morphological deviating lines have become established. The species is primarily annual in the U.S.
with perennial lines found here as compared to Europe. According to Greenfield, a creeping perennial form known as *Poa annua*, variety *reptans*, which breeds true is being developed in England for sports turf use. Youngner reports that perennial types of *Poa annua* are characteristically fine textured, dense and darker green than annual types. Daniel collected 1,000 field germinated plants for greenhouse study and found 5 creeping perennial types in the total population.

Hovin also found considerable difference in the germinating ability of seed gathered from annual and perennial lines. Freshly harvested seed from perennial lines germinated readily in contrast to seeds of similar maturity from annual lines. Alternate low temperatures (50 degrees Fahrenheit) and high temperatures (70 degrees Fahrenheit) increased germination of unripe seed of perennial lines but did not overcome the dormancy period of seed from the annual lines. However, seed stored for 3 months or longer prior to germination tests germinated without cold treatment whether from an annual or perennial line. These results agree with the common observation that most germination in the field takes place in the fall when nights begin to get cool.

**Factors Affecting Growth.** According to Engle, *Poa annua* infestations are favored by compacted soils, over-use of water, insect and disease damage to other grasses, mechanical injury to desirable grasses, incorrect fertilizer use, and high soil phosphate levels. Hallowell adds thatch conditions to this list.

**Soil compaction.** *Poa annua* is a very shallow rooted plant and the belief is commonly expressed that this accounts for its ability to thrive on compacted soils where trampling or poor subsurface drainage has produced a poorly aerated soil. Sprague and Burton, however, feel that *Poa annua* grows in such areas because its growth period is confined to the cooler seasons when poor aeration of soil does not become sufficiently serious to cause death of the plant. It is an established fact that the oxygen requirements of plant roots are considerably lower in cool weather than in hot periods. Assuming Sprague and Burton's theory to be correct, the combination of low soil oxygen content in compacted soils and high oxygen requirements of the roots in hot weather may be one of the primary factors in the loss of *Poa annua* during the summer months.

Sprague and Eaveal made comparisons of the amount of roots produced by various grasses on a clay loam soil under compacted and non-compact ed conditions, and found total root weight of *Poa annua* reduced by 50 to 66 percent under compacted conditions. Surprisingly, they found some roots under both compaction and non-compaction at a depth of 10 inches. They further found that on the compacted soil, *Poa annua* produced 86.8 percent of its total roots in the top three inches whereas Kentucky bluegrass produced 92 percent and Colonial bentgrass 88 percent of their total roots in the same area. Annual bluegrass produced 6 percent of the root system below the fifth inch; Kentucky bluegrass 7 percent; and Colonial bentgrass 4 percent. This would indicate that *Poa annua* root development is similar to that of permanent turf species under substantially the same conditions. *Poa annua* does not inherently develop a shallow root system unless forced to do so because of conditions which prevent root penetration. The limitation of roots to the upper inch or two of soil on *Poa annua* dominated areas may well be an index of unfavorable soil conditions.

Compaction, of course, is quite unfavorable to the development of many of
our desirable grasses, including bentgrass and, therefore, encourages *Poa annua* through reduced competition from the desirable grasses.

**Temperature.** It has already been noted that *Poa annua* normally is injured or killed under conditions of high temperature (85 degrees Fahrenheit plus) and moisture stress. However, Haves reports that the damage as a result of high day temperatures (above 85 degrees F.) may be minimized by cool (55 degrees F.) night temperatures. Cool night temperatures tended to increase the root system of the plant.

It has been my experience in Pennsylvania that a great deal of *Poa annua* is killed indirectly by low temperatures through desiccation in late winter when soils are still frozen. Beard of Michigan State reported in 1963 that many turf with high *Poa annua* populations exhibited healthy foliage with the advent of spring thaws but subsequently died following a few warm sunny days. Death could not be attributed to pathological causes. Microscopic examination of annual bluegrass leaves after spring thaw but prior to death showed that no injury had occurred from direct low temperature effects. The upper portion of the crown and stem appeared normal but examination revealed that most of the root system was dead with the few live roots newly initiated from higher on the crown. Detailed microscopic examination of cross sections of the crowns and roots indicated the destruction of protoplasts in the roots and crown tissue as a result of intercellular ice crystal formation. Injury of this type occurs from the sudden formation of large ice crystal masses in the spaces between protoplast. Under these conditions the foliage of the plant appears normal but as warmer temperatures promote growth and transpiration of the leaves, the injured crowns may not be capable of producing a new root system to meet the water uptake requirements of transpiration. Under these conditions, the plant tissue becomes desiccated and dies.

**Water.** The over-use of water results in poor root development and subsequent weakening of the desirable grasses. With reduced competition from the permanent grasses, *Poa annua* will flourish. Although, annual bluegrass can withstand relatively high soil moisture levels, it may be lost quite readily through wet wilt, especially when coupled with high temperatures. Wet wilt occurs when saturated or near saturated conditions exist in the soil and a deficiency of oxygen prevents normal root uptake of water. Thus, the plant wilts even though it is virtually sitting in water.

In my opinion, mismanagement of water is one of the major problems on many golf courses. Time and again, I have seen fairway irrigation systems installed on excellent non-irrigated Kentucky bluegrass fairways. Within a few years, these fairways have changed from a solid bluegrass population to a predominantly *Poa annua*, clover, Kentucky bluegrass ecology. Fairway irrigation installation also leads to lower height of cut which favors the *Poa annua* over the Kentucky bluegrass. Sprague and Evaul in work done in 1929 showed that heavy soils kept at 30 percent saturation, produced very little *Poa annua* growth; those at 40 percent only fair growth; and those at 50 to 60 percent saturation or slightly above field capacity, permitted maximum growth of the *Poa annua*. Soils with 70 to 80 percent saturation permitted only fair to good growth. The same experiment also clearly showed the effect of over-use of water in developing soil surface compaction.

**pH.** Brenchley in England reported that *Poa annua* is rarely found on chalk
soils which are highly alkaline. Sprague and Evaul in greenhouse experiments found that good growth of _Poa annua_ was obtained at pH 4.2 but that best growth was obtained at a pH of 6.1 to 6.5. Above 7.0 and below 4.0, the grass made very little growth and eventually died. pH 6.5 to 7 is also the optimum range of growth for desirable cool season grasses eliminating any hopes of control of _Poa annua_ through pH adjustment.

**Fertilization.** Fertilization of _Poa annua_ infested turf has been highly controversial. To favor desirable grasses over _Poa annua_, Musser suggests that spring fertilizer applications be withheld until the bentgrass or Kentucky bluegrass has initiated growth. Late summer or fall fertilizer application, on the other hand, should be made before _Poa annua_ begins to make its vigorous cool weather growth. Essentially this is an attempt to apply fertilizers when they will provide optimum growth of the desirable grasses. Contrary to Musser's suggestion for fertilization, there are others who advocate heavy nitrogen fertilization in early spring as a means of keeping the _Poa annua_ in a vegetative stage and reducing seed production.

Sprague and Burton found that ground limestone applications reduced seed head formation 23 percent due to the greater vegetative growth induced by the beneficial effect of the limestone on the nitrogen supply in the soil. In general, they found liberal nitrogen feeding to restrict seed head production whereas the addition of phosphates and potash stimulates seed head formation. Over-use of nitrogen to restrict seed production may result in a reduction of the density of the sod even though clipping weights may be increased. Thus, a compromise level of nitrogen application must be adopted in the management program to restrict seed formation as much as possible without reducing the density of the turf too greatly.

_Poa annua_ requires liberal supplies of phosphate for optimum growth. Sprague and Burton found that it responded more to superphosphate applications on unlimed soils than on limed soils suggesting that a portion of the response may be attributed to the calcium contained in the superphosphate. Their work also indicated that soluble aluminum may be highly toxic to _Poa annua_. A summary of Pennsylvania soil test results of greens 10 years old or older and heavily infested with _Poa annua_ showed that 70 percent of these greens contained excessive amounts of phosphate. In addition to favoring the development of _Poa annua_, high soil phosphate levels also reduce the effectiveness of arsenicals used for _Poa annua_ control.

**Disease.** _Poa annua_ is susceptible to many of the same diseases that attack bentgrass and Kentucky bluegrass. Sprague and Evaul consider Anthracnose, Helminthosporium leafspot, and Fusarium snow mold as the most damaging diseases of _Poa annua_. Couch reports _Poa annua_ to be susceptible to _Helminthosporium_ leafspot, Septoria leafspot, _Fusarium_ snow mold, _Fusarium_ root and crown rot, dollar spot, Brown patch, Red thread, _Ophiobolus_ Patch, rust, and striped smut.

McCullough indicates that some fungicides are less effective on _Poa annua_ as compared to the same disease on bentgrass. He has found _Poa annua_ to require much higher rates of mercury fungicides for snow mold control than do the bentgrasses.

I do not want to go into control methods as I am sure this will be adequately covered by the panel that follows. I would like to close with an item of
historical interest. As early as 1825, Sinclair in England was advocating Poa annua control. He recommended covering the Poa annua plants with a layer of lawn clippings in sufficient thickness to create fermentation. When this covering was removed in a week or ten days, the Poa annua was dead. He fails to mention the effect on any desirable grasses in the treated area.

BIBLIOGRAPHY


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IRRIGATION PRACTICES ON POA ANNUA

Joseph R. Flaherty
Assistant Superintendent
Baltusrol Golf Club

In the northeastern quadrant of the United States and in southern Canada we have, for lack of an effective means of eradication, at least tacitly accepted Poa annua as the most important turf grass with which the superintendent has to deal in his daily maintenance program on irrigated areas. Our consideration of Poa annua as an undesirable specimen for turf areas is, in practice, of secondary importance to the fact that in the majority of cases it constitutes so large a percentage of our grass populations that a general loss of this grass will result in a sharp deterioration of playing conditions throughout the course as a whole.

During the critical summer months the cultural practice which has the most direct and immediate effect on Poa survival is irrigation, with the more basic factors of soil aeration and drainage also being closely involved. Due to the shallow rooting habit of Poa annua it is readily susceptible to wilt even under moderately high temperatures, so that although the soil medium beneath may have an adequate supply of available water for the deeper rooted grasses, the inadequate Poa annua root system is unable to supply enough of this water to the plant to balance a fairly rapid loss through transpiration. The stop-gap measure we almost universally use at this time is syringing or light watering. The objective here is not to replenish deficient soil water but rather to cool the leaf surface and thus reduce the transpiration rate.

Until very recently this requirement for light, frequent watering generally restricted adequate maintenance of Poa annua to greens and perhaps tees. On the fairways, in all but the ideal conditions of an abundant water supply and available labor, we have found it necessary to allow the bents to survive
as best they could, and tolerate a partial or complete loss of Poa annua. Now, with the advent of automatic irrigation we can, in a practical manner, apply to the fairways the same light watering we do to greens and thus from the viewpoint of water management we have taken a long step towards the elimination of Poa annua loss in summer.

Other problems remain, however, and although water is the most obvious factor involved others are certainly influential. Drainage and aeration are both integrated in the broad spectrum of water relationships. Poor drainage undoubtedly encourages the proliferation of Poa annua throughout a turf area; the Poa itself can tolerate poor drainage, while other bluegrasses and the bent grasses will soon suffer from oxygen deficiency under conditions where soil air is largely replaced by excessive water. Poa annua itself probably does not benefit from good aeration in a direct physiological way; in fact it is probably impeded, as good aeration benefits the deeper rooting grasses, increasing their ability to withdraw oxygen and nutrients from the soil solution and producing a turf of greater vitality which, other conditions being equal, increases competition with the Poa and helps check its encroachment.

So we find ourselves in the incongruous position of trying to eliminate Poa annua while being forced in practice, by the demands of the game, to do whatever is necessary to insure its survival. I don't feel that the long term future prospects in turf management indicate any general elimination of Poa annua from golf courses, but rather that the superintendent will live with and improve his management of this grass. In the future, perhaps the greatest challenge to our breeding programs will be the production of a hardy, vigorous, well rooted strain of Poa annua which will be able to withstand the wear of heavy play as well as the bentgrasses do today. Though this may sound far fetched at the present, I think that, given the progress in the science of genetics, it will be feasible within a generation. Research is now altering the characteristics of plants and animals in the laboratory through chromosome manipulation; this will one day have a practical application. When that time comes, the production of an acceptable strain of Poa annua by genetic alteration may well produce the most luxuriant and prolific species of turfgrass we have yet seen.

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FROM POA ANNUA TO BLUEGRASS

Charles H. Tadge
Superintendent
Mayfield Country Club

Most golf course superintendents are convinced that the elimination of Poa annua is essential for continuous high quality turf maintenance. The questions which arise in addition to how to eliminate the Poa are: how to replace it with desirable turf; how to do this with little interference to the golfer; how is this to be done without spending a fortune; and how to sell the members on the whole idea.

The first step in any major fairway renovation program is selling the program to the Board of Trustees or the membership itself. Some superintendents may
have no trouble selling such a program, but I feel most have the same problems
I had. The golfers thought the turf was fine until about July or August when
the Poa began to fade. This is the time to sell a fairway renovation program,
but you must be quick. If the discussions drag into September or October, the
fairways are recovering with a new crop of Poa, and the club member can see no
need to tear up the turf and spend all that money.

How can you sell such a program in the short period usually allotted by
Mother Nature? If a course nearby has successfully completed such a program,
you could take the committee or board members on an inspection tour. We did
not have this opportunity, but probably had something better.

We put test plots of pre-emergence materials in one of our worst fairways
in 1960. When the fairway Poa annua turf became very poor in the summer of
1964, we had some very good examples of what could be expected from a Poa annua
control program. The plots containing arsenicals had shown good results for
several years. Most important, these examples were on our own fairways for
the entire membership to observe.

As an added selling aid, we brought in two outside experts who met with
members of the Board to confirm our ideas with their own experiences and
observations. The men called upon were Dr. W. H. Daniel of Purdue University
and James L. Holmes, U.S.G.A. Green Section Agronomist.

The next big hurdle was to decide what kind of turfgrass should replace
the Poa annua. We decided that bluegrass would best fit our ecological conditions,
maintenance budget and the desires of our golf playing members. We knew from
the test plots that bluegrass would make a tight turf which golfers found desir-
able when mowed at one inch. For several years bentgrass had been seeded into
the fairways including the test plots, but the turf was still predominantly
bluegrass in these plots and Poa annua otherwise.

So, on August 31, 1964, we overseeded the fairways with 68 lbs. bluegrass
blend per acre. After vertical slitting, seed and fertilizer were incorporated
with a chain link fence drag. At the start the fairway turf was about 70% Poa
annua, crabgrass and knotweed. The other 30% being bluegrass and bentgrass.
Almost no broadleaf weeds were present.

As soon as seedlings were up to mowing height, calcium arsenate applications
were started. Three applications totaling 3.9 lbs. per thousand square feet
were made between October 2 and October 26, 1964. Light watering followed
these applications.

The following spring a total of 5.3 lbs. per thousand were applied in four
applications from April 20 through May 30th. The first three applications were
not watered in. Where showers did not follow immediately the burning effect
on the Poa annua was beneficial. Permanent grasses showed discoloration for
about two weeks.

On August 23, 1965, we overseeded again with 68 lbs. bluegrass blend per
acre using same procedure as in 1964. From October 25, through November 29,
1965, three applications totaling 4.8 lbs. calcium arsenate per thousand were
made.

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It was originally felt that 10 to 12 lbs. calcium arsenate per thousand would bring us to a toxic level. Estimating a loss of one third per year, it was assumed that we had reached about 12 lbs. active material in the soil in November, 1965. Evidence of good toxicity to Poa annua had shown up in the spring of 1965. It was now estimated that 2 to 2.5 lbs. calcium arsenate per thousand applied spring and fall would maintain this toxicity.

From April 20, through May 1, 1966, 2.4 lbs. calcium arsenate per thousand were applied. On May 20, 1966, we sprayed 0.5 lbs. Banvel-D per acre to kill the small amount of knotweed showing. In August, 1966, the fairways were again overseeded with 63 lbs. bluegrass blend per acre. From October 24, through November 22, 1966, 2.5 lbs. of calcium arsenate per thousand square feet were applied. In September, 1966, we estimated Poa annua to be only 10% of our fairway turf. Crabgrass control was good for both seasons. Goosegrass control was fair the first year and good the second year.

Timing for the spring applications of calcium arsenate we feel should be between April 1, and May 10, for control of Poa annua as well as crabgrass. Timing for the fall applications should be as soon after seeding as possible, but delayed long enough that seedlings will not be injured. We felt that the month of October best fitted our conditions.

Material used was 85% tri-calcium arsenate in powder form. This was sprayed with a 10 gpm. pump through a boom mounted on the front of a tractor. Solution rate varied from 1 lb. to 1.4 lbs. per gallon of water. Although not serious, some trouble was encountered with screen and nozzle clogging. We felt that the several light spray applications gave us better uniformity of distribution. Also, the arsenic effect on the leaf surface was extended over a longer period.

In future years if no seeding were planned, the calcium arsenate might best be applied in late August or early September to get the jump on Poa annua germination. Watering should follow applications at this time to keep discoloration at a minimum.

Our late August seeding instead of the customary early September seeding might have been a key factor in the success of our program. Seed mixture used was 35% Merion, 20% Delta, 20% Newport, 15% Windsor and 10% Common Kentucky bluegrass. Mowing height was held at one inch during the entire program.

Fertility with an arsenic program is very important. Phosphorus must be kept low for the arsenic to show results. In the three years prior to starting the arsenic program the average N applied was 4.3 lbs. per thousand and the average phosphate applied was 1.2 lbs. per thousand. During the program the average N applied was over 6 lbs. and phosphate was 1.2 lbs. per thousand per per season. Potash applied was about one half the nitrogen. Soil tests showed slight acidity with available phosphate in the medium to high range.

Water management is another very important factor in Poa annua control. After our new seedlings were established in the fall, we did not water until the desirable bluegrass showed stress. Naturally by this time the Poa annua was dying rapidly, but this was what we wanted.

This brings up another point in the selling program to the members. Unless
the club can afford to resod the fairways, there will be some inconvenience to the golfers. They will have to understand that for one or two seasons the turf is going to be thin as the Poa annua fades out and before the desired turf fills in. The water system will not be used just to see it operate or to keep the ground soft to walk on. Many of the high handicap golfers will really enjoy the extra distance they get from drives during the summer months.

The areas which have given us the most difficulty were poorly drained. These areas, if known, should be drained prior to the start of an arsenic program. Drainage was installed in several of our worst areas during the Fall of 1966. I think there are two factors working against the turf here. The arsenic may act much faster in wet conditions injuring the desirable grasses as well as the Poa annua, and then be dissipated so that the Poa annua can return. Also, during a drought period these areas may not come under much stress between irrigations, thereby allowing the Poa annua to hang on.

During our program we also made several fungicide applications using different materials and leaving some fairways untreated for checks. No significant improvements were observed in comparison of materials to the check areas. Disease incidence to date has not been severe enough to cause concern.

In conclusion, I would say that this program worked under conditions existing at the Miami Valley Golf Club in Dayton, Ohio, but if one or two factors were to be changed it might not work at all. I would advise spot testing before jumping into anything full scale. This is exactly what I will be doing in my present position with the Mayfield Country Club.

RENOVATION - TIMING AND NUTRIENTS

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Eastern Region, USGA Green Section

What is meant by fairway renovation? When we speak of fairway renovation we think in terms of renewing and improving the turf surface: the changeover from unadapted grasses to grasses adapted for fairway play. Though we think in terms of changing the turf cover, the fact is we must correct whatever deficiencies there are such as seepage and drainage problems which may exist, nutrient levels which are important for turfgrass growth must be corrected.

If the fairways in question reverted to weeds for one reason or another, the answers to why this happened must be resolved. The recent installation of a fairway watering system or one that is in the making should be weighed to determine the advisability of a proposed renovation program. Nine times out of ten, a new watering system will mean a renovation program, if any hope of establishing adapted grasses can be entertained. Bluegrass and creeping red fescues which were used extensively in fairway seed mixtures in early days, have for the most part disappeared from fairways because of watering practices and close mowing. Mismanaged irrigation, and close mowing practices demanded by the adventurous golfer of the 60's has stimulated fairway renovation programs.
Today's fairway irrigation and close mowing practices of 1/2 to 5/8's inches, means bentgrass fairways. Not Poa annua - bentgrass, but bentgrass and bentgrass alone. We have made progress in renovation techniques, we have more "know-how", improved grasses, better chemicals, improved equipment and more efficiency in getting a renovation job done. We can and have established excellent bentgrass fairways, our approach to the outcome of the renovation program has to be one of a positive approach.

The subject of renovation of one sort or another is almost a continuous and endless cycle. You can't hold this against your membership for wanting to improve; whether such improvements are feasible is a question that the golf course superintendent must answer. The area to be renovated, the degree of renovation, and a cost estimate should be drawn up. Material costs for an average fairway renovation is usually quite nominal when pro-rated over a period of years.

Inform your membership what will be taking place during the renovation program. A well-informed membership is a working membership, one that will stand behind the management program that will be necessary to keep the improved turfgrasses.

It's true that during the renovation program we will have player inconvenience. Today's heavy play will interfere with the work schedule, renovation will have to be done along with the daily maintenance practices. Seldom are you able to put on additional work force to complete the renovation program. The weather factor may be with you or against you, and results may be slow to show. We have many variables working against us but just as many working for us.

There are few techniques used in fairway renovation ...each have met with success and the choice depends upon personal preferences. One program would be to thatch and aerate. A second would be only to thatch. A third would be that of aeration only and a fourth would be a scorched earth program. The Thatching and aeration programs will take at least three to four consecutive years before a strong permanent turfgrass program is realized, while the scorched earth program will give the quickest results within one season.

The timing of these cultural programs is critical and cannot be left to chance. Regardless of which type of program employed, they must be completed before the first of September within any given year. It should take no longer than two to three weeks to complete the renovation program of your choice. The important part of the renovation program is to remove as much excess thatch as possible and to expose all available soil to have a good seedbed for germination purposes.

We have learned a great deal in the past few years about material applications. It is not necessary to seed at heavy rates, fertilizer is important but not necessarily so during the initial renovation program. The pH of the soil is of extreme importance. Limestone applications should not be applied at the time of renovation.

When we are trying to convert to a bentgrass population we have to realize
that bentgrass will favor a more acid soil than what Poa annua will. Poa annua is sensitive to strong soil acidity. I'm not trying to say that we should get on an acid Era kick as this died with the grass in 1926. What I am saying is that we have more "know-how" today, more technology to know how to cope with situations that occur and can grow a great deal of bentgrass within a pH range of 5.0-6.0. As I have stated Poa annua is sensitive to acidity at this particular range.

The toughest part of the renovation program is setting up the required program of maintenance and management that will insure the new turfgrasses will do what is expected of them.

Watch closely your fertilizer programs and the components that are in your fertilizers. Nitrate of soda, potassium nitrate, cyanamid, calcium nitrate, and superphosphate will decrease acidity, while ammonium sulfate, urea, urea-form and ammonium phosphate will increase acidity. Murate of potash and sulfate of potash will have little effect on changing the pH of the soil. Acid forming fertilizers such as ammonium sulfate and ammonium phosphate under experimental conditions did not let Poa annua come in even though soil conditions were not favorable for bentgrass.

Light frequent applications of fertilizer with a low total amount of actual nitrogen is required to maintain a healthy permanent turfgrass population. A total of two pounds of actual nitrogen applied per 1000 square feet over a normal growing season may be more advantageous than doubling or tripling that figure over a given season. Feed your turf according to its requirements, not what you think your membership wants in respect to color. A bentgrass fairway will not green up as early in the year as Poa annua. By forcing it, you will accomplish only headaches.

It is true that strong soil acidity will check the decay of clippings and they will accumulate at the surface sometimes several inches thick. This accumulation which will take several years in the making is not of extreme importance. Today's mechanical measures of reducing the thatch zone or keeping it within tolerance, at least 1/2 to 3/4 inch accumulation is desirable from the management and playing standpoint.

Phosphorus seems to be the most critical element. Phosphorus, as one knows, aids in the quick establishment of a fast growing root zone of any bluegrass which Poa annua happens to be one of. Bluegrasses thrive on high phosphorus. Phosphorus is more mobile in the soil between a pH of 6.2 and 6.5, while it is fixed in difficult soluble forms when the soil is strongly acid. The need of phosphorus over the past years has been overemphasized.

The greatest mistake every superintendent makes when he tries a renovation program is that he does not change his old cultural practices but rather tries to make the new adapted grasses work under his old unadapted program.

Renovating fairways or any turfed area is big business, it takes a qualified superintendent who is not afraid of hard work.
POA ANNUA PANEL
Questions & Answers

Alexander M. Radko, Director
USGA, Green Section

(1) QUESTION - Pre-emerge herbicides are recommended for weed control generally. What is a pre-emerge herbicide? What is a post-emerge herbicide? How do they differ?

ANSWER - Pre-emergence herbicides act upon the seed or the very young plant before it can become established. Post-emergence herbicides act upon the growing plant. So little is known about mechanisms, it is actually impossible exactly to say what the differences are in mode of action with most herbicides. Some post-emergence herbicides are contact poisons while others depend on plant uptake, translocation and internal physiology.

(2) QUESTION - Are any pre-emerge herbicides recommended for Poa annua control? If so, which ones have been found to be safe and successful?

ANSWER - Pre-emergence herbicides such as Betasan, Pre-San, Dacthal, calcium arsenate, and lead arsenate have been used with varying degrees of safety and success. Any of these could cause damage, depending upon conditions.

(3) QUESTION - Are there any post-emerge herbicides recommended for Poa annua?

ANSWER - Sodium arsenite and Endothal are post-emergence materials recommended for Poa annua control. These materials are recommended on fairways, but should be applied carefully under controlled conditions.

(4) QUESTION - Is 2,4-D or 2,4,5-T recommended for Poa annua control?

ANSWER - Neither of these used singly or in combination is recommended for Poa annua control.

(5) QUESTION - Why do so many turf people favor Poa?

ANSWER - Turf people do not truly favor Poa, although it does generally form an acceptable turf. Actually turf growers "live" with Poa annua because it is so prevalent, and there is no fool-proof way of preventing it. Golfers favor Poa, they feel it is a great turf for about six months of the playing season.

(6) QUESTION - Can Poa annua be grown without irrigation?

ANSWER - Perhaps under just the right set of environmental conditions it could be grown and maintained without water, but generally speaking, the answer would be no.
(7) QUESTION - Does early irrigation favor Poa annua?

ANSWER - Early spring irrigation or heavy spring rains can easily encourage Poa annua to develop. Irrigation is sometimes necessary during the early spring period to prevent desiccation of turfgrasses, but early overwatering could lead to problems with Poa.

(8) QUESTION - Does early fertilization favor Poa annua? Effect of acid fertilizer?

ANSWER - Early applications of inorganic fertilizer encourages a rapid growth of Poa annua. Quick acting fertilizers such as ammonium sulfate, Urea, ammonium nitrate will be quickly absorbed by and will cause rapid growth of Poa annua, especially when heavy rates are applied. Acid fertilizers will tend to make a more acid reaction to the soil. Poa annua is sensitive to strong soil acidity.

(9) QUESTION - Does early and heavy fertilization keep Poa seedheads reduced?

ANSWER - Heavy frequent fertilizer applications applied to Poa annua in the spring will reduce the seedhead formation and will keep the plant vegetative (leafy). Heavy feeding produces more tops than roots, thus a less favorable root-top ratio. As hot humid weather approaches, this soft, succulent growth could prove dangerous. The end result is adding fuel to the fire -- flirting with an already dangerous condition because once heavily fertilized, there is no recall.

(10) QUESTION - What role does pH play in Poa annua incidence?

ANSWER - The pH (potential of Hydrogen) is an arbitrary scale which runs from 0 to 14, with 7 as the neutral zone between acidity and alkalinity. Acidity increases as the figures decrease below 7 while alkalinity increases as the figures increase above 7. Poa annua prefers very slight acidity (6.2) to slight alkalinity (7.5). With many golf course soils falling between 6.0 and 7.0 in the Northeast, we readily see that the Poa annua is favored.

(11) QUESTION - What role does phosphorus play in Poa annua incidence?

ANSWER - Phosphorus is one the principal elements needed for healthy turf plant growth; it is a necessary part of all living plant tissue. Phosphorus is important in the development of good roots in newly seeded soils; it is quickly fixed in the soil. Phosphorus therefore plays an especially vital role in the establishment of a quick, fast-growing, shallow-rooted turf such as Poa annua. Poa annua, like all bluegrasses, thrives on adequate amounts of phosphorus. The more phosphorus in the soil, the greater the percentage of Poa annua establishment.
(12) QUESTION - How did Poa annua become introduced in golf turf? Which seed is freer of Poa contamination -- Domestic or Foreign grown?

ANSWER - Poa annua is a native of Great Britain (known there also as annual meadowgrass) and was introduced into this country early in this century. It was not solely introduced on golf courses by imported contaminated seed for at one time some greens were deliberately overseeded to Poa annua. Presently, domestic seed is freer of Poa annua than foreign grown seed. New York State considers Poa annua as a noxious weed in any seed mixture. The State of Maryland will not let any seed be sold in that state that has more than 16 Poa annua seeds per ounce. As many as 44,000 Poa annua seeds per pound have been found.

(13) QUESTION - Can Poa be cut close and persist? high and persist?

ANSWER - Poa annua can persist at both the high and low cut. However, at low cut many other grasses are weakened, and the Poa is more noticeable.

(14) QUESTION - Does aeration encourage Poa annua germination? Does thatching encourage Poa annua germination? Does spiking encourage Poa annua germination?

ANSWER - It appears that any disturbance of the soil encourages Poa annua germination to some extent, but we cannot avoid these practices completely. Timing is very important when undertaking cultivation.

(15) QUESTION - Does Poa annua stand up under traffic or does heavy traffic result in Poa annua invasion?

ANSWER - Heavy traffic promotes Poa annua invasion. Poa annua will stand traffic best in cooler weather, it is not too tolerant to heavy traffic in July and August. Compaction of soil favors Poa annua invasion as it is a shallow-rooted plant. Here too, with compaction and shallow roots winter injury is more severe on Poa annua than what it is on bent or native bluegrasses due to the root zone.

(16) QUESTION - What diseases affect Poa? Which is principal disease on Poa fairways?

ANSWER - Poa annua is affected to some extent by just about all the diseases which affect other bluegrasses, however its principal disease emmisis is Leaf Spot caused by one of the Helminthosporium organisms.

(17) QUESTION - (a) What is the general life cycle of Poa annua? (b) Is it a true annual? (c) Are all Poa annua plants alike? (d) How long does it take for seed to germinate when conditions are favorable? (e) How long do seeds remain viable in the soil?
(17) ANSWER - (a) The Poa annua life cycle is not truly known. Depending upon varying conditions it seeds, germinates, and dies whenever it wants to - management plays an important part in its welfare. 
(b) Poa annua is not truly an annual. Because its behavior is so unpredictable very few generalizations can be made about it. 
(c) No, some seed profusely; some do not seed at all; some are fine bladed; some thick bladed; in reality no two seem alike. 
(d) Within days. 
(e) For several years. 

(18) QUESTION - Do insects affect Poa annua? 

ANSWER - Insects attack and feed on Poa annua just like any of our other turfgrasses. There is one in particular that seems to favor Poa annua and this is a weevil (most commonly but erroneously called the clover weevil) found at present on Long Island. In mixed Poa annua-bentgrass turf, the Poa annua seems to be the weevil's principal target. 

(19) QUESTION - What other management practices are important to the management of Poa annua? 

ANSWER - (a) Remove clippings from tees, aprons, and greens. 
(b) In stress periods try to reduce injury due to traffic by moving cups and tee markers frequently. 
(c) Syringe when necessary. 
(d) High fertility and close mowing is a combination that will bring out Poa annua strong. 
(e) A heavy hand with the use of water will also favor this grass. 
(f) It grows better than most grasses in shade where heavily fertilized, watered and cut close. 

THE GREEN SECTION SPECIFICATIONS FOR A PUTTING GREEN 

James L. Holmes, Agronomist 
Mid-Western Region, USGA Green Section 

In 1960, the USGA Green Section staff published an article in the USGA JOURNAL AND TURF MANAGEMENT entitled "Specifications for a Method of Putting Green Construction." The article sparked a considerable amount of controversy about the concept even though the various principles embodied in the method are rather widely accepted, and readily demonstrable. 

After a period of five years, there are presently some 1,200 greens in existence that have been built by this method. There is no question that the method is both practical and successful.
There are, however, some questions which continue to arise. There are some who have failed to grasp the significance and the importance of each single step in the process. There are some who have experienced partial failure because they only partially followed the specifications.

It is the purpose of this talk to restate the steps involved in the construction procedure, to reemphasize the significance and the importance of each step, and to point out again the danger of following the method just partially.

The following seven steps in the construction procedure are discussed.

1. **Subgrade.** The contours of the subgrade should conform to those of the proposed finished grade, with a tolerance of plus or minus 1". The subgrade should be constructed at an elevation 1/4 inches below the proposed finished grade. The subgrade should be compacted sufficiently to prevent future settling which might create water-holding depressions in the subgrade surface and corresponding depressions in the putting surface.

   Where terrain permits, it is possible to build the subgrade into the existing grade or to cut it into the subsoil. It is not necessary to elevate or "build up" the green unless design considerations dictate the desirability of doing so.

   It will be noted that courses of materials above the subgrade consist of 4 inches of gravel, 1 1/2 to 2 inches of coarse sand, and 12 inches of topsoil. Thus the total depth will be 17 1/2 to 18 inches. However, this fill material will settle appreciably, and experience indicates that 14 inches will be the approximate depth of these combined materials after settling.

2. **Drainage.** Tile lines of at least 4-inch diameter should be so spaced that water will not have to travel more than 10 feet to reach a tile drain. Any suitable pattern or tile line arrangement may be used, but the herringbone or the gridiron arrangements will fit most situations.

   Cut ditches or trenches into the subgrade so tile slopes uniformly. Do not place tile deeper than is necessary to obtain the desired amount of slope. Tile lines should have a minimum fall of .5%. Steeper grades can be used but there will seldom be a need for tile line grades steeper than 3% to 4% on a putting green.

   Tile may be agricultural clay tile, concrete, plastic, or perforated asphalt-paper composition. Agricultural tile joints should be butted together with no more than 1/4" of space between joints. The tops of tile should be covered with asphalt paper, fiberglass composition, or with plastic spacers and covers designed for this purpose. The covering prevents gravel from falling into the tile.

   Tile should be laid on a firm bed of 1/2" to 1" of gravel to reduce possible wash of subgrade soil up into tile line by fast water flow. If the subgrade consists of undisturbed soil, so that washing is unlikely, it is permissible to lay tile directly on the bottom of the trench.

   After the tile is laid, the trenches should be backfilled with gravel, and care should be taken not to displace the covering over the joints.
3. Gravel and Sand Base. a). The entire subgrade should be covered with a course of clean washed gravel or crushed stone placed to a minimum thickness of 4 inches.

The preferred material for this purpose is washed pea gravel of about 1/4" diameter particle size. Larger gravel or stone may be used, but it is important that changes in size between this course of material and the succeeding one overlying it not be too great. Otherwise, smaller particles from overlying material will wash into the gravel, clog the pores or drainage ways and thereby reduce the effectiveness of the gravel.

The maximum allowable discrepancy appears to be 5 to 7 diameters. In other words, if 1/4" pea gravel (about 6 mm.) is used, then the particles of the overlying course of sand should not be less than 1 mm. in diameter. If stone of 1 inch diameter were used, it would be necessary to include a course of pea gravel to prevent the movement of smaller soil aggregates into the stone.

b). When the gravel is in place, assuming that pea gravel has been used, a 1 1/2" layer of coarse washed sand (commercial concrete sand is satisfactory) should be placed to a uniform thickness over the gravel.

The tolerance for error in the thickness of gravel and sand courses should be limited to plus or minus .5 inch.

4. Ringing the Green. When the courses of gravel and sand are in place and outlets have been established for subsurface water (through tile lines), the green should be "ringed" with the soil which is to be used for aprons and collars. This soil should be placed around the green and any contours established in such a way that they will blend into the putting surface.

The next step is to fill the depression, which represents the putting surface, with the prepared topsoil mixture.

5. Soil Mixture. A covering of topsoil mixture at least 12 inches in thickness should be placed over the sand and gravel layers.

The soil mixture should meet certain physical requirements.

Permeability - After compaction at a moisture content approximately field capacity as described by Ferguson, Howard and Bloodworth, a core of the soil mixture should permit the passage of not less than 1/2 inch of water per hour nor more than 1 1/2 inches per hour when subjected to a hydraulic head of .25".

Porosity - After compaction, a sample of the soil mixture should have a minimum total pore space of 33%. Of this pore space, the large (non-capillary) pores should comprise from 12 to 18% and capillary pore space from 15 to 21%.

Information with respect to bulk density, moisture retention capacity, mechanical analysis, and degree of aggregation in the hands of a soil physicist may be helpful in further evaluating the potential behavior of a putting green soil.

Few natural soils meet the requirements stated above. It will be necessary to use mixtures of sand, soil, and organic matter. Because of differences in behavior induced by such factors as sand particle size and gradation, the mineral
derivation and degree of aggregation of the clay component, the degree of
decomposition of the organic matter, and the silt content of the soil, it is
impossible to make satisfactory recommendations for soil mixtures without
appropriate laboratory analyses.

The success of the method of construction herein described is dependent
upon the proper physical characteristics of the soil and the relationship of
that soil to the drainage bed underlying the green. Therefore a physical
analysis of soil should be made before the soil components are procured. When
the proper proportions of the soil components have been determined, it becomes
extremely important that they be mixed in the proportions indicated. A small
error in percentages in the case of a plastic clay soil can lead to serious
consequences. To insure thorough mixing and the accurate measurement of the
soil components, "off site" mixing is advocated.

6. Soil Covering, Placement, Smoothing and Firming. When the soil has been
thoroughly mixed off site it should be transported to the green site and dumped
at the edge of the green. Padding the edge of the green with boards may be
necessary to prevent disturbance by wheeled vehicles of the soil previously
placed around the outside of the putting surface. A small crawler-type tractor
suitably equipped with a blade is useful for pushing the soil mixture out onto
the prepared base. If the tractor is always operated with its weight on the
soil mixture that has been hauled onto the site, the base will not be disturbed.

Grade stakes spaced at frequent intervals on the putting surface will be
helpful in indicating the depth of the soil mixture. Finishing the grade will
likely require the use of a level or transit.

When the soil has been spread uniformly over the surface of the putting
green it should be compacted or firmed uniformly. A roller usually is not
satisfactory because it "bridges" the soft spots.

"Footing" or trampling the surface will tend to eliminate the soft spots.
Raking the surface and repeating the footing operation will result in having
the seed or stolon bed uniformly firm. It should be emphasized that the raking
and footing should be repeated until uniform firmness is obtained.

Whenever possible after construction, saturation of the soil by extensive
irrigation is suggested. Water is useful in settling and firming the surface.
This practice will also reveal any water-holding depressions which might inter-
fere with surface drainage.

7. Sterilization of Soil and Establishment of Turf. These steps may be
accomplished by following well-known conventional procedures.

With the restatement of these procedures, let us reexamine the recommend-
ations step by step and point out some of the opportunities for error.

THE SUBGRADE - When a new green is built and the subgrade is contoured, it
frequently happens that there is a rather large amount of fill. It is very
difficult to compact filled areas sufficiently to preclude further settling.
However, the builder must strive to prevent further settling if at all possible.
If uniform layers of gravel, sand, and soil overlay the subgrade, it is obvious that any settling of the subgrade will result in a corresponding settling of the top. Therefore the thorough compaction of filled areas is necessary if the green is to maintain the contours built into it.

**TILE DRAINAGE** - It is commonly believed that the use of a gravel layer provides adequate drainage and that the installation of tile is a needless expense. No doubt there is good reason for this belief in many cases. However, when large amounts of water are moving through soil under conditions of heavy rain or rapid irrigation, and where the water must move a considerable distance to reach an outlet, tile lines aid in the removal of excess water. It is also true that despite the best efforts to compact the subgrade, it sometimes settles after construction and "pockets" appear. Tile lines help to remove such trapped water. A putting green is expensive to build and the relatively small additional cost of adding tile drainage appears to be a small price for the insurance it provides.

**GRAVEL AND SAND BASE** - In a few cases builders have used tile and have then assumed that there is no need for a gravel base. This assumption is the result of a failure to understand how water moves in the soil. Lateral movement of water is relatively small unless there is a barrier which impedes its downward movement. Therefore when tile is placed near the surface it must be very closely spaced if it is to remove much of the excess water. Conversely, if it is spaced at intervals of more than 4 or 5 feet it must be placed very deeply.

When the gravel layer is used beneath the putting green, it provides a medium whereby water can move laterally very easily. Thus tile can be placed just at the bottom of the gravel layer and spaced at intervals of ten to twenty feet, depending upon the degree and direction of slope.

The layer of coarse sand used over the gravel base is for the sole purpose of preventing the soil particles from migrating downward into the gravel. This principle can be most easily pictured by an overly simplified illustration. Suppose one filled a room half full of basketballs and then poured a sack of marbles on top of them. The marbles will move down through the voids to the floor. So will small soil particles move down through gravel. In contrast suppose the room half full of basketballs were covered with a layer of baseballs. They would remain in a layer. Then a layer of golf balls would stay on top of the baseballs. Then if you poured the sack of marbles on top they would stay in place. Thus, if you wish to keep fine soil on top of coarse materials, it is necessary to build up with successively finer layers of material.

**RINGING THE GREEN** - Some builders place topsoil around the edges of the green after the sand and gravel are in place. They will then proceed to place the putting green soil mixtures on top of the gravel and bring it to the finished grade.

There is one disadvantage to placing a heavier topsoil contiguous to the porous putting green soil mixture. Moisture is sometimes drawn out of the putting green edge because of the greater tension exerted by fine textured soil. This disadvantage can be overcome by using something like polyethylene plastic sheeting as a vertically placed moisture barrier between the "ring" of topsoil and the soil mixture on the putting surface.
Without the use of such a moisture barrier, the edge of the putting green may dry out faster than the remainder of the green.

THE INTERFACE - Apparently one of the most puzzling of the principles involved in the Green Section is the function of the textural barrier. Water does not move from a layer of fine soil into a lower layer of a coarser textured soil until the fine textured soil becomes saturated. The reason for this failure of water to readily cross the "textural barrier" is a matter of surface tension. When sufficient gravitational force (weight) accumulates, the tension force is overcome and water then drains out through the sand and gravel.

The "textural barrier" then can be used to increase the water holding capacity of an open textured soil. If irrigation is stopped just before the soil reaches the saturation point, no drainage occurs. On the other hand, in the case of a heavy rain, the soil will not hold too much water. It is paradoxical that the soil overlying such a "textural barrier" can be made to hold more water than it would without the gravel layer, but it cannot be made to hold enough water to be harmful to plants.

THE SOIL MIXTURE - The compounding of a soil mixture based on laboratory tests is one of the essential elements of the Green Section Specifications.

In some cases greens have been built and called "Green Section Specification" greens where the builder has borrowed a formula based on his neighbor's tests. This is a dangerous practice because soils, sands, and organic matter are likely to vary widely within a community. In some experimental plots where the same sand and the same organic matter were used but where two different high clay content soils were used, a suitable mixture required 40 percent of one soil and less than 10 percent of the other.

The Green Section can provide laboratory tests at a nominal cost. Such a test is of utmost importance.

Some critics of the use of laboratory methods have argued that one cannot substitute laboratory measurements for good judgment. How true! But how much better is a judgment based upon measurable physical facts rather than on instinct, "feel", or visual estimation?

SOIL COVERING, PLACEMENT, SMOOTHING, AND FIRMING - In our experience we have found no difficulty in following this step in the method we have advocated. It may be well to reiterate that soil should be mixed "off site". It is virtually impossible to do a satisfactory job of mixing soil materials in place on the green site.

ESTABLISHMENT OF TURF - Because of the fact that soil mixtures prescribed are quite porous, there have been a number of cases where greens have been rather slow to become established. Frequent, light fertilization of newly seeded or vegetatively planted greens appears to be one method of speeding establishment.

In several cases these greens have been sodded. This is a satisfactory procedure provided the sod is grown on the same soil mixture as is used in the green. Growing sod on a heavier soil and then moving it to a porous putting green soil is an almost certain invitation to failure.
USE THE "WHOLE PACKAGE" - The steps outlined for constructing putting greens will provide excellent results if they are followed exactly and completely. This fact has been amply demonstrated.

Equally demonstrable is the fact that going just part of the way with these procedures is an invitation to failure. A great many years of research have gone into the study of each phase of this method of construction. If one uses a heavy soil, he must either use a much deeper seedbed or he must leave out the gravel layer. If one mixes a soil that is too sandy and too deep, it will be droughty.

These are negative ways of saying that if you undertake to construct a putting green by this method, follow the instructions completely.

HOW EXPENSIVE? - Some clubs have been deterred from building putting greens by this method because they have thought that the construction costs will be excessive. It is obviously impossible to predict the cost in any given area because of variations in the cost of soil materials, gravel, and labor. Some ideas of quantities of materials may help in cost estimations. The following quantities of materials are required per 1,000 square feet of putting surface:

- Gravel 4 inch depth - 12.3 cubic yards
- Sand 1 1/2 inch depth - 4.6 cubic yards
- Soil Mixt. 12 inch depth - 37.0 cubic yards
- Tile approximately 100 lineal feet

Finally, we suggest you refer to an article published in the USGA Journal in September 1960. The same procedures are still recommended, and the same criteria for determining soil mixtures are still being used. This publication contains a list of references which will provide informative background reading. In the same issue, there is an article describing laboratory methods used in soil mixture evaluation. Five years of field experience in widely separated geographical areas provide abundant evidence of the merits of this method.

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SOIL MODIFICATION AND RESULTS OF FURTHER TESTING

Donald V. Waddington
Pennsylvania State University

Establishing and maintaining good soil physical conditions is essential for the production of good quality turfgrass. Soil types which are heavy and lack good aggregation often possess poor physical conditions which limit grass growth and/or the use of a turfgrass area. Water movement into and through the soil is very slow, and the soil may remain too wet for satisfactory use for long periods following rain or irrigation. Fertilizer movement into the soil is impeded, and beneficial microbial processes are inhibited by anaerobic conditions. Poor physical conditions may also exist on lighter textured soils, especially when they are severely compacted by heavy traffic.

1 Other project personnel include Dr. J.M. Duich, Dr. L.T. Kardos, Dr. G.J. Shoop, B.R. Fleming, and T.L. Zimmerman.

A-25
Several approaches can be taken to lessen the detrimental effects of compaction. Various types of aerating equipment, coarse textured topdressing mixtures, and wetting agents are used to combat and overcome the effects of poor soil physical condition. On new areas a soil can be modified with various amendments to produce a soil mixture which will have an acceptable physical condition even when compacted.

A soil modification research project is currently being conducted at the Joseph Valentine Turfgrass Research Center at Pennsylvania State University. In this study various amendments are being evaluated for their effectiveness in modifying soil physical properties. Response to compaction is being determined using several criteria to evaluate the physical condition of both uncompacted and compacted mixtures.

The materials used in this study and their particle size distributions are shown in table 1. The coarse sand is a sharp quartz sand, and the mortar and concrete sands are washed river sand. USS B. F. Slag is water quenched blast furnace slag, and the Wunderley Slag is a blast furnace slag which has been treated with pickling liquor. Per-lome is a porous material obtained by heating a siliceous volcanic rock called perlite. The perlite expands when heated and light-weight, porous, and relatively fragile particles are formed. Turface is a calcined clay material. The Hagerstown soil found at the experimental site was used as the soil source. The peat used in the mixtures was a reed-sedge peat.

Extensive laboratory tests were run on the individual materials and on compacted and uncompacted mixtures. Laboratory tests included determinations of moisture retention, percolation rate, bulk density, particle density, total porosity, and aeration porosity. The data obtained from 132 laboratory mixtures were used to select 81 mixtures for field evaluation.

Preparation for the field study was started in the summer of 1960. The topsoil was stripped from the site and a 0.5% slope was established on the subsoil. A six-inch layer of one-half inch limestone chips was placed on the area, and in July 1961 the 81 mixtures were mixed off site and then placed on the stone layer. The mixtures were allowed to settle until the spring of 1962. The settled depth was ten inches. The plots were seeded with Penncross creeping bentgrass in June-July 1962. In 1963 a compaction treatment was applied to half of each plot. A compacting machine which utilizes a water filled roller is used to compact the plots. Golf shoe soles are attached to the roller and a footprint effect is obtained.

Samples from each of the 81 mixtures were taken into the lab for laboratory testing. The results of laboratory tests are being correlated with the field results. Percolation rates, which designate the rate of downward movement of water through a saturated soil, were determined on compacted and uncompacted samples. These results are being compared with infiltration rate data obtained in the field using a double ring infiltrometer. Infiltration is the movement of water into the soil.

Results of percolation and infiltration determinations on some of the mixtures are shown in table 2. The most obvious observation to be made is the effect of compaction on water movement. The values are the extremes for what might be expected with a particular mix if used on an actual playing area such
as a putting green. Cupping areas would have a high amount of compaction, while some areas would have very little traffic due to the size or design of the green. The increase in infiltration and percolation with increasing sand or coarse material content is also shown in Table 2. Approximately 40 to 50 percent coarse amendment had to be added before a definite beneficial effect could be noticed. Enough of these materials must be added to get bridging of the particles which gives larger and more stable pores. Sands vary in their effect on modification. Contrasting results can be seen by comparing coarse sand results with mortar sand data.

A trend toward decreased infiltration from 1963 to 1966 is apparent on both the compacted and noncompacted plots. Some seem to have come to a relatively uniform rate while others show decreases each year. Some mixtures which were considered satisfactory early in the experiment now have very low infiltration rates. The frequency of compaction was less in 1965 than in other years, and the less severe compaction no doubt is the cause of slightly higher infiltration rates on certain compacted mixtures that year.

As the permeability of a mixture is increased by addition of coarse amendments, the available moisture held by the mixture decreases. The available moisture data in Table 2 show this relationship. The values shown indicate the available moisture at a moisture tension of 25 cm H₂O, and are expressed as inches of water per 12-inch depth of mixture. Additions of Peri-lome, which had only a slight effect on infiltration, brought about an increase in available moisture. Available moisture was decreased by additions of the sands, slags, and Turface. A differential effect of the sands is apparent as it was with the infiltration results.

Aeration porosity values have correlated closely with infiltration and percolation rates. High aeration porosity values are associated with those mixes having high permeability. Those mixtures with high aeration porosity and permeability have presented a maintenance problem due to their rapid drying. Due to their low moisture holding capacity, they demand more frequent watering to keep the plant supplied with adequate moisture.

All acid soil mixtures were limed according to a lime requirement test when the plots were established in 1962. The pH values for the mixtures are shown in Table 2. The pH values on the slag plots are very high due to the alkaline nature of the slag. The Wunderley slag, being treated with the acid pickling liquor, did yield as high values in the mixtures as the USS slag. The values were still high, being in the range of 7.5 to 7.6.

Other determinations being made on the soil modification plots include root weight and distribution, oxygen diffusion, nutrient accumulation in the grass, nutrient content and cation exchange capacity of the soil, and moisture utilization. Thus this paper has included only certain phases of the entire study.

The most often asked question concerning our work is: "Which is the best mixture?" We are not looking for a single "best" mixture. Our objective is to characterize the various materials and mixtures so that they can be utilized and maintained in the best possible way. A good mixture should
satisfy the needs for moisture retention as well as for permeability. The ratios of sand, soil, peat, and other amendments in a mixture should depend on the kind of sand, soil type, and the characteristics of any other amendments used. To depend upon some magical ratio indicates a lack of appreciation for the soil physical property relationships mentioned earlier in this paper. More than one ratio or combination of materials certainly should satisfy your objective of obtaining a mixture which gives you a playable turfgrass area with a minimum of maintenance problems. Your choice of a mixture may be dependent on the cost and availability of materials, your management program, and your personal preferences and judgment.

Table 1. The particle size distribution (percent by weight) of the individual materials.

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<tr>
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<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Coarse Sand</td>
<td>0.0</td>
<td>14.7</td>
<td>80.7</td>
<td>4.4</td>
<td>0.2</td>
<td>0.0</td>
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<td>Mortar Sand</td>
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<td>4.3</td>
<td>22.5</td>
<td>50.4</td>
<td>19.6</td>
<td>2.8</td>
<td>0.3</td>
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<tr>
<td>Concrete Sand</td>
<td>14.3</td>
<td>6.3</td>
<td>18.4</td>
<td>43.2</td>
<td>14.8</td>
<td>2.1</td>
<td>0.6</td>
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<tr>
<td>USS B.F. Slag</td>
<td>5.4</td>
<td>26.1</td>
<td>39.1</td>
<td>19.0</td>
<td>6.3</td>
<td>3.4</td>
<td>0.8</td>
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<tr>
<td>Wunderley Slag</td>
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<td>38.2</td>
<td>36.6</td>
<td>10.0</td>
<td>3.2</td>
<td>2.4</td>
<td>3.6</td>
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<tr>
<td>Perl-lome</td>
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<td>37.1</td>
<td>13.2</td>
<td>7.1</td>
<td>8.7</td>
<td>7.5</td>
<td>3.3</td>
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<tr>
<td>Turface</td>
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<td>35.4</td>
<td>37.2</td>
<td>20.2</td>
<td>1.7</td>
<td>0.2</td>
<td>0.0</td>
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<tr>
<td>Hagerstown Silt Loam</td>
<td>0.0</td>
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<td>2.0</td>
<td>1.5</td>
<td>3.6</td>
<td>14.3</td>
<td>58.8</td>
</tr>
</tbody>
</table>
Table 2. Percolation rates, infiltration rates, available moisture, and pH values for various mixtures used in the soil modification research project.

<table>
<thead>
<tr>
<th>Mixture by Volume</th>
<th>Laboratory Percolation Rate, in./hr.</th>
<th>Infiltration Rate, in./hr. 1963</th>
<th>1964</th>
<th>1965</th>
<th>1966</th>
<th>Available Moisture, in./ft.</th>
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* U = uncompacted
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* U = uncompacted  C = compacted
WATER IN THE RIGHT AMOUNT IN THE RIGHT PLACE AT THE RIGHT TIME FOR TURF

Eliot C. Roberts
Iowa State University

One of the most important turfgrass management practices for 1967 is WATERING. Year in and year out proper use of water makes the difference between high quality and average to low quality turf. Whenever irrigation is considered, calculations should be made that will permit you to place the right amount of water in the right place at the right time. Failure to meet any one of these 3 criteria will work to the detriment of the turf.

Too little water applied at one time may temporarily prevent dry wilt; however, continued practices of this kind encourage root development near the soil surface and in addition create conditions favorable for the spread of disease. Too much water clogs air spaces in the soil and causes the turf to be weakened. Wet soils compact more readily and also are more likely to promote disease problems.

In order to apply the right amount of water it is necessary to know the right place for it. Root zones of turf are relatively shallow particularly in the summertime when irrigation practices are most important. If roots on a green extend only 1 1/4 inches into the soil, watering to a depth of more than 1 1/2 inch has little value to the turf. Deeper rooted grasses may be watered less frequently because irrigation practices can be adjusted to deep watering within the soil profile.

As with most turf management practices, timing is very important. Grasses wilt quickly when either water or oxygen (in soil air) are not available. As little as 15 minutes under these unfavorable conditions and damage is done. Where large areas of turf require irrigation, proper timing makes it essential that well designed, engineered and installed systems be used. There simply aren't enough hours in the day to water adequately with many of the old systems in use today.

Turfgrass research at Iowa State University has emphasized some of the more important relationships between water and turf production. These include:

1. Effects of moisture and moisture vapor on turfgrass growth.
2. Influence of soil properties on water relations and turf.
3. Importance of water quality and influence of source on quality.
4. Flooding damage to turf.
5. Problems associated with localized poor drainage.
6. Drought injury from localized water shortages.
7. Wilting injury to turfgrasses.
8. Effect of tree roots on turfgrass water relations.
10. Effect of surfactants on water relations.
11. Annual bluegrass and moisture relations.
12. Foa trivialis and moisture relations.
13. Clover and moisture relations.
14. Crabgrass and moisture relations.
15. Effect of moisture on Helminthosporium leaf spot.
16. Effect of moisture on Rust Disease in Bluegrasses.
17. Moisture and control of fairy ring and localized dry spot.
18. Effect of moisture on frost heaving.
19. Moisture relationships and winter kill.
20. Effect of moisture on fertilizer burn.
21. Water application systems.

These 21 topics will be discussed briefly so as to provide a background for your consideration of irrigation needs during 1967.

MOISTURE AND MOISTURE VAPOR

Turfgrass growth is influenced by moisture in both vaporous and liquid forms. The microclimate associated with fine turf is nearly always moisture saturated. Loss of vaporous moisture from leaves through transpiration and evaporation of soil moisture keeps the air humid at all times within the leaf canopy. In addition air spaces in the soil are normally filled with vaporous moisture. These moist air conditions provide an ideal environment for the development of a variety of microorganisms — some beneficial to the turf, some pathogenic.

Roots absorb moisture as liquid, a supply of which must be constant from either rainfall or irrigation.

It is evident that turf is normally cultured in a very humid environment. Moisture control, then, becomes very important. In addition, control of moisture related diseases and weed problems is of prime importance in the maintenance of high quality turf.

EFFECT OF SOIL PROPERTIES ON WATER RELATIONS

Physical properties of soils determine infiltration rates and water holding capacities. Soil texture (percent of sand, silt and clay) and amount of organic matter influence these water relationships. The arrangement of soil particles to form granules (soil structure) also has an effect on water infiltration and retention in the soil. In general the heavier the soil and the poorer the structure the slower the infiltration of water and the higher the water holding capacity. The converse of this is also true, i.e. the lighter the soil and the better the structure, the faster the infiltration of water and the lower the water holding capacity.

Rate of water infiltration determines how much water can be applied at once and also how long sprinklers can be operated before runoff occurs. Time between irrigations is determined in part by water holding capacity of the soil. Utilization of water by the turf and depth of the root system also influence determinations of irrigation frequency. The faster water is used by the turf and lost to the atmosphere and the shallower the root system, the more frequently water will need to be applied.

WATER SOURCES AND WATER QUALITY

Irrigation water varies in suitability for use on turf. Some sources are sufficiently hard to cause increases in soil pH. Accumulations of Calcium and Magnesium as well as Sodium and other chlorides and sometimes sulfates
interfere with soil processes that are considered desirable for plant growth. In addition iron and aluminum compounds may vary in solubility or form precipitates which have adverse effects on turfgrasses.

In general, water purification systems are too costly for use in turfgrass irrigation, and little information is available on the most desirable methods for correcting or improving soil-turf conditions resulting from use of poor quality water.

In many areas water from ponds, streams and rivers is better for use on turf than well water. In the final analysis, the most economical source of water is usually applied to turf with the expectation that as problems develop from poor quality water some means will be found to cope with them. In this regard many questions still remain unanswered.

FLOODING OF TURFGRASS AREAS

The unreliable and uncontrollable nature of local climate and weather conditions make it difficult to predict the kind of problems related to water that must be solved in any given year. These may vary from general flooding to localized drainage problems to drought.

Much of the damage to turf from floods is more related to accumulations of sand and silt than to the presence of the water. As long as flood waters are cool, as in the early spring, and as long as they move fast enough to keep oxygen levels relatively high, grass can withstand considerable periods of time under water. However, when the water is warm and moves slowly, injury to turf develops rapidly and is complete.

Often flood waters carry large quantities of sand and silt as well as weed seeds. The silt settles out and coats the grass plants and smothers them, or at times turf may be buried under layers of sand. Even where flooded areas are completely reconstructed, difficulty in turf establishment is often encountered because of weeds.

LOCALIZED DRAINAGE PROBLEMS

Rainwater or irrigation water collecting in low spots is a constant threat to high quality turf production and uniformity. Fields that have poor surface drainage become saturated quickly wherever there is a depression. Use of turf for sports purposes when fields are wet increases soil compaction and leads to the ruination of the sod. Depressions of this type form over the years on golf greens. Where adequate topdressing is not used to prevent these low areas from forming, grass has little chance of creating good playing conditions. Pitch shots to wet greens create ball pocks that ruin the putting accuracy of the surface and also injure the grass.

Some surface moisture can be picked up and pumped off low areas by machines such as the West Point Aeridrier. During winter months when turf is not being used, sod stripped from low spots to adjacent areas creates drainage channels for movement of water.

A more permanent solution to problems associated with low wet areas involves
the installation of slit trenches from the poorly drained spot to an adjacent area. These trenches are filled with crushed rock so that water may flow laterally through them and thus lower the water table in the problem area.

Several chemicals including gypsum have been recommended for opening up soil below impounded water. None of these have worked consistently well enough to be used in general recommendations.

DROUGHT AND LOCALIZED WATER SHORTAGES

Shortages of rainfall have been experienced in most sections of the country at one time or another. During these periods it becomes practical to irrigate only small areas of turf of high value. Turf in parks and on athletic fields, play grounds, golf fairways and even many home lawns is allowed to go dormant. Fortunately most turfgrasses adjust to drought conditions in such a way that recovery is assured when conditions become more favorable for growth. Of the most commonly used grasses in the cool sections of the country, the bentgrasses are most sensitive to drought damage. Inadequate or limited watering prior to the onset of drought keeps turf from natural adjustments to dormancy and promotes injury to the grass stand.

Use of dormant turf may cause injury in the form of wheel marks or foot prints where traffic is heavy.

Dormant brown grass is far less unattractive where there are no green weeds to interfere with uniformity of the sward. Deep rooted plants like dandelion and Knotweed often retain full color throughout the driest of summer weather. Green tints and dyes may be used on relatively small areas of high value turf to restore color to dormant foliage.

Localized water shortages may develop in grass grown above rocks, boulders or ledges where top soil is thin or lacking. Frequent irrigation is the only remedy short of reconstruction in these areas. Often turf which has developed a heavy thatch receives only a small portion of rainwater or irrigation water that falls upon it. The rest runs off the surface and is lost. Use of mechanical devices to open up the thatch and wetting agents to improve moisture penetration into these hard to wet areas helps to get water into the root zone. Under some conditions, aerification of turf during warm weather causes injury in the form of desiccation in and around the aerifier holes.

WILTING OF TURFGRASSES

Research has shown that either too little or too much water may cause wilting of turfgrass. When water transpires from the leaves faster than it is absorbed by the roots, wilting occurs. A deficiency of water in the rootzone brings on wilting, because there is a limited supply for roots to absorb. A saturated rootzone soon becomes deficient in oxygen which is necessary for roots to function in the absorption of water.

Characteristically, turf grasses develop a bluegreen to purple cast in the foliage as a first indication of wilt conditions. The formation of conspicuous footprints in foliage colored this way provides a clue that
unfavorable moisture relations are at hand.

In either instance water must be applied quickly. Where there is a deficiency of moisture, irrigation must supply it to the root zone. Where there's already too much water, a light syringing must be used to cool leaves and cut transpiration loss.

Grasses differ in their sensitivity to wilt. Bentgrasses are among the most sensitive. Some strains or clonal selections are more sensitive than others.

EFFECT OF TREE ROOTS ON TURFGRASS WATER RELATIONS

Turfgrasses seldom grow in a soil environment free of roots from woody plants. It is assumed that grass roots and tree roots compete for moisture and that generally under moisture stress the turf suffers most. Most research in this area has been concerned with effects of shade and air drainage on growth of turfgrasses in wooded locations. Data on limits of tolerance to low light intensities and to disease incidence under these conditions have been of considerable interest. Little information is available, however, on water relations between grasses and trees and shrubs growing together as in a home lawn.

EFFECT OF MOISTURE STRESS ON TURFGRASS FOLIAR AND ROOT DEVELOPMENT

Research conducted at Iowa State University on moisture relations in turf has involved use of a solution culture technique. Additions of a polyethylene glycol to the solution create moisture stress conditions for the turf. As moisture stress (lack of available water) increases, fresh and dry weight yields of clippings decrease and percent dry weight of foliage increases as would be expected under field conditions. In addition as moisture stress increases root development increases as long as nitrogen levels remained low. At medium and high levels of nitrogen the amount of roots produced under varying moisture stress treatments do not change.

It may be that lack of soil moisture stimulates some process resulting in increased root production when foliar growth processes are restricted by lack of nitrogen.

EFFECT OF SURFACANTS ON WATER RELATIONS

Where soils have become compacted and hard to wet or where thatch layers slow down moisture penetration, wetting agents or surfactants have been used to increase rates of moisture infiltration. Many turf managers rely on these materials and include their regular use as a part of their maintenance programs. Others have found little value from use of wetting agents and have resorted to other methods (aerationification, spiking and vertical thinning of turf) to help improve moisture penetration into the turf and soil.

Both field and greenhouse experiments have been conducted at Iowa State University using Penncross and Seaside creeping bentgrasses, Astoria Colonial bentgrass and Common Kentucky bluegrass. Bentgrass plots were maintained as putting greens and bluegrass turf was clipped at a 1 1/2 inch height and maintained under lawn conditions. Soils have varied from very sandy to silty clay loam. Results of these studies are summarized briefly as follows:
Aqua-Gro, All-Wet, Pro-Green and Solar-25 wetting agents were applied at rates less than, equivalent to, and greater than manufacturer's recommendations. Treatments were made monthly throughout the growth season. No effect either beneficial or detrimental was noted on the production of high quality turf or on moisture relations under field plot conditions.

When the same four surfactants were added to a standard nutrient solution and the turf grown free from soil in a hydroponics system, increasing concentrations of surfactant caused production of yellow (chlorotic) foliage and reduced growth of leaves. As surfactant level increased in the treatment, copper and zinc concentration increased in leaf tissue. These increases were found to be great enough to create toxic conditions within the turf. It was obvious that there was a striking difference between the lack of response obtained in soil and the injury obtained in solution culture. Thus a third experiment was set up to determine what happens to the surfactant under soil conditions that prevents the type of injury noted in solution culture experiments.

Results of this study indicated that even where very high concentrations of wetting agent were applied to the turf, over varying lengths of time, none could be leached out of the soil. Either these materials were decomposed very rapidly or they were attached to soil particles through polar attractions. Adsorption in the soil systems seems a most likely explanation for this immobility of the surfactant molecule. Thus, it appears that wetting agents, even though non-ionic, may through polar attractions be quickly tied up near the soil surface. In this way injury to turfgrass may be prevented. It is also likely that the surface active or wetting properties of the soil water are in large measure reduced in this process.

It is important to note here that soils may be divided into 2 groups—those that wet easily and those that are difficult to wet. It is not clear how frequently "difficult to wet" soils occur under turf conditions. In addition, the tie-up of the surfactant in these soils would indicate an accumulation in upper layers and the need for frequent light applications for any improvement in moisture penetration over a period of time.

ANNUAL BLUEGRASS AND MOISTURE RELATIONS

Annual bluegrass (Poa annua) in close clipped turf often has a very shallow root system. This combined with a natural sensitivity to wilt makes it difficult to bring through hot summer weather. Using water in the right amount in the right place at the right time for Poa annua means light frequent irrigations plus thorough disease protection by use of fungicides. Poa annua problems are not as great on unirrigated turf as on greens, tees and fairways that are watered regularly. It appears that increasing use of fairway irrigation as well as more irrigation on home lawns will cause spread of Poa annua through the north cool humid regions of the country. Watering practices will need to be adjusted to meet the requirements of this grass or chemical control measures must be followed to eradicate it.

POA TRIVIALIS AND MOISTURE RELATIONS

Another bluegrass that does well in moist situations is Poa trivialis. It is also quite shade tolerant and thus is used some on tees situated in wooded
areas. As long as moisture levels are adequate this grass is competitive with other species and strains. Where water requirements are not met Poa trivialis disappears rapidly from the sward.

CLOVER AND MOISTURE RELATIONS

Clover and other legumes often show considerable drought tolerance. Extended root systems plus availability of fixed nitrogen appear related to production of green foliage in the midst of brown drought damaged turf stands. Plants of this type are considered weeds in fine turf; however, they have been found of value in getting cover established in areas where soils and climate are unfavorable for initial rapid growth of grasses.

CRABGRASS AND MOISTURE RELATIONS

Moisture availability at time of seed germination in spring determines to a large extent how serious crabgrass infestations will be. Where soil surfaces are allowed to remain dry during this time of year fewer weed seeds germinate and crabgrass is easier to control. In addition research at Iowa State University has shown that preemergence herbicides are more effective where crabgrass seedlings are weakened because of dry surface soil. Moist soils permit crabgrass seedlings to maintain more rapid development and often extend roots below the zone of herbicide activity before permanent injury is brought about. Even where herbicides are not used, crabgrass seedlings may be significantly weakened by dry surface soil. In these instances a vigorous deep rooted turf can compete with the crabgrass and keep it in check. Close clipped shallow rooted turf has little chance in the presence of crabgrass because of these moisture related growth factors.

EFFECT OF MOISTURE ON HELMINTHOSPORIUM LEAF SPOT

Moisture availability to Kentucky bluegrass influences infection by Helminthosporium leaf spot. The greater the moisture stress (harder it is for the grass to obtain water) the fewer leaf spots develop. In addition those that do develop are smaller when water is lacking. Apparently plentiful moisture produces a succulent rapidly growing plant which is more susceptible to this fungus disease. Careful use of water during late spring and early summer may help to make this disease easier to control with fungicides.

EFFECT OF MOISTURE ON RUST DISEASE IN BLUEGRASSES

Not all turf diseases are more infectious under high moisture conditions. Rust in Merion Kentucky bluegrass is significantly reduced where turf is well watered. Besides a more rapid growth rate being responsible for removal of diseased portions of leaves as clippings, basal portions of the grass appear to have fewer rust infected areas where turf is adequately irrigated. It is concluded that Merion bluegrass should not be watered like Common Kentucky bluegrass. It is likely that each grass has its own specific water requirements that should be considered in the formulation of irrigation practices. We are inclined to water turf as grass and not as specific varieties or strains. Improvements in turf quality may be realized by paying attention to this turfgrass-irrigation factor.

A-37
MOISTURE AND CONTROL OF FAIRY RING AND LOCALIZED DRY SPOT

Fairy ring and localized dry spots caused by accumulation of hard to wet fungus mycelium in the soil can only be controlled by getting water into these areas. Use of surfactants may help in movement of water from holes punched in the soil. Water must penetrate through the entire profile infested with the mycelium. Dry pockets will contain accumulations of fertilizers and other chemicals used on the turf. When these are finally wet, injury to adjacent turf may be noted. As these areas are wetted and returned to a more normal level of microbiological activity, antagonistic organisms may be increased to help check the further development of the detrimental types.

EFFECT OF MOISTURE ON FROST HEAVING

Where moisture fails to drain away during fall and early winter, frost heaving of turf can be significant. Changes in surface grade brought about in this way must be corrected by rolling in early spring followed by careful applications of topdressing to elevate depressed areas. Procedures for preventing this type of condition include reconstruction to improve internal drainage and to remove rocks and other debris that may be lifted by frost action.

MOISTURE RELATIONSHIPS AND WINTER KILL

More serious types of winter injury related to moisture include drying out or desiccation and ice or slush damage during early spring.

Strong dry winds during winter months may remove considerable amounts of water from turf root zones. Where roots are shallow injury to turf may be extensive. Watering during winter months, location of fences and brush to collect and hold snow and careful fall fertilization to encourage deeper root development all help to conserve moisture and protect turf from winter injury.

Collection of ice and slush often, but not always, is noted in low spots. It appears that alternations of freezing and thawing injure the grass, often beyond recovery. Grasses differ in their susceptibility to injury of this type and appear to be influenced by some management practices. The occurrence of winter kill is difficult to predict and even harder to prevent. As the several moisture related growth factors involved are better understood improved recommendations for preventing winter kill will be possible.

EFFECT OF MOISTURE ON FERTILIZER BURN

Very small amounts of moisture which form on turfgrass leaves as dew or guttation water are often sufficient to cause burn from chemicals spread on the turf. Even though materials are applied to dry grass some particles may lodge between leaves and sheaths and consequently be in position to injure foliage as moisture accumulates during the nighttime hours. It is always desirable to drag such materials into the turf following spreading or wash them from the leaves with a good forceful watering.

WATER APPLICATION SYSTEMS

Irrigation engineering has become a highly specialized field during recent years. Systems designed to apply the right amount of water at the right
place at the right time are now a near reality. Much of the labor formerly used to set or move sprinklers is now eliminated by installation of automatic devices which can be timed to apply water just long enough for the soil to take it without runoff loss. In order for these systems to do their jobs properly they must be accurately designed and carefully installed. There can be no corner cutting, short cuts, or bargains when it comes to turfgrass irrigation and meeting water requirements of the grass. Remember the water must be applied in the right amount, at the right place, and at the right time for continued production of highest quality turf.

"THAT'S NOT WHAT I SAID":

Frank Gallagher
Hercules Incorporated

During the few moments I'm waiting to be introduced I often think of the young actor who worked so hard and waited so patiently for a part in a Broadway show. Finally, the big break came, he got the part and on opening night he was just as nervous as you or I would have been. This was his first experience before a Broadway audience. The house was packed: he plowed through his lines, sure that every sound he uttered would be his last. It was during the first act, as he shared the stage with a veteran Broadway star of thirty years experience, that this "moment of truth" came.

Someone off stage pushed the wrong button and the telephone on stage rang. This loud insistent ring was definitely not in the script! The young man froze. He didn't have an idea in the world how to cope with this situation. As he stood, transfixed, forgetting everything he had ever learned, his horror changed to admiration. Without so much as a break in stride the star walked over to the telephone, lifted the receiver from the hook, smiled and said "Hello", a line which was definitely not in the script. The young actor watched, filled with admiration for the experience which gave the star this ability to cope with the unexpected. Suddenly, his admiration turned to panic as the leading man held the receiver out to him and said, "It's for you."

This is your position every time someone speaks to you. As a person begins to speak he holds out the receiver and says hopefully, "It's for you." Granted, your situation as listeners is seldom quite so desperate as the position of the inexperienced young actor, but the one who is speaking is even more dependent on your complete cooperation than the young actor was on the veteran leading man. The rapport between sender and receiver in oral communication is the heart of the communication problem.

You and I know how serious this problem is in business. It is no accident that the people at the top in most business organizations are among the best listeners in the outfit. These people have forced themselves to listen so they could hear and learn all they needed to know to get to the top and, hopefully, to stay on top!

Please note that I said - forced themselves to listen. The cultivation
of the listening habit is such a long and hard job that any attitude - short
of persistent determination will break the pattern before the habit is formed.
I don't know of any other emotional and mental discipline that is harder to
exercise than listening. The reason is simple. Man has a basic human instinct
which causes him to be more interested in expressing his own thoughts than he
is in listening, without interruption, to what another person is saying. This
act of self-expression is treasured by each of us. When a stronger human being
thwarts our effort to express ourselves, deep resentment is kindled. There
is no communication until the heavy hand is lifted and our resentment passes.

The home is the place where good-or-bad-communication habits have their
beginning and are nurtured. Most of us are parents. One of our greatest
challenges is the need for patience while our children are speaking. This is
particularly true if we have been interrupted. The two words "Keep quiet" have
done more to kill communication than any other two words I can think of.
Unfortunately for many of us these two words are spoken in haste, frustration
or anger. Indeed, it is not the child who interrupted or talked too much who
must be quiet. It is the parents. We have destroyed the possibility of ready
acceptance of anything further we might say.

A lot of the trouble we have communicating in business stems from our
experiences earlier in life. Not many of us are naturally good listeners. We
have ignored - or been ignored - too often. We have shouted or been shouted
at. We have hurt or been hurt. We have humiliated - or been humiliated -
until many people have built a protective coating around themselves and resolved
to communicate no more.

The strength needed in the discipline required for good listening is
drawn from each person's reserve of emotional stability and self-control.
When rapport is destroyed between the speaker and the listener, whatever
listening skills we may have developed are likely to fail us. Our concentration
is broken by the emotional upset.

Some bosses can raise the roof with the people who work for them and things
do get better. The workers listen, evaluate what is being said, accept it and
get on with the job. Other supervisors and managers can talk to the people who
work for them and their words are fruitless. Human beings, no matter how young
or old, will really listen and respond only to those who have listened - with
honest interest - to them!

Pity the supervisor or manager who mistakes vacant attention or quiet
submission from the people who work for him for understanding and acceptance
of what he has said! If the people in charge do not listen - with genuine
interest - to the people who work for them, everyone associated with the enter-
prise is in trouble. We have only as much authority as our subordinates are
willing for us to assume.

Really it comes down to this: communication is the only effective tool
you have with which to run your business.

Then, too, the kind of silence we observe while listening is, I believe,
a very important consideration.

First, there is the silence that is chilling. I can think of nothing
better calculated to destroy a conversation between two people.

There is another kind of silence - actually an attitude while listening - that is challenging. This can be stimulating, if the speaker and the listener have enough common ground on which to communicate, reasonably freely. When the listener is the boss he is well advised to gauge the speaker's reactions and inhibitions carefully lest too challenging a listening attitude cut off communications.

And there is the silence that is encouraging and warm. But this warmth must be honest! It can't be faked.

Don't listen with suspicion. Listen to learn; not to disprove.

You may feel as I do. How strange that we give so little thought - so little personal attention - to the cultivation of a good habit that is as rewarding as attentive listening.

I believe most of us feel we are better talkers than listeners. I wonder if this is so?

One reason for overconfidence in our ability to get ideas across through speech may be rooted in our failure to recognize that speaking clearly is a discipline and requires preparation. Speaking demands concentration too. In fact, the preparation and concentration necessary for good talk require greater subtlety in execution than is the case for listening. We accept, without question, our listener's concentration. If his attention is evident and his concentration quite apparent we feel complimented. On the other hand, if our speech is overly careful and our delivery noticeably deliberate, our listeners may be made to feel uncomfortable and ill at ease.

Our whole nervous system and its computer - the brain - function so remarkably efficiently that we're encouraged to be increasingly bold! We forget our personal computer operates in the same way as the computers we build. Output is dependent upon input.

Most of our talking can be clear and straightforward if we spend but a fraction of a second in arranging the input. We call this simply, "Thinking before we speak." If we did take this moment of time needed to think about some orderly arrangement of our ideas before we spoke, we could cut down the number of times we are misquoted, misunderstood and misinterpreted.

We can fling words at people in whatever disarray they tumble out but this is no guarantee they make sense and convey meaning.

We are frustrated in our dealings with one another by poor communication. In our own country, this vast land with 200 million people speaking a common language, there are two basic reasons why our communication problem continues. First, the receiver of an oral message doesn't really listen, attentively, from start to finish. Second, the sender of the message may have started speaking before he was finished thinking! Many of us go in heavily for this bit of tossing comments and opinions off the "top of our heads." No thought beforehand. No attempt to arrange ideas. No order. Just talk. Then, every
once in awhile, we pause to take a breath and a bewildered employee – or student – ventures a comment. "But that's not what I said", we respond indignantly. Then to prove how patient and long-suffering we are we may mutter something that sounds like, "Now let me explain again."

As I said earlier, communication – meaning largely the spoken word – is just about the only tool most of you gentlemen have with which to manage your business. The kinds of operations you manage remind me of J.P. Morgan's reply to the man who asked him how much it cost to run a yacht. You may remember Mr. Morgan's answer: "If you have to ask that question, you can't afford to own one!" You never have enough money to get your jobs done the way you would like to do them.

You're providing beauty, recreational opportunity and facilities all, as your grounds committee chairman constantly reminds you, on a business basis. Always on a business basis but, too frequently I fear, on a limited budget. That's so you can prove, starting at sunup, six months a year, what good business managers you are!

Maybe there's a superintendent in the room who just picked up a new nine or twenty more acres to manicure with 2 less men on his crew than he had last year. This is what the club officers and the grounds committee call your "new challenge." They know you can do it because you're a good man and your men do a good job for you.

Well, here you go again.

I'm sure you are good men and certainly you have the interest and desire to do a professional management job – or you wouldn't be here. I would be agreeably surprised, too, if there were not many of you facing serious problems in manpower for budgetary and other reasons.

I'm a layman in your business operations but I expect I'm at least partially correct when I assume you, as superintendents and managers, give direct personal leadership to your men. I doubt that many of you have supervisors and other staff assistants to assist and relieve you. So, as Harry Truman said, 'The buck stops with you!' When you want a man to know something you tell him. You don't go back to the office and write a memo. And neither you nor your men have time for loose talk or poor communication. You have to plan your work and work your plan – or the jig's up.

You have very real management responsibilities. A ten-man job with only seven men available to get it done will only be done through good personal leadership. And this brand of leadership is supported by two main props -- example and the right words, spoken plainly after careful thought and with patience. Blowing our stacks is no cover or remedy for poor communication. When there are only seven men on a ten-man job – they've got to be sold – all day, every day. Patient understanding and a word of encouragement will only get you one thing – more effort.

This is sort of a new ball game for all of us. We present greater challenges everywhere and at all times to one another. There are also greater opportunities for all of us. there's more – much more – we all need to know.
It matters not whether we are workers or managers; employees or employers. We're linked, closely. We're increasingly interdependent. We cannot do our jobs unless we get the information we need - and get it straight.

As with so many other good habits in our personal and business lives there are real bonuses that attach to good communication. If we think straight, we should be able to talk straight. We clear away the cobwebs and free our minds and our spirits to get on with the jobs of life.

Most of the people we meet and work with have as many or more cares and responsibilities than we do. If we show genuine interest in other people; if we give our attention to their problems and really try to understand them we will strike a mortal blow to this communication problem.

And -- we will slowly but surely build bridges of trust between human beings.

GROWING AND DISTRIBUTION OF SOD

Ben Warren
Warren’s Turf Nursery

Growing sod is a combination of soil, water and grass under intelligent management using the proper tools.

Sod is successfully grown on a wide range of soils, but there are advantages and disadvantages inherent in the different types. Where there is a choice we have our preferences. Our first choices are the high organic soils such as muck and peat. The lower specific gravity is a freight saver and generally one is able to develop mature turf somewhat faster on these soils than are many other types. These soils can be difficult to manage in both abnormally, wet and dry weather and require special flotation equipment. We attempt to avoid rocky and gravelly soil, but we produce sod satisfactorily on soils such as sandy loams, black loams and some pretty rough clay.

As important as an unfavorable soil type is the presence of undesirable contaminants - some of these make satisfactory production impossible and some make the task very difficult. Quack would illustrate the latter and bent that has been allowed to seed, the former.

An adequate water supply is essential. We hesitate to undertake a planting if there is not 5 to 7 gallons per minute available per acre. An ample supply of water must be combined with a well engineered system of efficiently distributing it. We use one system to germinate seed which applies water at the rate of .1 inch per hour. A second system with an application rate of .3 inch per hour is used in growing and maintaining. We use both wells and open streams as water sources, but much prefer pumping direct from wells.

The choice of grasses grown varies from area to area, but most locations have a species that is accepted by the majority of lawn owners. This selection of course accounts for the major effort. More and more the grasses for special
uses become interesting. Grasses adapted to play use such as golf and athletic fields, selections adapted to shade, rougher blends suitable for highway use and the grasses tolerating unusually short mowing heights for the hobbyist are examples of diversification that become increasingly attractive.

Distribution is a combination of grass and a customer. Our policy is to distribute our grass through landscape contractors, garden stores and retail nurseries. We maintain a staff of representatives that contact these outlets regularly, offering what aid it is possible to furnish. Such printed material as sales aids and technical information is made available. We attempt to keep our representatives well posted on the technique of handling sod and good management practices.

A very important part of our distribution is the facility for vacuum cooling. This equipment enables us to send sod from our fields at a temperature of 33° to 340 F. irregardless of weather conditions. At this temperature sod may be kept rolled for 4 or 5 days without damage. This has been an aid to the contractor who is laying sod and even more to the retail outlet. These people can hold grass for several days without fear of loss. Some merchants have found polyethylene holding beds an aid in retailing. The use of these beds enables one to unroll sod for display and holding and avoids the problems incurred when rolling out on loose material.

We attempt to extend our distribution to maintenance of the grass after it is established. Good market areas for our product are those communities which desire good grass and have the willingness and the information necessary to properly manage lawns to that end. We supply such aids through our literature, garden club appearances and other means of communication. Such activity while not originally conceived for that purpose seems to be contributing some to the Beautification Program.

POST MANAGEMENT OF SOD

George F. Stewart
Karandrew Turf Farms, Inc.

The production of quality sod is the most important step toward assuring good post management. Post management recommendations are as follows:

1. Sod should be of excellent quality.
   a. good handling characteristics.
   b. free of weed or other grass contamination.
   c. free of insects and nematodes.
   d. cut uniformly.
   e. true to strain.
   f. sold subject to rejection upon delivery if quality not satisfactory.

2. Sod variety adaptable to use area.
   a. adaptable climatically.
   b. adaptable for intended use.

A-14
   a. adequate topsoil.
   b. finish grade.

4. Water required on job site.
   a. adequate amounts available.
   b. proper equipment for putting water on.

5. Lime and fertilizer to meet sod requirements.

6. Proper mowing management.
   a. equipment in good condition.
   b. frequency of clipping and height of cut programmed for
      sod variety.

7. Sound program for future maintenance.
   a. lime and fertilizer.
   b. water.
   c. mowing.
   d. weed and insect control.
   e. physical renovation.

Literature for sod customers, in all phases of future maintenance, a
must in order to keep sodded areas in top condition.

The future of the sod industry is directly proportional to the quality of
sod produced and sound (thus successful) post management.

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SOD CERTIFICATION

Henry W. Indyk
Rutgers University

The use of sod is not a recent innovation. It has been in use many years,
particularly from the standpoint of soil stabilization. Today, interest in
the use of sod is primarily expressed in its aesthetic value and rather complete-
lly overshadows its utilitarian value.

The production of sod has rapidly developed within recent years from the
"pasture stage" into a highly specialized industry. Large acreages, resembling
pampered king-size lawns, are being devoted exclusively to the production of a
high quality sod of improved varieties of selected turfgrasses. Animals no
longer are permitted to roam and graze these areas. Terminology such as
"cultivated" or "nursery grown" has been adopted by the industry as a means of
distinguishing it from the pasture-type sod. The marked improvement in quality
of sod perhaps more than any other single factor has stimulated the surging
interest in the use of sod for establishing a lawn.

The improved quality has been brought about by a combination of factors.
Aside from intensive cultural practices in use at present, perhaps the most
significant contribution has been the high quality seeds of improved varieties
of known genetic purity that have been made available. Such seed rightfully
commands a premium price in contrast to the pot-luck wide genetic base of hay
mow sweepings formerly used in pasture establishment. As an example, Merion
Kentucky bluegrass, representing a superior strain of Kentucky bluegrass, is in popular use on sod farms at present. Development of other improved strains in the future will be rapidly adopted in the sod production industry.

A sod certification program has been initiated in New Jersey as an aid toward continued progress in improving sod quality. The benefits derived from certification in the seed industry are readily apparent to the members of your group. The sod industry, I am confident, will accrue similar benefits from a properly organized and executed program.

The initiation of the New Jersey sod certification program was stimulated by several factors:

1. Increased use of sod as a means of establishing lawns and other turfgrass areas.
2. Wide variation in quality of sod being produced and installed.
3. Difficulty encountered by the homeowner in recognizing high quality sod.
4. Provide the producer of high quality sod recognition for efforts expended and thereby better able to compete fairly with the low quality producer.
5. Simplify writing of specifications by architects.
6. Increased number of new turfgrass varieties becoming available thereby complicating the problem of maintaining identity, primarily from the standpoint of the purchase of sod.

The primary objective of the New Jersey program is to make available to the public high quality sod of superior types of turfgrasses so grown and distributed to insure genetic identity and purity, and reasonable freedom from injurious insects, diseases, nematodes, and weeds.

In order to achieve this objective, a program was organized between the College of Agriculture and Environmental Science and the New Jersey Department of Agriculture. In order to qualify for the distinction of certified sod, sod must be grown and meet rigid certification standards involving pre-planting and post-planting field inspections for weed, insect, nematode and disease problems, genetic purity and identity, green color, density, and freedom from foreign material. Before planting, seed source must be established and its quality accepted. Sod which meets certification standards is entitled to a blue pressurized seal for application to invoices.

On the basis of two cooperators, the program was initiated with the enrollment of approximately 50 acres in the program as of April 1, 1963. During the initial stages in putting the program into effect, field training was provided for the inspectors of the New Jersey Department of Agriculture who were delegated the responsibility of the regulatory work. This proved to be beneficial in getting the program organized and working smoothly. It was particularly encouraging from the standpoint of the rapidity with which the inspectors became acquainted with turfgrasses, weed problems and their responsibilities in conducting the necessary inspections conforming to the standards of the program.

In September 1964, the first square foot of sod in a parcel of 1 1/2 acres was officially certified and harvested. From this point on, the program has
steadily grown and received national recognition and attention. To date, slightly more than 100 acres have been certified. Many other states have expressed interest and initiated similar programs.

The program has been very effective in the following ways:

1. Stimulated a more intense interest by the sod producer in the production of high quality sod.
2. Provided the high quality sod producer recognition for his efforts.
3. Provided the purchaser a very simple and easy means of specifying a high quality product together with the assurance that a high quality product was being obtained.
4. Simplified writing of specifications.
5. Increased the use of high quality seed for sod production.
6. Stimulated seed suppliers and producers in providing the sod producer with high quality seed. The impact of the program in the seed industry was more far-reaching than anticipated. Contacts from growers in the seed production area indicated their interest in producing seed which would conform to the specified seed standards.
7. Provided a closer working relationship between the Extension Service and the sod producer, the New Jersey Department of Agriculture and associated interests.

The program has also had problems. Some of the major ones encountered included:

1. Drafting of a set of standards which were practical and effective in achieving the desired objectives. Efforts to obtain standards from other states proved to be fruitless since no other state had a program of this nature.
2. Skepticism of the sod producers.
3. Sale of sod before completion of certification requirements, seriously hindered promotional efforts.

Sod production as a specialized industry has made many advancements but it is still in its infancy. The striking improvements in quality, as a result of improved cultural techniques and high quality seed of improved turfgrass varieties, has stimulated the surging interest in the use of sod more than any other factors. I foresee a continued increase in the demands for sod as long as the industry continues to progress in more efficient productions and has a high quality to offer. Sod certification is an aid toward continued progress in improving sod quality. Quality more than any other factor will provide the pathway to increasing demands and use of sod.

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MANAGEMENT OF VARIOUS PARK AND TURF GARDENS

Robert W. Sharkey
Superintendent
Attleboro Parks

The maintenance of park lawns and flowers may be somewhat more difficult than on golf courses (or before golf carts) and cemeteries. I believe that we can all benefit from one another. We all have had a problem or problems that
we worried about and the solutions were so simple that one was mad with one's self for being so stupid. We can get something from the smallest source to the biggest and the one man operator may be the one that solves a problem that has stumped us and the experts. "From the mouths of babes come words of wisdom." I remember my son at seven years and his bicycle. He talked his mother into a basket for the front and then asked me to put it on, which I started to do as any good father would. I wasn't too far along when he said: "You're doing that wrong." I was.

What I am going to say concerns what we do in Attleboro. We have an exhibit called a Rain Forest and an electric eye count of 300,000 persons a year. We keep no one off our lawns, to picnic or just sit, and the children's games. We have a High School to which the pupils that walk, cross the park, and of course, they cannot use the roads or walks, they use the lawns, flower beds and shrubs, borders or whatever is the straightest line, regardless of weather conditions. This totals up to a lot of feet that pound around Capron Park in a year's time. To keep things looking good I rate the essential requirements in this order: (1) water (2) fertilizer (3) labor (4) equipment.

The drought of recent years has made everyone water conscious. A few years ago how many golf courses had water available except for the greens? Now a system is built in as new courses are made. In Attleboro the Highland course put in a system last summer and what a change in appearance and I believe the scores because the better turf did away with the holes in the turf so the golfers could call weather hazards and all but tee the ball up again. We put water in our athletic field and now we have a beautiful green turf which replaced a dust bowl. We eliminated weeds and crabgrass. The weeds we sprayed for in May with 2,4-D. The crabgrass was held back by the heavy turf. The Anderson Gardens also have water but the rest of the Park really is a sad sight during the dry weather, or so I think.

Fertilizer: we know that without it our growth is weak and the color does not add anything to appearance. What is prettier than an expanse of green grass properly mowed? We have experimented with many kinds of fertilizers, at different rates per acre, feeding at different periods and our results have us now feeding in late April or before Memorial Day and again late August or early September. We are having a special mixture made: 12-5-5 with other additives with at least 75% of the nitrogen from Ureaform. We set the spreader, tractor drawn, at 700 lbs. per acre and for Spring and 350 lbs. for Fall. We have had no burning from overlapping. Around trees and where we can't put a 12 foot spreader, fertilizing is by hand spreaders.

This brings us to the third item, Labor. We are finding this more difficult and frustrating all the time. The day of hiring for the season and having the same help back is gone. I used to put on in vacation time college and high school boys. I have given that up and find it is cheaper to pay over-time and it also helps my disposition. I have six men and their years of service range from three to eleven and the oldest is 46 years of age. I can't say that they came easy as they are the result of a few that didn't measure up. I can leave for one day or a month and know that my men are working, and if we have troubles an extra effort is made to overcome them. It is certainly a relief to know that the work is being done and done right. It is nice to know that the equipment is being used properly to do a proper job and not abused so one can loaf while repairs are being made. It is nice to know that oil and grease are used:
it is a relief to know that bolts are checked and tightened. Whatever the good
words are about Capron Park, the men are as deserving as I because what can any
of us do unless our help is willing and capable. "Red" in Newfoundland.

Finally, Equipment. The day of all kinds of labor whenever it is needed
is gone. We have had to mechanize. Capron Park was at one time mowed by hand
mowers, then by several 18 inch powered machines, then a 70 inch mower, and then
a 75 incher was added, finally with a tractor and three units. We can't get
among the trees with any more units. What at one time kept two or three men
going every fair day is now done in one day by two men, one man on a tractor
and one man around the trees and small areas that the tractor misses. The
spreading of fertilizer by 12 foot spreader instead of 3 or 4 foot by hand. We
use our aerifiers on our lawns once a year and a smaller one in the Anderson
Garden three or more times and it is difficult because of the traffic to prevent
the grass from being worn off. I hope to have a thatch machine when I am able
to convince the city fathers that the few hundred dollars that it will cost is a
good investment. We use a power sweeper in the Spring on all our lawns. This
used to be a hard job of several weeks duration; now it takes one week and a
cleaner job is accomplished and is also used for grass cuttings, if required.

Our annual flower beds receive a heavy dressing in the Fall and fertilizer
in the Spring at planting time. We used to pull the flowers after they were
frosted and dump them in a compost pile. We now put a rotary mower through them,
put on the dressing followed by the rotary plow and we have saved time and also
put into the soil valuable compost.

Our Rose Bed of about 1000 hybrid tea, Floria, Grandi plants sustains a loss
of about 3 percent each Winter which I believe is exceptionally low. I wouldn't
feel bad if it were 10 percent. This is our winterizing procedure. About
Nov. 5 we cut back to knee height. All the leaves are picked off and then taken
away. We then spray heavily with fungicide sprays, and while we put in an insecticide it may be eliminated. We then hill them up with dirt in the beds as high
as possible. We now wait until the ground is frozen 3 or 4 inches and then we
put on a good mulch of meadow hay. After Christmas we pick up trees that were not
sold and people also bring them in. These we put on top of the hay and so the
roses remain until after March 15 when if the weather warms, we start uncovering,
Christmas trees then a week or so the hay and then a good dressing of rotted shredded
cow manure and fertilizer dug in 4 or 5 inches as we unhill and by April 10
we are ready for another season.

We use only permanent grass seed for new seedings or reseeding where the
turf is thin. But I have found that thin turf if properly fed, watered and cared
for will thicken without reseeding. I have found that grass is really tough and
will survive under very adverse conditions. Water, fertilizer and sun do wonders.

"Is soil so important?" A while back a WW II veteran who was working for me
came back to Stockbridge and I sent soil for analysis. Prof. Dickinson asked him
if grass was growing on the soil. We thought the turf was good. About 5 years
ago I sent soil to Prof. Troll. He reported, "You know you can grow grass anywhere
if you give it tender care." Grass is growing on this soil and where fertilizer,
water and care are given, it isn't doing too badly. Dr. DeFrance always said,
"Good turf eliminates weeds." At the Park one day he said that the turf was good.
There were also plenty of weeds, plantain, buckthorn - so I asked him "how come"
the turf is very good and you say this keeps the weeds out. "Well," said Jess,
"Let's say it keeps out a great many." The experts get stumped, so why shouldn't
you and I?

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