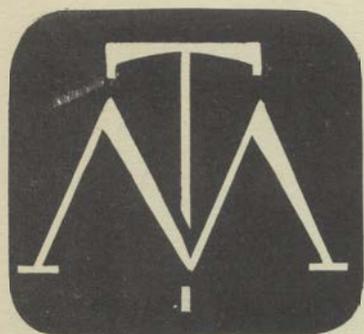


March 1955



Midwest

Regional Turf

Foundation Conference

Proceedings

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President's Report
Annual Meeting 1955
Midwest Regional Turf Foundation
Frank P. Dunlap

This has been a year in which the steady increase in growth of the Midwest Regional Turf Foundation has not only continued but in some respects greatly improved.

The improvement is most marked in the increase of industrial memberships, grants, and contributions. This is indeed an encouraging sign of advance and recognition.

The staff of the Foundation has in turn greatly expanded its services to the membership and turf minded people as a whole. There are more strains of grass under propagation and experimentation than ever before; and more is being done each year in the field of chemicals of all kinds as they pertain to fine turf and its improvement.

The work done by the Foundation to improve the professional standing of the superintendent is most gratifying, not least of which was the publication of the results of the salary studies. This is a good start and it is my hope that more work in this direction is forthcoming, as it is my firm belief that salaries in the turf profession are far below what they should be for a profession that places so much responsibility on the men engaged in it.

Although the Midwest Turf News and Research publications have been good, I feel that there is room for improvement in this department.

Financially the Foundation is in a better position than ever before. The financial gain has taken place in all phases of the operation, from memberships, commercial grants, and funds from the University. This is good, for it assures not only the continuance of the Foundation's activities but a chance for expansion thereof.

The addition of space for the Foundation, both in the new Life Sciences building and at the agronomy farm, promises much in the way of productive research work and presents a better opportunity for those interested in turf to bring their problems here for solution.

I feel that this has been the year in which the Midwest Regional Turf Foundation has definitely taken its place as the leading turf research center in the country, and Dr. Daniel and his staff are to be greatly complimented for their efforts in bringing this about. It has been a privilege and a pleasure to serve as president of this fine organization.

I want to take this opportunity to thank the other officers, the staff, and the membership for its fine cooperation this past year and to assure you that the incoming officers for 1955 will carry on the good work, and that the Midwest Regional Turf Foundation will be even better in the years to come.

Let me in closing ask that all of us as members keep up our efforts to increase the size and scope of the Foundation so that it will continue to advance as in the past.

Thanking you for this opportunity of being of service, this report is respectfully submitted.

THE STUDENTS PURDUE SERVES

Dr. N. M. Parkhurst, Associate Registrar,
Purdue University

In the short time allotted to me this afternoon may I present some facts which may give you a general picture of the size and composition of our student body. I would also like to give you some comparative figures that point up the potential future enrollment for colleges and universities, especially the enrollment of Purdue.

At the present time there are 10,232 students enrolled on the campus (8689 undergraduates and 1543 graduates). In addition to those enrolled here in Lafayette, there are 5631 others enrolled in the Purdue Centers at Columbus, Fort Wayne, Hammond, Indianapolis and Michigan City.

We feel that the students here on the campus are an unusually good group. They have been selected carefully from among the best high school graduates. Approximately seventy percent of those admitted as undergraduates ranked in the top one-third of their high school graduating classes. Therefore, the competition of the students is unusually stiff. In fact, those of us who are responsible for admissions counselling feel that we should be especially aware of the chances for success of those who will be admitted. We feel that it is our duty to point out to high school groups various ways of educating oneself beyond the secondary school level, many of which do not require a college degree.

The undergraduate students on this campus are pursuing degrees in five different schools--Agriculture, Engineering, Home Economics, Pharmacy, and Science, Education and Humanities. The 898 students now enrolled in the School of Agriculture are pursuing degrees in Agricultural Economics, Administration, Education, Engineering, Science; Agronomy, Animal Husbandry, Biochemistry, Conservation Education, Dairy Husbandry, Entomology, Forestry, General Agriculture, Horticulture, and Poultry Science. The School of Agriculture also offers short winter courses to meet the needs of those who for lack of time, money or preparation are unable to take the degrees programs. There were 145 enrolled in agriculture winter courses this past January and February. Another service of the School of Agriculture is that of providing conference services. Your Midwest Regional Turf Conference is an example of the many for which the agricultural staff gladly lends assistance.

The Engineering Schools have a current enrollment of 4223. These students are working toward degrees in Aeronautical Engineering, Air Transportation, Agricultural Engineering, Chemical Engineering, Civil Engineering, Electrical Engineering, Engineering Science, Engineering Law, Mechanical Engineering, and Metallurgical Engineering.

The students in the School of Home Economics now number 868. They are following curricula in Vocational Home Economics Teaching, Dietetics and Nutrition, Clothing and Textiles, Food Management, General Home Economics, Housing, Costume Designing, Interior Designing, Commercial Designing, and Home Economics in Business.

The School of Pharmacy now has an enrollment of 329 students. They are a very highly selected group of students. The most diversified group of students are enrolled in the School of Science, Education, and Humanities. A total of 1605 students are enrolled in the various options or areas offered.

The Graduate School now has an enrollment of 1543 students. Graduate students can complete a Master's degree with practically every instructional department. Twenty-six departments grant the Ph.D. degree in addition to the Master's.

You can readily see that the student body represents a variety of interest. They also represent every county in Indiana, every state in the United States, and fifty-five countries and territories. The majority of our students are from Indiana and that is as it should be because Purdue University is a state institution.

The living quarters of our students can be divided into three types: (1) the University-operated residence facilities, (2) 16 sororities, 39 fraternities, and 10 men and 6 women cooperative houses, and (3) private homes. Approximately one-third of the students live in each of the types of residence facility.

You should also know that there are 182 student organizations that provide extra-curricular activities. One wonders when students have time to study.

Couple all the variations of more than ten thousand students together with the approximately fifteen hundred staff members, whose interests, qualifications, and peculiarities vary even more than the students, and you can imagine how really complex our organization is.

For several years I have been interested in predicting enrollment. By January 1946 it was obvious that the return of the veterans of World War II would almost double the enrollment. In fact, the total enrollment rose from 5803 in September of 1945 to 11,472 in September of 1946. It increased further to 14,674 in September of 1948. As the veterans of World War II decreased, so the enrollment decreased. However, the decrease was not back to the pre-war high of seven thousand students. Instead the decrease levelled off at 9273 students in 1951 and then started to increase gradually.

We must still make estimates for each succeeding year in order to arrange for classes, laboratories staff assignments. Estimates on a long-time basis are needed to have the facilities and staff necessary to train our proportionate share of those boys and girls now between the age of 1 and 18 who will desire and can profitably use a college education.

The projection of our future enrollment must take into consideration two very definite factors. The first, that the number of young people reaching college age will increase almost every year for the next decade. Second, the percentage of people who reach college age and actually enter college has been increasing and will probably continue to increase.

Most of the students who entered as freshmen in September 1954 were born in 1936. Of those born in Indiana in 1936, 2766, or 5.11% were freshmen at Purdue University in September 1954. Assuming that our fair share of the Indiana students is only 5.11 percent of those born in Indiana, our freshman class in 1971 would be over 5400 students as compared to 2766 in 1954. This seems like a large number, but it is probably low because it does not take into consideration the increasing percentage of our people who go to college. At the turn of the present century, only four percent of those of college age in the United States were attending a college. This increased to 10 in 1923, to 17 in 1929, and to 31% in 1953. When we consider the increasing number of births and the increasing percentage of students entering Purdue, it is possible to assume that the freshman class of 1971 will exceed 6500. Likewise, we could predict a total enrollment of more than 20,000 students. The number we will have will depend upon the facilities available. Just now it would appear that something less than 20,000 would be the limit of our capacity of 1970.

Every college and university will have to expand to the limit of its capacity if those who reach college age in 1970-75 are to have an opportunity equal to that afforded our present students. You no doubt have observed much construction taking place here. This construction is being done on a ten-year plan and we hope that our present students and those who visit us will understand its purpose. To you I say, I am glad to have you visit our campus, glad that you can see that we are doing all we can for our students of today, and also planning to do our fair share and more if necessary to provide a higher education for the students of the future.

A STUDENT REPORTS
Bill Roach, Purdue University

To the parents of a prospective college student finances play an important part in their plans. A college education today, although available to many more young people than ever before, is an expensive investment. Four years spent in a land grant college, such as Purdue, will cost about \$ 5,000.00 to \$ 6,000.00. If we break these figures down to a yearly basis, we find them distributed something like this:

	<u>State students</u>	<u>Out-of-state students</u>
University fees	\$ 160.00	\$ 160.00
University deposit	25.00	25.00
Tuition fees	-	310.00
Class supplies	90.00	90.00
Residence halls	700.00	700.00
Clothing, transportation, amusement	<u>\$150-500.00</u>	<u>\$ 150-500.00</u>
	\$1125-1475.00	\$1435-1785.00

Although some differences in board and room figures prevail due to different housing facilities, the biggest variation occurs in the last item of clothing, transportation and amusement.

The picture is not as gloomy as it may appear, however. To the good student who is willing to put out a little effort, many opportunities are available to earn money. Many scholarships are available to needy and deserving students. Some pay as much as \$250.00/semester. Loan funds exist for students that need small amounts of money for short periods.

The most common financial aid to students is part-time employment. Many opportunities are available for work either on or off campus. For part-time employment the maximum time that can be spent working is usually thought to be about twenty hours a week. Students who have difficulties with their studies should not work unless it is absolutely necessary. Conversely, those with scholastic ability can well afford to put in a few hours a week.

Even more important than finances is the proper adjustment to college life. Many high school graduates come to Purdue each year with high ideals, fail to make the necessary transition and leave at the end of the semester very disappointed. Learning to study, budgeting our time, and becoming part of the college community are just a few of the important phases of college adjustment.

Rather than go into a detailed discussion of college adjustment, I would like to outline just a few suggestions that I would have appreciated when I was a freshman.

- A. Come to college with graduation in mind.
- B. Don't be afraid to change majors or schools if you are not satisfied and have found a subject in which you are truly interested.
- C. Classroom education without amusement, recreation, entertainment and fellowship is of little value.
- D. Your time is precious, budget it; some for study, some for recreation and entertainment, and eight hours for sleep.
- E. When you study really study.

CORRECTIVE MANAGEMENT OF SHRUBS

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Corrective maintenance of shrubs involves cultural and management practices that should be done beginning with planting a plant in its permanent location on through the life span of the plant or its removal or replacement.

These practices are listed as follows:

- | | |
|----------------|---------------------------|
| 1. Pruning | 5. Spraying |
| 2. Fertilizing | 6. Removal or replacement |
| 3. Watering | 7. Special effects |
| 4. Mulching | |

1. Pruning. At planting time it is advisable to remove from one-fourth to one-half of the foliage bearing wood. If the shrub is vigorous it will quickly recover. If it is weak this pruning may save its life.

Prune the branches to various lengths, perhaps removing one entirely if the plant appears weak. Cuts should be made near to and parallel to the direction of growth of the twig or bud below the cut.

The younger the plant that is set out, the less pruning required. Small shrubs or potted shrubby-type evergreens should require very little pruning. Broken twigs or branches should be removed. Otherwise, light pruning for shape-ness may be desired.

The primary purpose of pruning shrubs is to keep them vigorous and in good form. A little pruning each year will accomplish this. The pruning should be timed in accordance with the blooming habit of the shrub.

Prune in late winter or early spring

Abelia	Hydrangea
Berberis	Honeysuckles
Buddleia	Hybrid Tea Roses
Ceanothus	Rugosa Roses
Callicarpa	Winged Euonymus
Kerria	Vitex
Hypericum	

Prune soon after blooming

Beautybush	Magnolias
Cydonia	Viburnum carlesi
Deutzia	Viburnum lantana
Forsythia	Viburnum burkwoodi
Climbing Roses	Winter Honeysuckle
Dr. Hugo Rose	Spiraea
Lilacs	

Prune lightly after blooming and again lightly in spring

Coralberry	Winter Honeysuckle
Shrub Dogwoods	Weigela
Most Viburnums	

On older shrubs new growth appears more in new shoots from the ground than in annual tip growth. In these cases some old wood should be removed at the ground. Some young canes and some old should have removals at various heights on the canes. When this is done the new wood will appear at the proper places to retain the general or natural form of the shrub without creating open spaces at the base of the plant - "legginess."

Some plants such as Kerria, Buddleia, Vitex, Mahonia and Weigela may winter-kill some annually and will thus need to have a spring pruning each year.

When a shrub must be sheared or heavily cut back annually to control its size, it should not have been selected for this location in the first place.

Such shrubs as the Hills of Snow Hydrangea and Rugosa roses respond to heavy spring pruning for quantity of bloom and a more shapely plant. Rugosa roses may need heavy pruning to short canes of 18 inches to near the ground and of varying lengths, every two to three years.

Some old shrubs, such as forsythia, honeysuckles, privets, gray dogwood, sumac, elderberry and euonymus, may need thorough renovation rather than removal. This is accomplished by cutting the entire plant back to near the ground in the late winter or early spring. The new growth shoots that come may need to be thinned and some shortened to control the proper form.

2. Fertilizing. When the soil is properly conditioned at planting time, little commercial fertilizer will be needed. In April, one or two handfuls of a commercial fertilizer, such as 10-6-4, worked into the soil about each shrub should be sufficient, or two pounds spread over each 100 square feet of shrub bed and worked lightly into the soil at two-year intervals will help to get vigorous growth especially on the lighter, sandy soils.
3. Watering. Ample watering is essential in establishing a new shrub planting. The shrub bed should be soaked deeply during droughty periods.
4. Mulching. Shrubs are most at home and respond best in a well prepared soil with a mulch. This is similar to a woods floor condition. Mulches eliminate cultivation, reduce competition from weeds and conserve moisture for the plant. Twigs from pruning can be allowed to decay under the shrubs with the mulch. Mulches of ground, crushed, or even whole corncobs are advantageous to establishing shrubs with the minimum of care. Mulches should extend beyond the spread of the plant to eliminate damage from mowing.
5. Spraying. Scale insects on shrubs, such as lilac, shrub dogwoods and some shrubby conifers, red spider on shrubby junipers, and plant lice on the new growth of some shrubs are the principal pests to watch for. Refer to your state experiment station or to your county agricultural agent for control measures.
6. Removal or Replacement. In some old shrub plantings, a decision to remove a plant or to replace it may be better than attempting to control it by pruning. Such a situation has its own peculiar environment. Other plants nearby are often reason for careful study in shrub mass composition. Decisions on procedure in such cases are an individual problem that should be determined after careful study on the spot.
7. Special Effects. Shearing shrub hedges for a special effect should determine the method and frequency of this phase of maintenance. Full, tight hedges to the ground are developed by frequent shearing and by keeping the hedge wider at the base than at the top.

Old, leggy shrub hedges may be renovated by cutting all the plants near the ground and bringing it up again with strict attention to the matter of breadth at the base.

8. Tools. Good tools are essential to good shrub maintenance. Hand pruners for small cuts, loppers for larger stems, and a narrow curved saw for large, old stems in old shrubs should be in condition to use at all times. A sharp knife is also a fine tool for light selective pruning.

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NUTRIENT ABSORPTION BY PLANTS

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The subject nutrient absorption by plants will be discussed from the standpoint of (1) The chemical elements found in the plants, (2) the role of soil in relation to nutrient absorption, (3) how the elements are absorbed by the plant, and (4) the correlation of these principles with turfgrass management.

Elements found in Plants

It seems probable that there is not a single chemical element which cannot be found, at least in traces, in some species of plant under certain conditions. Some forty odd elements have been identified by chemical analyses as occurring in plants. How many elements are actually essential for healthy turfgrass growth is not known; that there is considerable variation in the amounts of the various elements found in plants is well recognized. For purposes of classification, certain essential elements are considered of major importance; these are: carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulfur, calcium, iron and magnesium -- C H O P K S Ca Fe Mg. Other elements known to be essential, but required in minute quantities, are generally referred to as "trace" elements. Some of these which might occasionally be deficient on turfgrass areas are: copper, zinc, manganese, cobalt, boron and molybdenum.

If water (which generally constitutes some 60 to 95 percent of the plant body, depending on the stage of growth) is removed -- by drying -- and if the remaining material is burned, the combustible fraction -- organic matter -- will be driven off and only the ash will remain. The ash represents roughly the minerals absorbed by the plant from the soil with the exception of nitrogen, which goes off with combustible fraction. Carbon, hydrogen and oxygen, the basic elements in carbohydrates, are acquired by turfgrass from the air (photosynthesis). Soil provides the minerals and in the case of grasses, also the nitrogen. This latter element combines with the carbohydrate fraction (C H O) in the synthesis of proteins (C H O N). Composition of the plant ash varies with both the species and environmental conditions under which the plant has developed.

Soil in Relation to Nutrient Absorption

As already mentioned, the soil is the source of the elements absorbed by the plant roots. Let us examine the situation more in detail and review the soil in light of this discussion on nutrient absorption.

Water is universally a component of soils, although the amount may vary from a mere trace to a quantity sufficient to saturate the soil. Dissolved in the soil water are varying quantities of numerous chemical compounds. These originate principally from the dissolution (chemical weathering) of the rock particles, from the decomposition of organic matter, from activities of micro-organisms and the soil constituents. The soil water contains oxygen, where the soil is well aerated, which acts in an oxidizing capacity on minerals and organic materials. Other substances in soil water are organic acids (humic acid), inorganic acids, and soluble salts.

When an inorganic salt is dissolved in water, it dissociates into ions. There are two types of ions; (1) cations and (2) anions. The cation is the element carrying a positive charge of electricity and the anion carries a negative charge. The number of charges carried by a given element varies. When cations and anions combine to form a salt, the positive and negative charges must be equal. Examples: potassium nitrate dissolved in water dissociates into the potassium cation, K^+ , and the nitrate anion, NO_3^- ; calcium nitrate dissociates into one calcium cation carrying two charges, Ca^{++} , and two nitrate anions, each carrying one negative charge,

NO_3^- , NO_3^- . The principal cations found in the soil solution are calcium, (Ca^{++}), magnesium (Mg^{++}), potassium (K^+), sodium (Na^+), aluminum (Al^{+++}), and iron (Fe^{++} or Fe^{+++}). The principal anions are carbonate (HCO_3^-), phosphorus (PO_4^{---}), nitrate (NO_3^-) sulfate (SO_4^{--}), chlorine (Cl^-) and silicate (SiO_3^{--}).

The plant feeds on the mineral plant food that is dissolved in the soil solution; i.e., the various cations and anions (collectively ions) are taken into the plant root in this form. Subsequently, they are remobilized and incorporated into the various compounds (carbohydrates, proteins and fats) synthesized by the plant.

Absorption Processes and Mechanisms

The next problem upon which we should direct our attention is the actual absorption process; in other words, how the elements get from the soil into the plant root.

The absorption of water and nutrients by living cells involves several complex forces which are only imperfectly known by plant physiologists. As the study of mineral uptake by plant cells has progressed, theories and mechanisms designed to explain the process have been proposed in abundance. These theories fall generally into two classes: (a) those which interpret the process in terms of special physical or electrical characteristics of cellular membranes, and (b) those which postulate regions of the root having special chemical properties.

An examination of the existing information on nutrient absorption reveals certain basic facts and conditions which are worthy of consideration. A simple listing, with limited discussion of the pertinent information concerned with water and nutrient absorption, rather than a detailed discussion of the various phenomenon appear to be in order.

The actual absorption of dissolved minerals by root cells from the soil solution does not follow any set pattern.

In some cases, the absorption of mineral elements by plant cells seem to follow the basic law of diffusion; namely, the molecules of a dissolved substance diffuse from the region of greater concentration toward a region of lesser concentration. As a result of simple diffusion, these dissolved minerals would move into a plant cell only when the concentration of these particles is greater outside the cell than it is inside the cell.

The reverse situation -- nutrient elements passing from a region of lesser concentration toward a region of greater concentration -- is the more common phenomenon in living plant cells. This active absorption, as it is frequently called to distinguish it from simple diffusion, seemingly occurs as a result of the expenditure of energy by living protoplasm. The source of the energy expended in nutrient absorption is presumably carbohydrates which are oxidized in the absorbing cell during the process of respiration.

Absorption of nutrients and water is thus part of the respiration processes of the root cells, which can only function in a soil that is adequately aerated.

The absorption of ions by a cell is usually independent of the absorption of other ions.

There is, at the most, only a slight correlation between rate of transpiration and the rate of absorption of mineral salts from the soil. The absorption of water and mineral salts are largely, if not entirely, independent processes. However, the dissociation of the salts occurs in soil water.

Water moves into the cell by osmosis and imbibition.

Roots not only absorb the freely diffusible ions in the soil solution, but can also liberate cations absorbed on clay particles which in turn can be absorbed by the plant root. In general, it appears that the cations which enter plants come largely from the outer layer of the clay particles, while the anions come largely from the soil solution.

The region of the root in which intake of water occurs is also the zone in which absorption of ions take place, and the pathway which nutrients follow in passing from the soil into the plant is the same as that followed by water. The root tips are, under favorable conditions, rapidly growing organs and, therefore, centers of high metabolic activity. Carbon dioxide resulting from respiration is continuously being released into the soil in which it reacts with water, forming carbonic acid; around each root tip there will usually be, therefore, a localized zone of high carbonic acid content. When the root is in intimate contact with the clay particle, hydrogen cations (H^+) from the carbonic acid may displace absorbed cations (Ca^{++})-- process of cation or base exchange -- which subsequently may be absorbed by the plant. The application of fertilizers to soils will also induce cation exchanges.

Nutrient Absorption in Relation to Turfgrass Management

Since most absorption occurs at the tip of the root, especially in the root hair zone, from a physiological point of view, the number of root tips borne by a root system is probably the most important consideration in its effectiveness as an absorbing organ. Absorption of water and nutrients by the root systems of most species of plants proceeds more in well aerated soils than in those which are not. Poorly aerated soils (poor drainage) contain a lower concentration of oxygen and a higher concentration of carbon dioxide than the atmosphere. Reduction in the available oxygen supply, at least when severe, reduces the rate of respiration of the roots. If this process is very greatly checked, the rate of root growth and other metabolic processes within the root cells are disturbed. While the roots of most species of plants can survive for short periods in soils practically devoid of oxygen (saturated soils), a continuation of this situation for any considerable length of time leads to a stunting, or even death of the roots in most species. Factors which influence the rate of root growth may, therefore, also have important affects on the amount of water and nutrients which can be absorbed.

An actively growing root system that is performing its function of absorbing water and nutrients will have a relatively extensive area of growing tissue (with many root hairs) permeating the soil. Roots must have water and air, as well as nutrients, to grow and develop; hence, the growing tip of the root follows or grows through voids (large pores) where these materials are found.

It is now well established that most of the water and nutrients which plant roots are able to take up are made available to those roots by their growth or extension into parts of the soil which have a sufficient amount of available moisture, and a new supply of nutrient elements. In other words, the plant root must seek out new supplies of moisture and nutrients, instead of these materials seeking the root; otherwise, it would soon utilize all the nutrients and water in a given area. This is one very good reason for developing and maintaining as favorable an environment as possible under turfgrass. A favorable environment means an adequate supply of oxygen, moisture and nutrients, and if turfgrass areas are to be what we desire, these three factors must be considered. Management practices which are conducive to satisfactory air, water and nutrient levels are well known and they are associated with good physical soil conditions.

Disease Development is Slow
Dr. Wm. Klomparens - Pathologist

The Upjohn Company, Kalamazoo, Michigan

Although many diseases affecting fine turf are not fully understood, it is known that plant diseases require a certain minimum length of time before they cause appreciable damage. The parasitic fungus must enter the plant, establish itself and then grow from cell to cell before evidence of damage can be seen by the observer. Thus, there are always early symptoms and various stages of infections prior to serious damage or complete killing. The correlation and explanation of some of these early symptoms, with which most Golf Course Superintendents are familiar, is to be the topic of discussion.

Initially the term "disease" must be defined. Most Golf Course Superintendents consider a disease present when they can see evidence of parasitic action; specifically, when many blades of grass in a restricted area are dead or dying. We shall attempt to broaden this accepted definition.

With this in mind, I should like to ask a question. How many Golf Course Superintendents are there who have not found evidence of dollar spot when turf which was ordinarily cut at $1/2 - 3/4$ inches was cut down to $1/4$ or $3/8$ inches? Dollar spot is frequently uncovered in this manner. Although not in accord with our restricted definition, the disease was present. The important point is that the disease was there whether you could see it or not. This is also the case with the other turf diseases. They are causing damage during most of the growing season even though it is not apparent as the greens are routinely checked each morning. Dollar spot may, of course, be seen when no more than a single blade has been killed and bleached. This would be an early, visible symptom to the careful observer.

Large brown patch is another problem. Remarks are often made that no large brown was present at 8 PM; but in the morning, dozens of areas up to 18 inches in diameter had become infected. Such things are biologically impossible. Starting from a central point, the organism is not capable of such growth. A more logical explanation would be that the infection had been present for several days. Day by day a few more blades became infected. These infections probably were on the lower blades where the humidity was the highest. The "smoke ring" was absent, but the disease was present. Then suddenly one of two possibilities enabled you to see the evidence. Possibly the humidity and temperature at night allowed a more general infection and the formation of the "smoke ring" was accompanied by evident killing of the turf. A second possibility would be found in a sudden drop in the relative humidity allowing the blades which had been infected several days earlier to wither and die. Syringing is practiced for this very reason. We all know what happens when evaporation and transpiration are excessive. The effect on diseased tissue would be the same, but greatly multiplied and permanent.

A similar set of circumstances apply to the leafspot on Kentucky bluegrass. The infection occurs in April and May when cool, wet weather is present. Little damage is seen, however, since soil moisture is present and the sunlight is not intense. But in June, the rains are less frequent, the soil moisture goes down and sunlight becomes intense, then the bluegrass may suddenly die. The infected grass parts are not able to withstand the changes in the environment. This would be no overnight event. It would be the result of a long infection period and prevention should have been started in April and May. Chemical treatment in June will not save the turf.

There seems to be no simple way for the Golf Course Superintendents to become aware of early disease symptoms if he cannot see them. This discussion then may only serve to stimulate preventive spraying where possible, or to justify the continuance of existing preventive spray schedules as they have been previously practiced. The parasites are present constantly. Practical disease control by management practices and toxic chemicals results in keeping the parasites within bounds so that the damage they cause is not apparent to the casual observer.

POA ANNUA CONTROL WITH ARSENIC MATERIALS

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One of the major problems in the maintenance of fine turf for putting greens, fairways, lawns and athletic fields is the potential infestation with Poa annua. We see it most obviously on the putting greens in fall and spring periods when the bentgrass grows more slowly and the Poa annua, because of its cool season nature, grows very rapidly and produces seedheads regardless of the height of cut. Many people have observed that vigorous growing grasses could reduce infestations of the Poa annua seedlings and that good maintenance which maintained a thick cover of competitive turf was a good Poa annua control. However, many of the practices of utilizing and maintaining turf provide openings which may permit an infestation of young seedlings during at least six months of the year in the midwest.

Poa annua is a so-called annual because it can germinate and produce a seed crop in as little as two months under ideal conditions. It does not have to develop the reserves and rhizomes that Kentucky bluegrass does before seed formation. However, Poa annua may live for several years, as observed around golf greens and on fairways, until either wilting or disease kills the plant. When these disasters come and the turf is lost, openings are left for crabgrass, clover, or later Poa annua infestations.

Before the introduction of new insecticides, many superintendents used repeated applications of arsenate of lead as an insect control. In 1940, 90,000,000 pounds of lead arsenate was used in the United States. In 1953 this had been cut to 18,000,000 pounds. About 1944 many superintendents began using chlordane and other insecticides. In 1950 they wondered if it was not the arsenic they had been using which had reduced weedy grass infestations, including Poa annua and crabgrass. Several golf course superintendents who continued to use lead arsenate regularly report little infestation of Poa annua.

Experimental

We started a series on the No. 6 fairway of the Lafayette Country Club in September 1951 using many chemicals, including lead arsenate at 30 lbs. per 1,000 sq. ft. On November 1, two months later, the Poa annua in the area given the lead arsenate topdressing showed reduced growth, shortened root system and very little vigor.

That winter in the greenhouse, two 4" bentgrass plugs were placed in each of 32 flats of soil which was overseeded to Poa annua. Three days later Chloro-IPC was used at 0 - 1/4 - 1/2 - 1 gallon per acre. All applications of Chloro-IPC gave good Poa annua control. However, the 1/2 and 1 gallon per acre caused the bentgrass to stop growth for as long as two months. Therefore, it is not recommended for seedling growth control in established turf. Likewise, Dinitrophenol was applied at .05 - .1 - .2 gal. per acre with the higher rate giving control. However, Dinitros are definitely foliar burning materials and the superintendent would need to be very careful to avoid foliar burn to his existing grasses; therefore, Dinitros are not recommended for Poa annua control selectively.

Meanwhile, in May 1952 the lead arsenate applied the previous September on fairway turf again showing definite Poa annua weakening so that it was not competitive with the bluegrasses. The following fall we established an additional series of Poa annua controls on the same fairway and on the practice green of the Lafayette Country Club. We did not observe any control on the practice green where soil tests showed there were very high phosphorus accumulations. In 1953 a second application was made to the putting green and since that time phosphorus applications have been cut considerably. A reduction in Poa annua was not observed the first two years after arsenic was applied.

In 1953 we again utilized the greenhouse and planted Poa annua in flats into which Merion bluegrass strips were seeded. Lead arsenate was used at 0 - 20 - 40 - 60 lbs. per 1,000 sq. ft. mixed into the upper 2" of the soil prior to planting. Sodium arsenite was applied at 0 - 2 - 4 and 6 lbs. of 91% dry powder mixed into the surface 2". When the Poa annua was approximately one month old the arsenic began to inhibit its vigor. We then applied 20% super-phosphate at one ton per acre, or 50 lbs. per 1,000 sq.ft., to one-half of each flat. Within two weeks the plants previously showing arsenic inhibition began to show new growth and normal vigor which continued for the following six months. Rates of 20 lbs. lead arsenate, or 2 lbs. sodium arsenite mixed into the soil prior to planting was sufficient for one year. Regardless of the amount of arsenic applied, the super-phosphate application overwhelmed the arsenic effect. The Merion bluegrass strips showed greater tolerance to high arsenic than did the Poa annua.

This relationship then becomes one of arsenic toxicity as the young plant roots take up arsenic and combine it into the carbohydrate metabolism of the plant, replacing some of the phosphorus normally present in the carbohydrate molecules. Apparently the arsenic-carbohydrates are not translocated; therefore, the Poa annua does not produce new growth. The plants will survive unless drouth or disease might kill the seedling. This did not occur under the greenhouse management. However, Poa annua plants five months old were no larger following arsenic toxicity than at the one month old stage.

In order to observe the effect of topdressing, we applied 1" of arsenic-free soil over an arsenic treated layer. The Poa annua readily established a root system throughout the upper inch; the plant secured sufficient phosphorus from this top layer and the varying arsenic application was of less effect. Conversely, when we put arsenic-free soil below arsenic treated soil, the Poa annua, soon after germination, absorbed sufficient arsenic that for an extended time the plants remained very weak. However, weeds gradually established a tap root into the arsenic-free soil, then after a delay they grew normally. The location relationship points out why Poa annua may have become worse on greens as recent topdressings were not accompanied by lead arsenate applications.

The question arose as to the differences in the tolerance of grass species to arsenic. We prepared 500 four-inch clay pots, using 0 - 250 - 500 - 1,000 - 2,000 lbs. of super-phosphate per acre. These were each divided and mixed with 0 - 10 - 20 - 40 - 80 lbs. per 1,000 sq. ft. of lead arsenate. Then Merion bluegrass, ryegrass, bentgrass and Poa annua were each planted on 100 of these, giving two replicates at both low and high greenhouse temperatures. In cool conditions, such as fall and spring weather, 60-65° F., Poa annua was more subject to arsenic injury than Merion bluegrass, ryegrass was intermediate, and creeping bentgrass tolerated very low phosphorus and very high arsenic concentrations with little evidence of restriction of growth. On the contrary, at high air temperatures, resembling summer temperatures, the Poa annua showed much less arsenic inhibition. This correlates with observations made on the fairway of the Lafayette Country Club where it was very difficult to see the effect during the bright sunshine, long day, high temperature periods of the summer. We found a similar root reduction in Poa annua plants on arsenic treated soils matching the top growth reduction.

Application of Principles

From the practical standpoint, this research, which is being continued, illustrates that superintendents wishing to reduce their weedy grass problems, including Poa annua, crabgrass and goosegrass, should reconsider their fertilization practices. Soil tests at most Experiment Stations in the midwest show excess phosphorus present in fine turf soils due to the repeated application of complete fertilizers in an attempt to get a nitrogen response. Out of more than 100 golf greens soil tests at Purdue University at least 95% show excess phosphorus, indicating that the use of arsenic chemicals to secure Poa annua inhibition would require rather

heavy applications. Even with plant use and phosphorus fixation it is estimated that it will be over 5 years before the excess would be removed. Thus, the need to reduce the annual additions of phosphorus, when there is an excess already present.

Some superintendents may be interested in applying lead arsenate in the early fall or early spring at approximately 20 lbs. to 30 lbs/1,000 sq. ft. to two of their Poa annua infested greens as an initial test application. Then they could use lead arsenate at light rates for cutworm and sodweb worm control throughout the summer period to maintain a concentration of soluble arsenic. Since lead arsenate breaks down slowly this could maintain such a concentration that weedy grasses germinating would be reduced in vigor at an early stage.

The mechanics by which the arsenic uptake inhibits the Poa annua vigor is most complicated. These factors favor arsenic inhibition:

1. Low phosphorus availability level
2. Cool weather
3. Short days for photo-periodic activity
4. Arsenic application prior to cool fall and cool spring periods
5. Having arsenic carrying soil as the surface area

These facts have been observed:

1. Arsenic availability and application must be approximately equal to those of phosphorus for inhibition.
2. Toxicity of an application of lead arsenate at 30 lbs. per 1,000 on unfertilized turf is still evidenced three years afterwards when phosphorus was medium in supply and none added.
3. On new seedbeds sodium arsenate gray powder 3 - 6 lbs./1,000 mixed into soil was equal in effectiveness to 20 - 60 lbs. lead arsenate. Severe leaf burn occurred when used on established turf at above rates.
4. Even surface applications of phosphorus, within two weeks, over-rode arsenic toxicity in greenhouse studies.
5. When phosphorus is excess in the soil, arsenic accumulations must be greater and may not be able to inhibit Poa annua.
6. There is a definite species tolerance in bentgrass and Merion bluegrass beyond that of Poa annua so the latter can be controlled selectively in turf if phosphorus is not excessive.
7. Extremely heavy applications of lead arsenate might produce lead toxicity.

This study is being continued. Its original purpose was to determine if arsenics or other chemicals would inhibit Poa annua. Other chemicals are being further tested in experimental work. This report should not be construed as an indorsement of lead arsenate along since any form of arsenic carrying materials, if applied without damage, could achieve similar results. And a word of caution-it may take considerable time before Poa annua weakening is observed.

LABOR RELATIONS AT THE CINCINNATI COUNTRY CLUB

John McCoy, Supt., Cincinnati, Ohio

In order to understand the labor arrangements at the Cincinnati Country Club, I believe you will have a better understanding if I first give you a brief picture of the overall club operations.

The Cincinnati Country Club, started in 1895, is located only four miles from the downtown area, on 100 acres of very rolling property. The membership consists of 750 families with approximately 3200 persons eligible to use the club facilities. The main clubhouse handles the social affairs with golf facilities in a separate clubhouse. There are 18 holes of golf, a swimming pool, four tennis courts with granular surfacing and the club grounds with many flowers. All maintenance outside of the club buildings, except the swimming pool, is taken care of by the Grounds Maintenance Department.

All departments of the Club operate on a budget. The club employs approximately 65 persons on a full time basis with extra help as needed. Eight men are carried on the grounds payroll throughout the year with extras during the golf and tennis seasons. The Club recognizes no labor unions. Some union members work for the Club mainly in the clubhouse kitchen and in the dining rooms. Union wages and working conditions, or better, prevail in all labor classifications. Grounds department wages and working conditions are considerably better than union cemetery workers doing similar work. Life insurance and disability benefits, to be mentioned later, similar to union contracts cover all full time employees. These factors help us to operate on a non-union basis as employees receive more than they would if unionized.

Some of the labor management features, which apply to all employees, and which help to promote long and faithful service are as follows:

The one probably most looked forward to by the average employee is the year end bonus contributed to by all the members for all the full time employees. The distribution of the bonus is based partly on length of service and partly on service rendered. The amount of the bonus may run from an extra week's wages for a new employee who has served for a year or less to upwards of two months wages for long time or supervisory employees. This bonus, more properly termed a gift, is not given as a condition of employment and is not subject to Federal Income tax.

Another feature of more recent date is life insurance and disability benefits for death, or for disability not connected with their Club employment. Each full time employee, after the first three months employment, receives a \$1,000.00 life insurance policy payable to their beneficiary in case of death and hospital and surgical fees up to specified amounts in case of sickness or injury. This applies only to the employee and not to their dependents and is paid for entirely by the Club without contribution from employees wages. State Workmans Compensation covers all employees sickness or injuries caused by their employment and is paid for by the Club. Since the state pays no compensation for the first weeks time lost in case of injury, the Club usually pays full wages for the first week and often the difference between compensation payments and their regular wages especially where injury may have been caused by another's actions.

Pensions on retirement caused by age or sickness have been and are being paid currently to some employees after long and/or faithful service. Each case is considered individually by the Board of Governors. There is no established policy.

Two weeks vacation with full pay is given each full time employee after the first year. At the clubhouse most vacations are taken in their off season, July and August. On the grounds vacations are taken in the winter months from mid-December to March. In the past sick leave up to two weeks was given employees.

Later this was reduced to one week. Abuse of this privilege made it necessary to stop this practice. At the present time some sick leave may be granted subject to the discretion of the Department Head and with the approval of the Committee Chairman. Laying off a day or two because you do not feel well is not considered sickness.

Now for a few things as they apply specifically to the Grounds Department. -

We guarantee all full time employees 44 hours work each week the year round if they report in. As far as possible we work definite hours each day, eight hours per day week days, four hours on Saturday, and as needed on Sundays and Holidays. We recognize six holidays, Decoration Day, July 4, Labor Day, Thanksgiving, Xmas and New Years. We pay a standard rate for the first forty hours in any one week, overtime at one and one half times standard rate for week days and Saturdays, and two times standard rate for Sundays and Holidays, with a minimum on Sundays and holidays of six hours pay. All wages are paid weekly at the end of the third day following payroll closing. Grounds employees also receive three paid holidays on which no work is done, Thanksgiving, Xmas and New Years. Special work required on these days is paid for extra. Employees receive an extra half day off before Xmas and New Years, and time to visit a doctor or dentist during work hours if necessary. During the winter months grounds employees take a coffee break in mid-morning, the clubhouse furnishing the coffee.

In all our operations we look at it both from the employers and the employees viewpoint and aim to make the work as agreeable as possible. Powered equipment is used wherever possible. Some items of power equipment that cannot be purchased have been developed in our own shop. The hilly nature of our terrain and old style golf architecture makes much hand work. Rotation of work whenever possible keeps the labor better satisfied. In other words, no course employee is hired for any specific job, but all are employed to do whatever is necessary to maintain the grounds. Criticisms and compliments are both passed on to the employee, the better to serve the membership. After all SERVICE is the reason for our employment and the Board of Governors, representing the members, have expressed their sentiments in the working conditions and benefits provided.

I think I have mentioned the most important incentives and methods we employ in trying to maintain our labor personnel and trust it may be of benefit to some of you in your circumstances.

LABOR POLICIES AT MY COURSE
Ernest Schneider, Supt.
Evansville Country Club

On golf courses as in industry, the number and type of workers available control labor policy. For instance, in a city like Evansville, where we have numerous factories in comparison with our population, our chances of finding capable help at lower wages are quite a problem. We have not been able to keep our hourly rate in line with industry. So when we find help who fit into our program, he usually likes the outdoor work and is looking for security. We in turn offer him a minimum of 47 hours a week, paid holidays, a small raise at intervals during his probationary period, a weeks vacation with pay after he has been employed a year, and two weeks for two years service or more. In return, he is expected to give us a good days work; and learn to exercise his mind so as to become an asset to the crew. He must be cooperative and by all means get along with people.

During the summer months, we have Sunday work and it is hardly ever necessary to force someone to work these hours, we usually have some of our men who are interested enough in the golf course to come in and do the job. While we have no provision for time and one-half for such work, we try to make it up by not charging time against them for such necessary trips as doctor, dentist, driver's license, etc., and quite frequently they are paid for their time coming and going when called in for parts of a day.

Usually one man cuts the same greens--when ever possible; it is good practice for him to look after all the jobs in that area. When a man becomes familiar with his area, he is more apt to notice anything that needs attention. He either takes care of the work or reports it to his superintendent--this is one of the best ways he can help me. While each operator is expected to know something in regard to mower repair, the bulk of it is done by men who are mechanically minded. On courses like ours, where we cannot pay a full time mechanic, I find that two men trained to do all the repairs on machinery, can be a big savings on the budget. Only the equipment which we cannot repair is sent out for servicing.

By studying a man, you can usually find particular machines that he will be capable of operating or certain jobs that he does unusually well. But on the other hand, I try to teach all men to do all the major jobs--in that way I never have to depend on any one man for a certain job. Also, when buying new machinery the one who will operate it is taken into consideration--this is good for the machine and the operator too.

Whenever possible, repairs on the club house and other buildings on the grounds, are done by the ground crew. This is not only a savings for the club, but has become a way of reimbursing my budget, and this is why I am able to keep four men the year round.

By letting each man know what is expected of him, by considering him as person with feelings such as our own, we will get the job done.

LABOR POLICIES AT MY COURSE
Don Strand, Supt., Westmoreland C.C.

Westmoreland is located in a white collared labor market. 80% of the inhabitants of the surrounding towns are business or professional people or work in business or professional offices. Skokie, which borders Westmoreland has many small industries which skim off of the labor market those who are not interested or are not trained for white collared jobs. All this creates stiff competition for golf course labor. At Westmoreland we have been able to maintain a full time crew of 6 key men, partly due to a policy of annual wage agreements with designated responsibilities wherever possible. Our foreman, tree man, mechanic, and gardener are employed on a monthly wage the year around. They work 45 hours per week and alternate Sundays in summer. All receive 2 weeks annual vacation and participate in a bonus proportionately to the length of employment. We are now trying to establish a policy of additional vacation time for accumulated overtime on the basis of 3 days for each 16 hours of overtime. Some of the men go South for their vacation and prefer a longer vacation to overtime pay.

Due to the critical labor market we have to depend on school vacation help for supplemental summer help. We try to recruit boys from the upper classes of our local High School, the idea being that capable boys who enjoy the work will return for all or at least part of their college vacations, an idea that has proved logical in past years. Since the \$600 limit is no longer a factor, we plan this year to establish a policy of paying a 5¢ per hour bonus for those boys who remain through the Labor day weekend, in order to try and prevent a grand exodus about the 10th to 15th of August for family vacations, football practice, or just plain tired of working, which usually resulted in either a green or short-handed crew for the last half of August and the Labor day weekend.

NITROGEN USE AND WHY

Robert M. Williams
Supt. Beverly C. C., Chicago, Illinois

When Dr. Daniel asked me to present this report he stated that he would like the practical reasoning behind the fertilizer program at our club and a resume of the actual program we follow. So let's reverse the wording of our title and start by discussing, WHY USE NITROGEN?

Nitrogen promotes vegetative growth, increases the green color of the leaves, and increases the succulence of the plant. Of course if we use too much nitrogen we get a weak, yellow, non-resistant plant. Our objective then is to find the happy medium so that we produce a good healthy plant and in turn a good healthy turf. Naturally we must keep a balance of other nutrients too in order to make the plant react in the proper manner. However this report is designed to deal primarily with the nitrogen factor.

Our fairway soil varies from heavy clay to light sandy silt, so we naturally will vary our fertilizer program on these areas. The grass type is predominantly bent grass with poa annua and poa trivialis mixed in. The height of cut is 9/16ths in the Spring and Fall, with about 3/4 inch in Midsummer. Our annual nitrogen application will total approximately 2 1/2 lbs. per 1000 sq. ft. This is usually applied in three applications. We start our program off in late February or early March by applying about 1 lb. of nitrogen per 1000 sq. ft., along with phosphorus and potash. The past two years I have used 6-12-12 for this purpose @ 700 lbs. per acre. Then we follow up with Milorganite at 800 lbs/acre in early August and again in September, if we have funds left and if the grass needs it.

This Spring I will vary the program by eliminating the phosphorus in the mixture in an effort to make our spring sodium arsenite treatment of poa annua more efficient. We have been trying some mixtures of Nugreen and muriate of potash for this purpose.

I have noted that over the past 8 years we have reduced our application of fertilizer to the fairways. It appears to me from both soil tests and turf condition that we are building up some of the depleted reserves of fertility. This same fact seems to be borne out in the green program as well.

In 1954 we used 5 1/2 lbs. of nitrogen per 1000 on the greens. In 1953 the figure was 4 1/4 lbs. Prior to that time we were using from 7 to 9 lbs. per 1000 per year. Along with the decreased use of nitrogen we have decreased to a greater degree the amount of phosphorus and increased the quantity of potash so that we end up the year with a nutrient ratio of about 5-1-2 on the greens and about 5-6-4 on the fairways.

The past two years I have been interested in watching the correlation between the summer condition of greens on various courses and the fertilizer practise on those greens. My observation is only a repetition of what so many of the older superintendents have told us in the past, that Greens should be kept slightly on the hungry side in the hot and humid weather. Greens that are seldom if ever given a square meal of nutrients will thin down and be victimized by disease, and have no color. Those that are overfed and usually overwatered too are devoured by disease and wilt, and usually appear trampled to death around the cups.

Our practise for fertilizing greens begins in November when we apply approximately 2 lbs. of nitrogen per 1000 sq. ft. to the greens in a dry organic form of either Milorganite or corn gluten. This gives us a head start in the Spring by bringing out color and growth several weeks ahead of the usual spring applications.

Also we do not have to rush around in the Spring trying to get the first treatment on the greens. With this procedure we can wait until we have the irrigation turned on which is usually about April 15th, and then go ahead and start our mid-spring fertilizing which is generally a complete fertilizer, such as 10-8-6. We use about 75 to 100 lbs. of this material at this time. After these two treatments, we have no green set schedule but depend more upon the weather conditions and the appearance of the grass as indicators of when and how much we shall fertilize. We have been using the same material throughout the summer months for the past several years and in about the same proportion. The materials are Nugreen and Muriate of Potash. The Nugreen is Dupont's synthetic organic with 45% Nitrogen content. The Muriate is Sunshine Brand from New Mexico and is a white sugar like material containing 63% potash. We normally use this combination at the rate of 6 lbs. of nugreen and 2 lbs. of potash per green of approximately 5000 sq. ft. of area. Thereby we yield 2.7 lbs. of nitrogen and 1.26 lbs. of potash. Dividing this figure by 5 to ascertain the quantity per 1000 we get approximately 1/2 lb. of nitrogen and 1/4 lbs. of potash. We have found this amount to be adequate under our conditions for a period of 3 to 6 weeks.

One of the primary factors guiding our choice of this material is cost. The application of 6 lbs. of Nugreen and 2 lbs. of potash costs 48¢ for the Nugreen and 9¢ for the Potash or a total of 57¢ per treatment per green. Another factor guiding our choice of this material is the fact that this fertilizer has a high safety factor as pertains to burning of the turf. It will burn and burn good if used improperly through quantity or time of application. I have learned by experience not to apply this or most any other material in the real hot weather where daily temperatures run over 90 degrees or when the soil is wet. When the Nugreen and Potash mixture is used it should be diluted in 100 gals. of water per green and then watered in lightly. If the weather continues hot for a long spell I usually apply the Nugreen without the potash and at the rate of 6 lbs. per green in 100 gals. of water and in this case no wash in is required.

This past year we tried out several plots on our fairways where we used the dry Nugreen as a fairway fertilizer. With the High analysis of 45% and the pelletized form, I felt that the kernels would be spaced apart from each other as they fell to the turf and if they burned it would be a very minor one. By applying only 50 lbs. per A. I would get about 1/2 lbs. of nitrogen per 1000 sq. ft. Also, 1 ton of this material would cover my 18 fairways of approximately 40 acres, at a cost of \$160.00. Our tests worked out quite well with the biggest problem being the adjustment of the spreader to this low rate. We will do some more work along this line this coming season.

In summary I would like to repeat. that we are using about 2½ lbs. of nitrogen per 1000 sq. ft. on fairways per year. On greens we are using about 5 lbs. per 1000 per year.

FERTILIZING GREENS AND WHY

Don Likes, Supt., Hyde Park C.C., Cincinnati, Ohio

Bill Daniel has asked me to present our greens fertilizer program, illustrating how we make use of fertilizers. He also asked for a little of the theory or the reasoning behind the program.

Most of you gentlemen have been growing grass for a long time. I would like to merely try to give you an idea of the problem the way we see it in Cincinnati. Our weather conditions are quite variable. We are located in a valley where air drainage is poor. We have very little spring-like weather. We go from winter into hot summer almost over night. And I repeat, the following fertilizer program is set up for the way we see the problem in Cincinnati and does not necessarily apply to other regions.

Sugar Theory

Why do we fertilize grass? We fertilize it because we want it to grow. Because only a growing turf is a healthy turf and only a healthy turf has a good appearance and good putting quality. Grass roots play an important part in the growth of the plant. Why do we have a good root system in our greens in the spring? Then as we go into the hot summer these roots get shorter and sometimes almost disappear? With the arrival of cool weather in fall we notice new white roots starting again.

What is the function of the grass root? It is common knowledge that the bulk of the so-called plant food is absorbed by the roots. We say so-called plant food because we do not feed grass plants, but merely supply the raw materials and the plant manufactures its own food. Now the roots are not only a means of taking in raw materials, but they are storage areas for plant food or sugars, which the plant has manufactured. The plant needs these sugars along with nitrogen for growth. If we force the grass to grow by applying nitrogen, a certain amount of sugar is used up. If the consumption of sugar is greater than the production, the plant must draw on its sugar reserves which are in the roots. Whenever this happens the roots become shortened or at least their normal development is retarded.

When is the consumption of sugar greater than the production? Bent grass produces very little sugar at temperatures above 85 or 90 degrees. To make matters worse the plant needs more sugar for growth at these high temperatures. This could account for the shortening of bent grass roots as we go into the hot weather. If excessive rates of nitrogen are applied, consumption of sugar may exceed production, especially in hot weather.

If nitrogen is applied when this sugar supply is low, it is not only harmful to the root system, but it causes the cell walls of the grass blade to become thin and we say the grass is tender. When in this condition it is easily penetrated by a fungus spore, very sensitive to changes in temperature and moisture. It wilts very easily and footprints badly. And even when moisture is sufficient it becomes nappy and is not the best putting surface.

It has been a common practice to apply heavy rates of nitrogen in the cool weather and light rates in the hot weather. This is not always a good rule. Because at lower temperatures, especially in the spring when soil temperatures lag behind air temperatures, the plant is unable to take up nitrogen. The result is that we may have a dangerous buildup of nitrogen which could be released all at once when the first few hot days of summer arrive. This is particularly true where you have weather such as we have in the Ohio Valley, where we often have a cool wet spring with very little change from our mild winters. This can continue right up to the first week in June and then overnight hot summer is upon us.

To keep this sugar and nitrogen in balance we must be very careful in regulating our applications of nitrogen. It looks like a slow even release of nitrogen would be desirable. Keeping the rates very low in late spring and summer and saving the heavier applications for fall.

Fertilizer Program

We first start with our fertilizer program in late March or early April. This first treatment is a bag of Milorganite mixed with about 35 lbs. of lead arsenate per green. Our theory on this first nitrogen treatment is that the grass needs nitrogen at this time, and although there is plenty of nitrogen present, soil temperatures have not been warm enough to release it and probably will not be until June. The spring application of Milorganite is on top where the warm air can break it down so the grass can feed on it.

After the Milorganite treatment in early spring, no more nitrogen is applied until about the 15th of July. This long interval is a precaution against a dangerous buildup of nitrogen in April and May which can be released all at once when the hot weather hits us, which usually is about the 10th of June. It has been our observation that enough nitrogen is released by the first hot weather in June to carry the grass well into July. We feel that June is somewhat of a barrier we must get through before weather and fertilizer reach an equilibrium. About the 15th of July we start feeding low rates of Milorganite each week or 10 days. The rates are about 30 pounds to the green and it is applied with two cyclone seeders going in different directions. This treatment is carried through until cool weather in the fall.

In the fall, usually in October, we repeat the Milorganite and lead arsenate mixture which is a bag of Milorganite and 35 lbs. of lead per green. This completes the nitrogen cycle for one year.

The potash treatment is in early spring. This consists of about 20 lbs. per green of the red potash with two cyclone seeders going in different directions. It is a granular form easy to broadcast in the cool weather and not watered in. About the 15th of May we start another potash treatment. This is about 5 lbs. per green of potassium chloride. It is a refined white potash and is easily dissolved in water. This is sprayed on the early morning dew and watered in. This treatment usually falls on a morning when we would ordinarily be hand watering our greens, so we kill two birds with one stone. We try to make this treatment about every other Monday through the summer until cool weather in the fall. Then we repeat the early spring potash treatment again, which is 20 lbs. of red potash per green applied with the cyclone seeders.

About the 15th of May we start weekly iron sulphate treatments. The rates are 1/2 lb. per green and is added in with the Tersan and Chlordane treatment. Due to the high alkaline content of the water used in Cincinnati, the pH of our greens is on the alkaline side which helps create an ideal condition for iron chlorosis.

This completes the outline of our fertilizer program for our bent greens. I might point out that no phosphorus is applied other than what is in the Milorganite used. We feel that this is ample phosphorus for this reason. All soil tests indicate our greens are high in phosphorus and we also hope to keep the phosphorus as low as possible and perhaps our lead will be more effective in the control of Poa annua.

NITROGEN USE AND WHY

Lawrence Huber, Supt.,
Ohio State Univ. Golf Courses, Columbus, Ohio

Nitrogen is essential to plants because it plays a fundamental part in the formation of the proteins that are the staff of life. The rate of growth of plants is more dependent upon nitrogen than any other element. In its combined form nitrogen is universally distributed in animals and plants in protein substances. The vital importance of nitrogen may be further appreciated when it is considered that without nitrogen there can be no growth or reproduction on the part of plants or animals.

Primary Source of Soil Nitrogen

Calcium, magnesium or iron originate from the decomposition of original rock material. Instead nitrogen in the soil must come from the air. The air is a mixture of which about 80% by volume consists of nitrogen in a free or uncombined state. It has been estimated that over every acre of your golf courses there are about 150,000 tons of this free nitrogen.

However, plants are unable to avail themselves directly of this immense supply of raw material. Before they can do so the element, nitrogen, has to enter a state of combination with other elements. Only through the intervention of powerful influences, such as lightning discharges or very powerful chemical reactions on one hand, or through milder but just as effective influence of soil bacteria on the other, can nitrogen be "fixed" with other elements.

The Nitrogen Cycle

Because nitrogen is one of the limiting factors in soil fertility and because of its stubbornness to combine with the soil and become readily available to plants, students of soil place much emphasis upon the nitrogen cycle. The nitrogen cycle is a continuous cycle going on of the building up of protein substances through the growth of plant and animals and then the tearing down of these substances through decays or wastes so nitrogen is released.

As plants or plant residues, nitrogen is introduced into the soil as organic nitrogen. Through decomposition of the organic matter, nitrogen may be released as ammonia. This can be converted into nitrites and finally into nitrates which are used by plants or lost through leaching. Some nitrogen remains in the soil for a long time as inert organic matter. If the plants are used as food for animals, a part of the nitrogen is recovered as manure and by-products of the slaughter house. When these are added to the soil, decomposition goes forward and the nitrogen cycle is completed.

It has been estimated that only a total of 5 to 7 pounds of nitrogen per acre annually is added to the soil due to lightning discharges uniting nitrogen and oxygen to form oxides of nitrogen. These unite with moisture in the air to form nitrous or nitric acid which is washed out of the atmosphere by rain and enters the soil. The so called artificial fixation of nitrogen means to bring the free nitrogen of the atmosphere into combination with other elements.

The presence in the soil of an adequate supply of available nitrogen is one of the most important factors relating to the maintenance or improvement of soil fertility. A deficiency of available nitrogen results in plants of poor color and appearance, poor quality and low production.

The textbooks tell us that a sufficient supply of available nitrogen is largely instrumental in getting plants off to a quick start and has a subsequent tendency to encourage stem and leaf development. Such plants will make a more rapid and thrifty growth and possess a normal deep green color and generally healthy appearance. Grass supplied with sufficient nitrogen is better able to utilize other nutrient materials such as phosphorous and potassium compounds. On the other hand, no amount of available phosphorous and potash will overcome a deficiency of available nitrogen.

REPORT ON EXPERIMENTAL GREEN

Camargo Country Club, Taylor Boyd, Supt.
Indian Hills, Ohio

This green was installed for the purpose of determining - first, whether Bermudas and zoysias had a place in Cincinnati as putting green grasses, and second, to learn whether bent cut at putting green height was compatible with Bermudas and zoysias growing next to one another and adjacent to the bent.

This green is 4000 sq. ft. with half in Bermudas and zoysia and the other half in bents. The Bermudas include 4 selections from Texas A. & M. (T-94; T-82; T-35A; T-83) and Tifton U-127, now named Tiffine. The bents are C-1; Pennlu (earlier numbered (10-37-4); C-19 C-52 and C-7. The zoysia is a fine-leaved hybrid $Z_t \times Z_j$, 34-35, now released in Georgia and at Purdue as Emerald.

The surface slope is down from the warm season grasses to the bent grass part of the green so that the warm season grasses can be kept dryer. The tile lines are 14' apart, running across the line of surface drainage. The topsoil is very deep with the top 4" of soil as weed-free as can be had without actually sterilizing the soil.

The planting was done April 19 to 24 with the exception of C-1 bent which was planted May 6. The tile layout, soil mixture, fertilizing and planting was done by a Purdue student majoring in Turfgrass Management under Dr. Daniel. He was permitted to do this work as practice for his own benefit.

Most of the grasses were ready for putting by July 4. The C-1 bent was later because it was planted late. The C-19 was quite slow so was not a good surface until in September. The C-7 was the first of the bents to make a surface, with Pennlu second and C-52 a close third. The T-94 and T-35 Bermudas came along fastest and held a finer surface than any of the warm season grasses. The Emerald zoysia was very slow and was a putting surface only at the end of the season.

The entire area was given at least $1\frac{1}{2}$ lbs. of nitrogen per 1,000 sq. ft. every 10 days until it became a putting green. This practice in the Cincinnati area is extreme abuse for bents. The Pennlu, C-19 and C-52 were at least 40% covered by large brownpatch on June 11. The C-7 had only 2 small patches. No brownpatch treatment was given purposely in order to learn how these grasses would withstand unreasonable abuse. The high nitrogen abuse of the bents was favorable to the Bermudas growth and runners grew as much as 1.5 inches per day. At this rate of growth it was impossible to get a true putting surface on the warm season grasses. During July and August lighter feedings were used, plus a verti-cut and ample good topdressing until the surface became good.

Personally, I have made only temporary conclusions which are:

1. C-7. A good bent for Cincinnati, very susceptible to dollarpatch, but responds to treatment.
2. Pennlu - A very fine grass - extra fine color with good treatment, a good grass.
3. C-52; C-19; C-1 - In order named are not good grasses for the Cincinnati area because of crabgrass and disease infestations.
4. T-94. Very fine texture, fine color and does not travel too fast into surrounding grass.
5. T-35A. Very fine, except color. Same as T-94.
6. Emerald zoysia. Makes a good surface. More stiff than Bermudas.
7. At this point Bermudas and good bents are holding original planting line. Emerald zoysia grows slowly so Bermuda quickly grew into zoysia plot.
8. When warm season grasses are cut at $3/16$ " , properly fed and top-dressed many of our members could not tell which area was bent and which was Bermudas.
9. C-7 and Pennlu were the only bents dense enough to keep Poa annua out in fall.
10. In conclusion, I want to thank Purdue University and Texas A. & M. for their assistance in providing grasses to make this green possible.

EXPERIENCES WITH FAIRWAY IMPROVEMENTS

Ray Davis, North Shore C.C.
(Report on Medinah C.C. renovation)

In the course of many years it would seem that the problem of fairway renovation confronts almost every golf course that has tried to keep watered fairways and to keep ideal summer golfing conditions. There has been a gradual change from the native bluegrass to the bent, which seems to be the only grass that will thrive under conditions of close cutting, constant forcing with watering and fertilizer and the high traffic that is the inevitable result of better playing conditions. It also seems that Poa annua, crabgrass, chickweed and knotweed often do even better than bent and finally become so firmly imbedded in the fairways that renovation has to take place.

Now the function of renovation, as I see it, is to kill as much of the undesirable vegetation as possible, recondition the surface soil so as to favor the rapid growth of desirable turf from seed sown in the newly stirred soil. This operation is expensive and as the case histories of many renovated fairways show, not altogether completely successful. However, it must be done.

In studying and discussing the problem with many superintendents who have gone through this particular headache, it became clear to me that the biggest problem was that of getting the players who would be the ones to benefit from better fairways to understand what we would be trying to do. Then they would know and look carefully for improvement rather than be confronted with the sharp curtailment of their golf in the best part of their season. Because the players do suffer. In order that the seed may be planted early enough to be able to make enough growth to stand the winter and to present a playable fairway the following year, it is necessary to begin the work sometime in August, or at the very latest Labor Day week.

In looking over the problem it became evident to me that the first step should be to inform the members of what we proposed to do and why it was to be done. My Chairman and I, after discussion, asked to form a new committee of interested members with whom we would discuss the problem, the cure and possible results and whom we would keep completely informed of every operation. This we did and because the control of crabgrass was, to us, a major problem, we called it the Crabgrass Committee.

This committee was formed early as we wanted plenty of time to plan to get them organized and educated to their jobs and to win their understanding so that they would be able to inform the members with complete confidence of what was being done and just what each action was expected to accomplish.

The first step after enlisting the aid of the committee was to have them study the problem. To this end we held a series of meetings with a guest of national prominence at each meeting with whom the committee went over the problem on the grounds, discussed it thoroughly, and asked for and received suggestions as to the best way to proceed and the probable results. These meetings were held through May and June, and by the last of June our plans were formulated, supplies arranged for and the work was ready to proceed on the schedule as set up by the committee.

This committee was probably the most valuable tool that I had during the next difficult two months. My Chairman and I kept them completely informed as to each stage of the job, and even those members who had not been able to be reached through their excellent publicity, knew of the progress of the work as soon as they reached the locker room and were not dismayed when they teed off to winter brown fairways in the middle of the most beautiful time of the year.

We started this operation July 7. Cut as low as the mowers would go. Sprayed with sodium arsenite and continued weekly until six applications were made.

The first two applications were applied at the rate of 1# in 40 gallons of water per acre. Then we went to 1½# per acre for the next two applications. The 5th and 6th applications were applied at 2# per acre.

Three days after the last application of sodium arsenite we started with our aerifiers, going over the fairway three times. Then we used a 3 gang, saw blade type, fairway spiker to break up the soil cores and cultivate more. This made a good seedbed.

Seeding was started August 24, using a 14 ft. wheelbarrow type seeder.

The bent mixture used was 40% Highland, 40% Astoria and 20% Seaside at 50# to 60# per acre.

After seeding, the fairway spiker was used to mix the seed slightly with soil, then rolled, and 400# of 5-10-5 fertilizer per acre was applied.

By starting this early we got a good coverage before freeze-up in the fall.

FAIRWAY IMPROVEMENT PROGRAM

Bert Rost, Supt., Park Ridge C. C.
Park Ridge, Illinois

We start the first week in August by spraying the fairways that are to be re-seeded with 2 lbs. of Sodium arsenite per acre. We repeat this treatment at 7 to 10 day intervals until after Labor Day at which time the fairways are thoroughly watered and we begin to aerify them. The players at our course have coined the phrase "terafying". Anyway, we aerify enough so that we are "terafied", the players are screaming and "terafied", then we "terafy" it once more for good measure, followed by twice over with a spike disk. This is followed by an application of 400 lbs. 5-10-5 per acre, then 50 lbs. of one-third Highland, one-third Seaside, one-third Astoria bent per acre. This is followed by a treatment from the spike disk to force some seed and fertilizer into the soil.

We let this stand for four days and then water, keeping the soil moist enough at all time to insure germination and growth. Our program started in 1952. That year we renovated and seeded two fairways. In 1953 we did 6; in 1954 we did 7. We have three fairways left, but have enough native bent in them that by proper management we believe they can be brought into satisfactory playing conditions without renovation.

EXPERIENCES ON MERION BLUEGRASS

Carl Habenicht, H.&E. Sod Nursery,
Tinley Park, Ill.

I find Merion bluegrass is far superior than Kentucky bluegrass in the climatic zone where Kentucky bluegrass is used. It can be mowed closer, stands heat and drouth better, develops rhizomes very rapidly which helps thicken the turf to crowd out weeds, and makes a good quality turf. Inturf it can be distinguished very easily from Kentucky bluegrass by its broader leaf and darker green color. It is not a perfect grass, but the superiority offsets its weak points. We have had rust in our Merion, but we find by keeping the nitrogen level up, to develop a more vigorous growth, rust will be kept down to a minimum.

We find after stripping off Merion sod there are enough rhizomes left in the ground that by quick aerifying and fertilizing and keeping it watered we can develop a new turf in a short time without reseeding.

We find Merion is relatively slow to germinate. To overcome this we set out small #40 Rainbird sprinklers about 50 feet apart, keeping the ground damp at all times and in seven days we have the Merion germinated. We usually try to have our Merion all planted by the latter part of August. Twenty pounds of seed per acre is used.

In summing up the merits on Merion, we find it spreads faster than Kentucky bluegrass, stands closer mowing, makes a far better quality turf. Weed control is held down to a minimum due to the lower and thicker growth, and it has more drought resistance due to the deeper root system. All the Merion sod has been moved very easily.

MERION BLUEGRASS EXPERIENCES

P. E. Drachman, Greens Chairman,
Evansville Country Club, Indiana

Gentlemen, may I first thank your program committee for this opportunity to appear at this Conference. I think it quite an honor for a non-professional lawnowner to have his name listed with such outstanding authorities as O. J. Noer, F. V. Grau, W. H. Daniel and a host of others.

For the past five years I have been in attendance at these Turf Conferences, but always as an eager and enthusiastic listener. I have asked many questions and I have written down many notes. I am most happy to be here today.

I live in Evansville, Indiana which is 200 miles south of Lafayette. Evansville is on the Ohio River where Indiana, Illinois and Kentucky come together. It is really more south than north. Our winters are fairly mild and our summers are often very hot. Our lawns and yards are never very pretty. Most of our lawns are crabgrass, in spite of the fact that they start out to be bluegrass. A few are Bermuda and one or two are zoysia.

I give you this information as a background for the Merion bluegrass story I am about to relate. It starts about four years ago, about the time Merion bluegrass seed first became available to lawnowners. This seed, you will recall, was scarce and expensive, but its qualities were so superior to ordinary bluegrass that I felt that here at last was the answer for the poor lawns of Evansville. Merion was a grass that could hold its own against crabgrass, would not go "dormant" in the summer, and was disease-free, or at least nearly so. Most lawnowners think that when bluegrass disappears in the summer that it merely becomes dormant, but what I am about to tell is that dormant is not the right word - "dead" would be more appropriate.

I started by Merion bluegrass lawn in September by first tearing up my old lawn and beginning from scratch. The seedbed was carefully prepared and the Merion seed evenly sown and by late November I had a fairly good stand of young Merion bluegrass. In its early stages the only differences I noted between Merion and ordinary bluegrass was that Merion germinated more quickly than ordinary bluegrass, but it produced rhizomes more slowly.

In mid-winter I had my first disappointment with Merion. The ends of the grass turned quite yellow from cold weather and I did not have the rich green winter lawn that I had anticipated.

However, when the month of March rolled around and I had had a chance to give it a shot of nitrogen, I was amply repaid for all of my work and concern. My Merion was without a doubt the most beautiful lawn I have ever seen. It was the kind of lawn that seed catalogues picture. It had such eye-appeal that every day dozens of motorists stopped to inquire and admire it. It was so luxurious that people hesitated to step upon it, and it remained in this wonderful condition all through April and May.

I was extremely proud of my Merion lawn. It was the first of its kind in Evansville so I took unusually good care of it. After discovering that it would not tolerate PMAS as a crabgrass remover, I delegated the elimination of crabgrass to my yard man who did it by hand. I was determined that it would not be ruined by weeds or crabgrass, or be discolored by the use of chemicals.

Everything went fine until about June 15th. Then suddenly it happened. Temperatures shot up from 90 to 95 and even 100°. First a little brown hole appeared -- then another -- and then more, and more. Each day they grew larger and each day my spirits dropped lower. It was difficult for me to believe that this wonderful new grass, this champion of champions, was being knocked out by disease.

I quickly referred to Musser's book on "Turf Management". I reviewed Noer's bulletins. I tried to call Fred Grau at Beltsville. Then I got in touch with Bill Daniel and he came down to Evansville to look at my sick lawn. He walked over it. He felt of it. He tore some of the grass blades apart. He shook his head and said, "When you find out what to do, let me know". That was four years ago and I still have not let Bill know.

Now, don't misunderstand me -- Bill did make a number of suggestions such as "cut back on the water", "water only in the mornings", "lay off the nitrogen", and "try certain fungicides". All of which I know did some good, but I still had a sick lawn all summer long.

In the fall I overseeded the bare spots, fertilized rather strong, and by mid-November I again had a very good looking Merion bluegrass lawn. Bill had recommended, and I had agreed to eliminate the next spring application of nitrogen, hoping that the grass would harden and not be so vulnerable to disease when the weather turned hot.

Next April and May my Merion was as beautiful as the spring before. The extra amount of fertilizer applied in the fall had carried it through the winter very nicely. Maybe my troubles were over, but I still feared what June and hot weather would bring.

Well, you guessed it. Out she went again, but this time she went clear out. The only place I had any grass at all was in the partial shade of my trees. The bare spots were completely bare because by keeping out the crabgrass and the clover there were no other grasses to fill in where the Merion had failed. My bluegrass had not only gone dormant -- it had gone "dead".

In the fall of that year I again tilled up the bare spots, but this time sowed a mixture of 50% Merion and 50% ordinary bluegrass, hoping that perhaps one or the other might survive the hot humid weather of the next summer.

Well, the next summer was last summer and I think you know what happened. The Merion went out -- the ordinary blue went out -- and I nearly went out. Now, for fear I might leave the wrong impression, please don't think I took these defeats lying down. I can assure you that I tried everything in the book, including Acti-dione at \$16.00 an ounce, and I kept Bill Daniel's phone hot trying to find out what to do.

Then, one day last fall the answer came to me just as clear as a bell. I got out my roto-tiller -- tilled up the whole mess again -- planted 50% Merion bluegrass -- 50% ordinary bluegrass, and then I added the necessary ingredient for having a good lawn in Evansville, Indiana -- I plugged the whole thing with Meyer zoysia.

Gentlemen, this is to be a continued story. I will tell you more about it at our Conference next March.

ZOYSIA FOR LAWNS AND NURSERIES

P. E. Drachman

Five years ago next April Charles Wilson, who was then at Beltsville, sent the Evansville Country Club a small amount of Meyer Zoysia, part of which I planted in a flower bed at my home. The soil in this bed was very rich and friable consisting of at least 50% peat moss. My sample of Zoysia grew very rapidly and from it I started my first nursery.

Early the next spring I made two interesting observations - the Zoysia in the original flower bed had continued to grow through the entire winter, as it was in a protected place, and the peat moss offered an ideal medium in which the Zoysia could run. All growth, however, was under the peat moss and some runners exceeded a foot in length. My second observation was that sprigs planted too early in the spring would freeze out.

I became intensely fascinated with this unusual grass. In an area of 20 x 20, I prepared an ideal plant bed. After tilling the soil I added a generous amount of peat moss, fertilizer, and lime, and then Dowfumed the entire bed. Then for good measure I added Krilium. Next, I sprigged in Zoysia on one foot centers - watered it down and stepped back to let it grow. In an adjoining plot of the same size I tilled the ground, added lime and fertilizer, and then set two inch plugs on one foot centers. The difference between the two plots was that one was "sprigged" and the other was "plugged"; one was Dowfumed and peat moss and Krilium added, the other was not; both, however, were fertilized and both were watered in the same manner.

In seventy-five days plot number One produced a solid turf of Zoysia. That is just two and one-half months. It required two years for plot number Two to become solid. The conclusions that I have drawn from these test plots are these:

1. Zoysia does best in a loose friable soil.
2. Sprig planting is far superior to plugs.
3. Weeds and crab grass greatly retard Zoysia growth.

Of course, the average lawnmower will not go to the expense that I did in the first plot.

Three years ago I plugged Zoysia on six foot centers into a crab grass plot in the rear of my yard. These plugs have grown from two to six inches and are still not very impressive. I am certain that Zoysia in time will crowd out crab grass but few lawnmowers are willing to wait that long. I know of four methods of keeping weeds and crab grass out of Zoysia - the most tedious and impractical one is the hoe but I recommend it, if other methods have not been used. Dowfume is by far the best, but few lawnmowers have the equipment or the technique for using this procedure. I have used Cyanamid with success, however I do not like the waiting period after its use. It now appears that the simplest and easiest methods of all are the new herbicides such as CRAG. I have used this chemical in numerous ways such as spraying it on newly "sprigged" or "plugged" Zoysia, or spraying it on newly prepared seed beds and planting Zoysia at a later date. I have used it on old beds after removing the visible weeds with a hoe. This chemical did not seem to harm the mature Zoysia plants in any way. This spring I plan to rid my entire yard of crab grass through periodic use of the chemical. Unfortunately, it has not worked too well on Poa Annua.

I am now growing four varieties of Zoysia - Meyer Z-52; the coarser strain which is Z-73; the new Emerald; and Matrella. Matrella, of course, is unknown in regard to its winter hardiness but does quite well in the South. The Z-73 is less attractive both in texture and color than Meyer but is better able to combat weeds

and crab grass. It has a definite place where strong turf is desired and beauty is not paramount. Emerald is brand new, is finer in texture and has a brilliant green color and is so close-knit that a light lawn mower literally rolls on the end of the grass and sometimes it becomes difficult to mow. To walk on it is not like anything one has ever experienced. No deep-piled carpet ever felt better under foot, and it immediately springs back and leaves no trace of footmark. I have a foot of Emerald adjoining a plot of Meyer and it is difficult to decide which of the two I prefer. The Meyer resembles Blue Grass, Emerald resembles Fescue. Both, of course, turn brown in the winter but the Emerald is even beautiful in the brown stage.

Zoysias are more difficult to mow than the other grasses and unless the mower blade is very sharp the ends of the grass become frayed and causes an undesirable brown cast. Clippings should not be allowed to remain on the grass because they deteriorate very slowly and often give Zoysia an off-color appearance. Zoysia must be cut as often as Blue Grass, but the height is not too important as it can be cut quite high or quite low, depending on preference. It loses its color in the fall a little later than Bermuda and regains its color a little earlier in the spring. I admire Zoysia so much that I now have plugged my entire front and back yard. In time, I expect it to take over the Blue Grass and then I will have 100% Zoysia. Incidentally, the combination of Zoysia and Blue Grass is not very attractive during the winter months because part of it is brown and part is green. I do not think we will ever have an attractive Blue Grass and Zoysia combination. Zoysia being the stronger of the two will always take over.

From a disease standpoint Zoysia is better than any grass that I know, however, I have seen some leafspot, and also some iron chlorosis. Both of these conditions were brought on by my attempt to force growth with too much nitrogen.

Zoysia is an ideal grass for Southern Indiana. It especially likes our hot summers, continues to do some growing all winter, will grow in almost any type of soil, will exist with a minimum of moisture, is practically 100% disease free, can be abused and will come back faster than most grasses and if handled properly will produce complete turf in one year. It has only two drawbacks - it turns brown in winter and will not grow in dense shade.

PREPARATION FOR MOTORIZED CARTS

James W. Brandt Supt.,
Danville Country Club, Illinois

I believe that Bill Daniel asked me to serve on this panel for making a rash statement 2 years ago while participating in a similar panel. I made the terribly erroneous statement that my opinion was that golf was played for the exercise derived from the sport and that motorized carts would not be a problem. Gentlemen, I must admit that I was far from the truth.

In preparing for golf carts I would say that this comes in two phases. First, the superintendent must prepare himself mentally; secondly, there are some physical changes that may have to be incorporated into the course.

I would like to try to point out to my fellow superintendents that the advent of motorized carts isn't the worst calamity that has befallen the superintendents. To do this, I would try and take you through the same reasoning process that I went through before I realized that carts weren't so terrible.

Let me ask the question "Why were we hired" We were hired to maintain a course that will be well groomed and a pleasure to play. If golf were played primarily for exercise, then as much exercise could be obtained from the playing of a course maintained at the cow pasture level as could be attained from playing a finely conditioned course. You golfing superintendents who work all day on the course certainly do not play golf in your off duty hours for the exercise, fresh air, or sunshine. You play golf for pleasure.

If a portion of our membership derives greater pleasure from the use of carts, then we should not object to their so doing.

For a moment let us look on the brighter side of the cart situation and see what it may do for our course.

1. May enable physically handicapped members to play.
2. May start some of our older members to playing golf again.
They are the ones who often control the purse strings for the spending of funds.
3. May help balance play on both nines.
4. Make for a longer golfing season. Can be used when caddies are not available in spring and fall.
5. Source of increased revenue for pro or club.
6. May enable you to secure funds for needed bridge and road improvements.
7. Course may receive more play when ground is hard and dry.
8. Little permanent damage to turf if carts are properly handled.

There may be other advantages to carts that can be brought out in our discussion. Now to the darker side of the picture. By this, I mean the added work and worry that it may cause we superintendents.

1. Footbridges may have to be changed, strengthened, or widened. On our course we had to widen a 140 ft. bridge. The bridge had to be refloored and was widened at the same time.
2. Steep inclines may require blacktop or other treatment in heavily traveled areas. Pro is to pay for the cost of material on our course for two areas that require blacktopping.
3. Turf in heavy use areas will require special attention. This year we are to try heavy aerification and other types of grass such as zoyzia and bermuda will be tested in these areas.
4. The superintendent must be the judge as to when carts are not permitted on the course.
5. Rules governing use of carts must be made. They should be kept to a minimum and as simple as possible. List of rules should be on each cart.
6. Work with the pro to keep the distinguished executives from becoming hot-rod enthusiasts on the course.

Many other problems will arise, depending on the course.

If you do not have carts on your course, do not be as naive as I was 2 years ago and think that you will never have carts on your course, but think ahead and be prepared for them when they are in use on your course. They are here to stay.

PREPARING FOR MOTORIZED CARTS

Carl Bretzlaff, Supt., Meridian Hills C.C.
Indianapolis, Indiana

This Power Caddy Cart just mushroomed up so fast in this area that there hasn't been enough time to set any iron clad rule or control. These are just some thoughts or suggestions.

I. Superintendents Question These Points.

The Club needs control over Power Caddy Carts especially individually owned Carts.

Insist rules and penalties be strictly enforced.

Be allowed to charge or assess members for damage done. (Both time and material).

Avoid putting yourself on spot - state what might happen - what means must be taken. (Put in writing).

Set up local rule if ball rests in Cart rut.

If course is hilly Carts can turn over easily. Will Club be liable?

Some bridges may be constructed. Hills may have to be cut down, etc.

Rule that allows Carts anytime that equipment is mowing is unreliable.

Tractor may be able to mow only some parts of course where ground is high and drains well. Never could get on other parts of course where Carts must go to cover the nine or eighteen holes.

II. What Some Clubs are Doing, a survey report -

Adding \$25.00 per month (\$12.50 in winter months) to Cart owners dues - for services and maintaining.

Do not allow reservation of Carts until their starting time.

Allow only one Cart to each group.

Possible to rope off routes Carts must take.

Prescribe path by white lines to avoid approach to greens.

Asphalt stations where Carts must be parked for putting and teeing off. (One course has 16 asphalt strips or areas already).

Have white lines to designate restricted areas.

Some Clubs allow Carts only in roughs.

Users must have medical approval from at least four (4) doctors.

Some clubs set up Medical Board made up of doctor members of Club.

Some allow only handicapped persons.

Some require caddy for each Cart.

At some Clubs carts not allowed nearer than 40 feet to green or tee.

Possible passing of rules on Carts through Club action.

Some Clubs are building own facilities. Buying own Carts and adding balance after investment to Golf Course Budget.

Large number of Carts on many courses already.

III. Possible Burden to Superintendent

Repair damage on course - often no allowance made in budget.

Carts often stored in Superintendent's Building utilizing necessary maintenance space.

Cart tow-in and repair and electric not budgeted.

Various grasses damaged and bruised at different times of season. Poa annua suffers in mid-summer; bent suffers from humid high heat conditions.

(Must sometime stop mowing greens and fairways because equipment does more damage than good).

On bent and bluegrass Carts leave unsightly tracks.

Cart tracks on Fescue during dormant and severe heat spells - tracks show for balance of summer.

IV. Arguments for Carts

Carts encourage play when caddies are in school.

Quick rounds by members by Carts.

Less fatigue by members.

Carts allow Clubs to retain members who otherwise would not play golf.

If not allowed members may join other clubs where Carts are allowed.

Every Superintendent should have one for his use and for crew's use - such as changing cups, etc., without disturbing play.

Increased traffic can increase stature of Superintendent at his Club

Carts really do not do too much damage if and when properly used.

V. What Must Be Done - Suggestions:

Install heavy enough electric power and wire for battery charging.
Build for storage and service of multitude of Carts.
There is a need to set up simple standard national rules for Club
except where local rules are necessary.
Clubs penalize severely any carelessness or abusive use of Carts.
Give Carts a fair trial - they may be just the thing. We cannot hold
back progress.

Editor's Note: In discussion it was suggested that where carts are to
be used then Club should-

- A. Buy or rent sufficient number needed for use. The Club buys tractors, kitchen and all other group service items.
- B. Set up maintenance on carts including recharge, tow-in service, storage and mechanic service - a function of Club.
- C. Establish and post minimum regulations for use to minimize possible damage which may reduce quality for following players.
- D. All Carts - a. Carry in view regulations for player reminder
b. Be obviously numbered to aid in identification.
- E. Establish penalties for misuse, fund to go for replacement and repair.
- F. This, it was pointed out, could give maximum service to the members, allow for golf course adaptation, and reduce interdepartment questions to a minimum.

MERION BLUEGRASS EXPERIENCES

Ben O. Warren, Warren's Turf Nursery
Palos Park, Illinois

Probably our greatest problem in raising Merion bluegrass has been the irregularity we have encountered in the germination of the seed. The following will illustrate the varying results we have experienced in the past six years.

In 1949 seed germination in three weeks, in 1950 three weeks, 1951 eight weeks and incidentally Kentucky bluegrass under identical conditions in 1951 germinated in ten days. 1952 was an unusually dry year for us, consequently we had no germination of Merion without irrigation, with irrigation in 1952 we got germination in four weeks. In the spring of 1953 we had germination in three weeks, but in the fall of 1953 with new seed we got germination in two weeks. One year old seed in the fall of 1953 germinated in six to seven weeks. Our spring planting in 1954 germinated in seven to fourteen days. In the fall of 1954 new seed germinated in about five weeks, while one year old seed in the fall of 1954 germinated within seven days.

Changing weather conditions undoubtedly had considerable bearing on these results, but it is our opinion that some of the variations may be the result of different seed lots.

In handling a new grass we must take into consideration the optimum thickness of the soil to be removed for the transplanting of the grass as sod. Hasty examinations of newly laid sod seemed to indicate that most of the new roots developed from the rhizomes than from the severed roots. In order to be more certain of this series of transplantings of Merion were made into fertilized sand. One sample was taken from spring sod, the other sample from fall sod; that is one test or examination made in the spring, the other in the fall. Specimens were examined daily, the sand washed away and a search made for new roots.

The first roots appeared on the second day. Fifty examinations were made from each sample over a period of fourteen days. The fall sod in all but two cases developed roots only from the rhizomes. These new roots grew from a zone about $3/8$ of an inch below the original ground level. Two plants developed new weak roots from the cut or severed ends of the old roots as well as from the rhizomes. The spring sod indicated slightly different development. The most vigorous growth was from the same rhizome area, but in almost all cases there was also lateral root growth from the severed roots ends. After ten days the two areas of root development compared as follows:

Total new root growth length arising from rhizomes three to four inches.

Total new root growth length from severed roots only $3/8$ to $3/4$ inches.

This seems to indicate that the vital area in Merion to be considered in transplanting is from the soil surface down $1/2$ inch.

One disappointment in handling Merion has been the appearance of rust in fields low in nitrogen. We have had serious set-backs, but where this nutrient has been in ample supply this trouble has not been of too much concern.

PENNLU DISTRIBUTION

Dr. W. H. Daniel, Turf Specialist
Purdue University, Lafayette, Indiana

In 1937 a selection of creeping bent grass was brought to the attention of Professor H. B. Musser, Department of Agronomy, Penn State University. This was observed growing on the No. 17 green of the Lulu Temple Country Club. The tests were observed until 1945 when it was incorporated into a new series comparing it with 50 or more vegetative creeping selections, plus 50 seed selections from creeping bents. This has been reported by Musser in the Pennsylvania Turf Conference Proceedings as well as at the 1954 Midwest Turf Conference.

The test program at Purdue began in the fall of 1951 when three vegetative selections from Pennsylvania were included in a replicated test of 20 vegetative bents planted on the experimental putting green at Purdue University. Of these selections the 10(37)4 has been outstanding in its resistance to disease. For three years it has been under playing conditions.

The qualities of Pennlu include

1. Dark green color
2. Vigorous growth
3. Brownpatch resistance
4. Dollarspot resistance
5. Tolerates heat
6. Crowds other grasses

Since brownpatch attacks often occur in damp humid weather following midwest thunderstorm activity, when disease protection is removed by driving rain and difficult to apply because of rain and dampness, then this partial resistance to brownpatch of Pennlu makes it very outstanding in its possibilities for use in the midwest.

Since it is a dark green color and a vigorous grower, the superintendents using it are encouraged to carry it at a lower nitrogen level than may have been practiced with other grasses. This could further reduce disease infestation and reduce the buildup of nap and the intensity of management required. The fact that it may be thinned less by disease indicates that it will also tend to reduce the infestation of Poa annua or weedy grasses to the extent that dense cover is maintained.

The Indiana Certification Agency has approved and established certification in that state for Pennlu stolons. Each year foundation stolons will be grown in the field for fall distribution to nurseries in the Midwest. Through this annual distribution of new proven source of material there should be a minimum chance for loss of identity in Pennlu stock. The purpose of certification and annual distribution is to maintain protection for the research program conducted at the Experiment Station, as well as to assure the superintendent of desirable vegetative material for his use. Pennlu distribution has been made to these nurseries for stolon propagation by April 10, 1955 -

D. G. Scott, D. G. Scott Farm, Marysville, Ohio
W. Diddel, R.F.D. 1, Carmel, Indiana
Link's Nursery, Routh 3, Creve Coeur, Missouri
Cock Brothers, 340 Pitt, East, Windsor, Ontario, Canada
Ted Cox, Jacobsen Power Lawn Mower Co., 833 Grandeur Road, Columbus, O
E. Schneider, 3810 Stringtown Road, Evansville, Indiana
H. & E. Nursery, 191st & Crawford Ave., Tinley Park, Ill
Warren's Turf Nursery, Palos Park, Illinois
Old Orchard Turf Nursery, P. O. Box 350, Madison, Wisconsin
Harold Glissman, 930 S. 48th Street, Omaha, Nebraska
H. F. Godwin & Sons, 22366 Grand River Avenue, Detroit 16, Michigan

At present these golf courses have some Pennlu either as one or more putting greens or nursery area for observation. You may wish to see these areas some time during the growing season for comparison:

Illinois

Danville Country Club
Idlewild Country Club
Golf Center
Medinah Country Club
Urbana Country Club
Lockview Country Club
Ravisloe Country Club
Peoria Country Club, Peoria Park District

Kentucky

Louisville Country Club

Ohio

Carmago Country Club - test green
Rosemont Golf Course
Firestone Golf Course
Monsillan Country Club

The announcements and encouragement in the use of Pennlu for the Midwest does not indicate where other grasses are performing satisfactorily that there need to be any change. However, for old greens in need of renovation and replacement and for new construction where disease problems may be critical, this grass (based on adequate research by the Experiment Stations to prove its qualities) offers real promise.

ZOYSIAS FOR MIDWEST LAWNS

W. H. Daniel, Turfgrass Specialist
Dept. of Agronomy, Purdue University

In a constant effort to develop superior turfgrasses for the Midwest, Purdue University has tested, since 1948, over 100 selections of zoysia. The earlier material, 1948-1952, included coarse bladed selections of Zoysia japonica labeled Big Springs, Compaction, Z-3, Z-9, Z-16, Z-21, Z-40 and Z-55. Of these Z-21 is best but very slow growing and open enough for weeds to come in. Also, Seneca and M-1 (Zoysia matrellas) were grown for three years only to be discarded as slow growing and weak competitors.

In 1951 a large number of seedlings, many of them crosses, were tested and most were discarded in 1952 as not superior. Also, in 1951 several hybrid crosses were secured from the Green Section of the U.S.G.A. This report summarizes the research to date. At present there are 24 selections in sod plots. Ten of these are definitely inferior.

Meyer Zoysia

Meyer zoysia was selected in 1940 by Forbes and Ferguson as a promising type. In 1941 it was transferred to Beltsville where it remained until 1946, assigned the number Z-52. It is named Meyer to honor F. N. Meyer, a plant explorer of the U.S.D.A. who collected Zoysia seed in 1905.

Meyer is widely distributed in the U.S. It survives winters in all parts, but since it grows only in warm weather (above approximately 60°F. day and 50°F night) it may spread and grow very slow in spring and fall seasons of colder sections of the Midwest. Conversely, it grows best in warm weather when fertilized rather heavily, particularly with nitrogen, and water during drouth periods.

Emerald Zoysia - A New Hybrid Turfgrass

Emerald zoysia is a hybrid between Zoysia M. var. japonica and Zoysia M. var. tenuifolia cross 34 seedling 35. One of a series made by Dr. Ian Forbes at the Plant Industry Station, Beltsville, Maryland in 1949.

Vegetative increase of this hybrid seedling was tested at Beltsville, Maryland from 1950, at Purdue University, Lafayette, Indiana, from 1951, at Coastal Plain Experiment Station, Tifton, Georgia from 1952. Many other plantings are distributed over the U. S.

Emerald zoysia is so named due to its beautiful dark green color. Since it is a hybrid, which resulted from a wide cross, it must be propagated vegetatively to preserve its superior characteristics.

Emerald zoysia combines the greater winter-hardiness, non-fluffy growth habit and faster rate of spread of its japonica parent with the finer leaves, denser turf, greater frost tolerance and darker green color of its tenuifolia parent.

Emerald zoysia is being released this spring. Mr. Hugh A. Inglis, Georgia Crop Improvement Association, Athena, Georgia, directs its certification and distribution in that state. At Purdue University, W. H. Daniel, Executive Secretary Midwest Regional Turf Foundation, Department of Agronomy, Purdue University is responsible for distribution in that area.

Research Results

Average Growth of Runners in Field Plots
August. 5 - Sept. 5, 1953

	<u>In one month</u>	<u>In last 18 days</u>	<u>Increase inches/day</u>
Meyer (Z-52)	5.8	3.6	.2
Emerald (34-35)	5.7	3.7	.2
Ave. of 9 hybrids tested	5.8	3.4	-
Z-73 parent	4.3	2.6	.15
Coarse vigorous seedling	8.6	4.9	.27

Runner Extension from dormant plugs placed in flats
Greenhouse Studies 1954

	<u>Ave. of 30 runners</u>	<u>Ave. of 36 runners</u>	<u>Rating for spread in field Oct. 18, 1954</u>
Meyer	5.3 inches	7. inches	1 best
Emerald	3.3	6.	2
Ave. of 9 hybrids	3.6	7.2	2
Z-73 parent	3.4	4.5	2
Vigorous coarse seedling	2.9	12.3	4
Matrella	2.5	8.	5

Rating for Color Retention in Fall
(1 is usual green - 9 is brown)

	<u>1953</u>			<u>1954</u>		
	<u>Nov. 4</u>	<u>Nov. 9</u>	<u>Nov. 23</u>	<u>Oct. 18</u>	<u>Nov. 12</u>	<u>Nov. 24</u>
Meyer (Z-52)	3	5	9	2	5	8
Emerald (34-35)	2 best	4 best	6	2	4	5
Ave. of 9 hybrids	2	4	6	2	5	6
Z-73	7	9	10	2	6	9
Vig. Coarse seedling	9 poorest	9	10	3	9	9
Matrella	2	5	8	2	3	5

Rating for Earliness of Greenup in Spring

	<u>April 6, 1953</u>	<u>April 20, 1954</u>
Meyer	2	3
Emerald	5	5
Z-73	-	4
Vigorous coarse seedling	-	3
Matrella	8 slowest	7

Leaf Characteristics beginning with Dormant Plugs
Greenhouse 1954

	<u>Comparative height as growing</u>	<u>Height of older leaf</u>
Meyer	3.5 inches	8 inches
Emerald	1.5	5
Ave. of hybrids	1.5	6
Z-73	4.5	9
Vigorous coarse seedling	6.0	10
Matrella	1.8	4

CRABGRASS PREVENTION AND CONTROL

W. H. Daniel, Turfgrass Specialist
Dept. of Agronomy, Purdue University

The major lawn grass of the Midwest is Kentucky bluegrass. Usually its seed is mixed with ryegrasses, redtop, fescues and bentgrasses in prepared seed mixtures. Whenever disease attacks thin the turf by killing older leaves, or any other condition weakens the turf cover, the crabgrass seeds have a better chance to germinate and to survive. This is the reason the lawnmower or turfgrass superintendent is repeatedly implored and encouraged to follow good management practices. Even though chemicals are available which selectively kill crabgrass, proper maintenance should be the first and continuing part of the effort.

High Mowing Favors Bluegrass

Bluegrass lawns or bluegrass mixtures will shade many crabgrass seedlings if dense and cut 2" high. Actually this is as high as most lawnmowers can be set. When leafspot disease kills older leaves, the new leaves left after high mowing enable the plant to remain dense. So, high mowing of bluegrass lawns is the first and cheapest thing to do to reduce crabgrass.

When Does Crabgrass Germinate?

In the Midwest a warm front (damp rainy weather with night temperatures above 65° F.) such as often occurs in early May, provides ideal conditions for crabgrass germination. Any time the temperature remains above 65° F. and the crabgrass seed gets light and constant dampness for 3 to 6 days, they may germinate. For this reason crabgrass is often called "watergrass", and lawnmowers are discouraged from watering the lawn lightly and often since it favors the repeated germination and survival of crabgrass, as well as other turf weeds. Thus, in the Midwest even if the lawn is not irrigated, damp wet spells may germinate a crop of crabgrass seedlings.

On the other hand, many lawns will stay more uniform and vigorous if watered once a week during dry spells. Most lawn sprinklers need to be left in each spot over one hour to wet the root zone to a 4 - 6" depth. Usually it is wise to avoid excessive watering in July and August because it favors leaf diseases as well as vigorous crabgrass growth.

At best chemical control of crabgrass is an attempt to provide a chance for improving the turf before the next crabgrass season arrives. Chemicals used at the right time in the right way may contribute.

Month

- Feb.) 1. Reseed thin spots as early as possible, leave old crabgrass stems as mulch. Freezing will not hurt lawn seed.
- Mar.)
- Apr. 2. Take mower to be sharpened early.
- 3. Lead arsenate spread at 12-20#/1,000 sq. ft. early may be toxic to crabgrass seedlings later.
- Mar.) Fertilize with ample nitrogen (1# actual N/1,000 sq. ft.) This encourages dense growth and desired grasses have better chance of shading crabgrass seedlings.
- Apr.)
- May)
- Apr.) 1. Mow lawn as high as mower can be set. Do not scalp the lawn.

May) 2. Before emergence (preventive) chemical sprays may be applied
June) monthly. These, to be effective, must be sprayed before the
oldest crabgrass plants are three-leaved, so timing is most
important. Also, ample material must be used to get root up-
take by the seedling. The spray will lose its effectiveness
in approximately one month as soil bacteria converts it
through toxic, then non-toxic breakdown. Therefore, repeat
spray later. Landscape gardeners, Golf Course Superintendents,
or the lawn enthusiast who has a sprayer may be interested in
these. If control is less than perfect a few crabgrass plants
may become obvious. Use of 2,4-D for seedling knotweed kill
in early April at 2# actual 2,4-D acid equivalent may delay
crabgrass infestation.

May) 1. Watch thin sunny spots in lawn for young crabgrass seedlings.

June) 2. DO HAND DIGGING EARLY. Isolated plants may be cut with a
kitchen "grapefruit" knife. The serrated edge saws the roots
very easily with a minimum of damage to the desired turf.
Sharpen knife with corner of file to keep saw edges on blade.
3. P.M.A. (Phenyl Mercury Acetate) can be used in three weekly appli-
cations at recommended rates (1 - 2 fluid ounces of 10% solu-
tion per 1,000 sq. ft. in 2 - 4 gallons water) to kill young
crabgrass. At the same time leafspot disease of bluegrass may
be reduced. Several companies have liquid formulations for
sprayer use. Also dry forms for spreader distribution are readi-
ly available. Excess rates applied may yellow bluegrass turf.
If this occurs, do not stop treatments but cut rate one-half
and continue weekly treatment until crabgrass is dead. P.M.A.
is a poisonous mercury compound; so store carefully. It can
cause skin burn so keep hands washed and equipment clean.

June) 1. A semi-selective foliar burning chemical, Potassium Cyanate

July) (KCNO), is sold under many trade names for crabgrass and
Aug.) chickweed killing. These may be soluble powders or dry forms
mixed with organic fertilizers or diluents. It is difficult
to burn all of the plant with one spray so plan three treat-
ments 7 days apart. Merion bluegrass is very tolerant to
KCNO, while susceptible to PMA damage. Bluegrass leaf tips will
be burned but soon removed by mowing. Bentgrass and fescue may
be damaged at high rates. Since KCNO does not prevent new ger-
mination, its preferred time of use is mid-summer to kill exist-
ing crabgrass before it becomes competitive to bluegrass. Also,
it is adapted for removing in early fall so that fertilizer
and moisture can encourage a new vigorous fill-in of bluegrass.

2. Di-Sodium Methyl Arsonate has shown selective control in fall
test in 1954 and greenhouse tests at Purdue University. In
1955 it will be marketed as a liquid and dry powder. It may
be used on bentgrass with less damage than KCNO. Like any
other foliar absorbed chemical DSMA should be applied weekly
until crabgrass is dead.

Aug.) As cool nights and fall rains begin bluegrass, fescue and ryegrass
Sept.) have favorable growth conditions. This is one way to give bluegrass
Oct.) room. Set the mower to cut as close as possible, mow and rake;
again mow and rake until all excess crabgrass is removed, then spot
seed where needed, fertilize and water thoroughly. Set the mower
up high again. Vertical mowers for custom or rental use may be
available for quick removal of excess. The mechanical reduction
in fall periods may be much easier than attempting chemical burning
on the mature crabgrass. The lawnmower if interested in chemicals
should select a good machine for uniform application. Also, he
should pick out the most important areas and treat those regularly
until crabgrass is dead.

PLANT CARBOHYDRATES MUST BALANCE NITROGEN

M. R. Teel, Dept. of Agronomy
Purdue University

It is not news to you that if you mismanage your turf the grass stops growing. We often hear the question, "I wonder why the grass won't grow?" Fundamentally, the answer is that the grass plant cannot manufacture certain materials which are essential for growth. The plant physiologists tell us that these essential materials are sugars, the first products of photosynthesis. The sugar level in the grass plant may prove to be a good measure of the response which a grassplant makes to treatments such as clipping, irrigation or fertilization.

We should recognize that new leaf growth in the spring is produced at the expense of sugars which the plant has stored during the previous fall. The more abundant the supply of stored sugars the more vigorous the spring growth. Similarly, the regrowth following mowing is produced at the expense of sugars which the plant stores by virtue of the fact that the healthy plant will normally manufacture more sugar than it required for its immediate needs.

With this knowledge we may be able to explain why some of our grasses stop growing. Our management system has probably prevented the plant from reaching the stage where it manufactures more sugar than it needs for growth.

We ask the question, "What factors govern the accumulation of sugar reserves in grass?" Perhaps it should be stated another way. "What management systems should we employ so as to maintain an adequate supply of reserve sugars and thus insure a vigorous turf?"

There are two factors which may prevent or at least delay sugar accumulation in grass. One is the application of water and the other is the application of nitrogen or fertilizer. Of course there are others, but I have chosen to speak of these two since we can partially control them. Both of these practices promote vegetative growth at the expense of sugar reserves. Without them there would be no growth, nevertheless experience teaches us that some moderation should be exercised in their use. There appears to be some critical balance between the sugars and the nitrogen containing substances in plants. When we add water or nitrogen, or if the weather changes from sub-normal to above normal temperatures, the grass usually grows rapidly at the expense of its sugar reserves.

I have some slides which show the effect of cutting a grass plant when the sugar reserves are low. Following these we will see some slides showing the effects of nitrogen fertilization.

Discussion of Slides

Slide No. 1. A population of orchard grass was clipped after having made considerable development in the greenhouse. One portion was fertilized with nitrogen the day of clipping; one received nitrogen 14 days later and the remainder of the pots were left unfertilized. The earlier N addition gave earlier growth.

Slide No. 2. Weekly determinations of the sugar level were made in each of the three populations. The sugar in which we are interested is called FRUCTAN. It is a large molecule made of a simpler sugar called FRUCTOSE. We know of Fructose as the sugar in fruit and in honey.

The nitrogen caused a marked depletion of the fructan when it was applied. However, if given sufficient time the orchard grass leaves soon began to manufacture more sugar than was needed by plant. This is because the leaves soon reach full vegetative development.

Slide No. 3. This slide shows that the sugar reserves will drop following clipping under both high- and low- nitrogen levels. The high nitrogen level caused a much greater depletion of the reserves. In the 35 day clipping interval of this experiment the leaves were able to restore the sugars and consequently there was very little reduction in the plant vigor in this experiment.

What would happen if we should cut the grass when the sugar reserves were low?

Carbohydrates and Nitrogen on Plant Growth

Slide No. 4. The work of J. C. Carroll at Wooster, Ohio should be of interest to you. He studied some 15 species of grass attempting to learn the effect of nitrogen on the plant.

In one of his projects he lifted sections of the turf and allowed them to dry for several days in the greenhouse at 95 degrees. By weighing the soil samples he could determine the moisture content. At 5% moisture he could determine that the nitrogen fertilized plots were suffering. At the 3% level he noticed a more marked reduction in the percentage of the plants which recovered.

Slide No. 5. Many times we wonder if the air temperature is hot enough to kill the grass. Carroll conducted two experiments to determine the reaction to temperature. One of these experiments measure the soil temperature, while the other measured the air temperature. If the soil temperature was maintained at 122 degrees F for 4 hours, or if the air temperature was held at 122 degrees for six hours he got a response similar to what we see in this slide.

Slide No. 6. Many people are advocating the fall application of nitrogen. This practice should have considerable merit. If the nitrogen is applied early enough the plant will go into the winter with abundant reserves. However, if the nitrogen is applied too late, the plant will be trying to grow when it should be hardening off for winter. Carroll hardened these plants off at 33 degrees F prior to placing them in a room at 23 degrees F. We see that the fertilized plants could not withstand this temperature. Analysis of the plants showed that the fertilized plants had a higher water content and less sugar in the protoplasm.

Summary

The relationship between food reserves and plant vigor is no longer a matter for speculation. The management systems which maintain an adequate level of plant sugars should be the primary objective of the turf manager. I have presented a little evidence that watering and fertilization with nitrogen appear to have mobilized the sugar reserves. If the plant is clipped when the reserves are low it appears to suffer. On the golf course the height of cut and leaf area remaining is near constant. The amount of nitrogen and frequency of irrigation are variables toward producing healthy "carbohydrate reserve" turf. Therefore, the supervisor may be wise to limit nitrogen applications to avoid over-stimulation of growth, thus depleting food reserves. The philosophy of maximum nitrogen use on putting green turf is questioned. The minimum nitrogen use for satisfactory growth may cause less concern.

PUT YOURSELF IN HIS PLACE

Fred V. Grau, Agronomist
West Point Products Corp., West Point, Pa.

We are moving ahead so rapidly today with new grasses, new machines, new chemicals and new technics that many of the things we do to provide better playing turf often are puzzling to others. Never before have we had so many new 'tools' to work with. In the interests of improving public relations it may be well for every super-

intendent of turfgrass areas to learn to explain every operation. And to explain so clearly that every player will understand that he is doing it for the member's particular benefit. In other words, to respect and to understand the other fellow's point of view means trying to "Put yourself in his place".

The Green Committee Chairman

The green committee chairman is the "open door" to the board, the budget and the members. He is a successful businessman and he understands dollars and cents. Put yourself in his place and you will appreciate why he wants to know about costs. Be prepared to show him that it is a saving to have an extra machine in case one breaks down--grass keeps right on growing and a delay in cutting can be costly in member feelings and maintenance repair. Show him in black and white how it pays to keep steady dependable labor the year around. Turf quality is built on steady, regular, frequent treatments accomplished by dependable intelligent help.

The MAN in management is the superintendent- of first importance.

The MEN in management are the laborers and are just as important. They must be trained to do a job. A machine is no better than the operator. Our modern precision equipment needs good men.

Give your chairman brief regular reports on expenditures, needs, accomplishments. Be prepared to justify the request for any new tool well ahead of time and anticipate the chairman's questions by "putting yourself in his place".

When the Superintendent is unable to communicate effectively with his Chairman we will find inefficiency in the management. An example that immediately comes to mind is some of the "bastard equipment" used on golf courses to "save money". Actually, makeshift equipment wastes money. It is a false economy. I recall a case that occurred on a golf course in the midwest. Brownpatch had hit and was progressing rapidly. An immediate application of a fungicide was needed to halt the progress of the disease. But the superintendent had to explain that he couldn't apply the fungicide because the sprayer was broken. Surely his local supply house had sufficient stock of replacement parts to meet the emergency! Probably they did, but the superintendent had built the sprayer himself from whatever parts were available, and standard parts would not fit it. It sounds like poor economy when you weigh the cost of a sprayer against the man-hours and materials that went into restoring the damaged turf, the dissatisfaction of the players until greens were restored and the sheer waste of that needless loss of expensively-maintained turf.

In another instance an agronomist was called upon for suggestions on eradicating broad-leaf weeds from several fairways. A good sprayer and a good 2,4-D formulation were all that were needed to control the weeds effectively and safely. But the officials said they could not afford to invest in a sprayer. So they borrowed one from the highway department. The sprayer had been used to apply CMU, a chemical that completely kills off all vegetation. Unaware of this, the golf course workman added 2,4-D solution to the material already in the sprayer and then did a thorough job of covering the weed infested fairways. Needless to say, there was a total loss of turf on some of those fairways. And the expense to replace the turf was several times the cost of a new sprayer. One chairman had heard of aerifying so, to save money, he bought a worn-out sheepsfoot roller and cut off the feet leaving a solid square end peg. For a year he used that compacting machine in the belief that he was aerifying.

Your committee chairman may not appreciate how exacting are the demands of turfgrass maintenance. Put yourself in his place and give a clear explanation of the technical problems involved.

The Professional

The superintendent and the pro are mutual friends. The pro represents the direct contact with the membership and can speak for the superintendent when he is busy - developing a new nursery - or any of a hundred other things. The pro wants to know "how will this help our game?" "Will the greens putt better?" "Will the ball sit up better on the fairway?" "Can we expect a better, firmer stance on the tee?" "Can we find the ball in the rough?" Put yourself in his place and tell him exactly how you plan to do this or that to improve the playing conditions.

Refresh his memory with the "Good old days" when the grass went out every summer and we had gangs of women picking crabgrass. Superintendents have to do their work in the daylight hours and it is necessary to maintain good soil structure by cultivating and to remove grain and thatch for better putting. More men and more machines can get the job done more quickly so as to minimize the time that the players are temporarily inconvenienced. This could be a real economy point for all concerned. Certainly the "good old days", when the greens were top-dressed once a month and good putting was almost an impossibility for a week afterward are gone. So, put yourself in the places of the pro and show him how every move is for his particular benefit. Remember, both of you want the golf course ready for use.

The Members

Members like to know what is going on at their club, with their money, and sometimes at their inconvenience. A note on the bulletin board in the locker room signed by the superintendent and his chairman will keep them posted on current happenings. It gives them something to talk about. Let them know who you are.

How many members know you by name-- by sight? Members have lawns. Most of them are not very good lawns. Who knows better how to improve a lawn than the superintendent? How about a monthly bulletin on LAWNS on the bulletin board-- or a copy in the mail with the monthly statement? Wouldn't every member soon learn to know you and to look to you for professional help? Let them know that your position with the club makes it possible to help them-- that what you learn at Conferences and on the course can benefit the members indirectly. Members understand a well-written letter so, put yourself in the place of the member and keep him posted on the things that you are doing that are to his direct benefit.

Golf Course Superintendent

Judging from the growing shortage of golf course superintendents it looks as though there are not too many who want to trade places with him. After all, why should they? Generally underpaid, he has to fight against the menace of someone else being hired for his place to save money. On the job 24 hours a day, seven days a week, sometimes he has great difficulty in convincing his club that he should get time off and expenses to attend the National and a couple regional educational conferences. Instead of helping him hold his key men his club often insists on dismissing the whole crew toward the end of the season. Can you put yourself in his place in the spring when he is breaking in green help and the chairman wants to know why in the _____ No. 6 is scalped and why the bunkers aren't raked? As a golf course superintendent you are competitive with no one. You are in a world apart, so to speak. You belong to the National and to your local associations. You mingle freely with your fellow superintendents and you share information. You are expected to produce playing surfaces of unquestioned perfection. And you must train your men to do this work.

The better the course becomes, the more vulnerable the superintendent becomes because any change for the worse is his responsibility. You may have to struggle along with poor help or not enough labor or equipment, or makeshift substitutes. You are in a terminal profession-- one that leads to no other type of work. You may or may not be in line for old-age pensions or a good retirement plan. If not, you will

do well to start asking for security-- you have it coming. When your boys grow up and they ask, "Dad, should I be a golf course superintendent?", what are you going to say?

Your Supplier and His Salesmen

Everyone depends on his supplier and the salesmen to service his equipment, demonstrate new equipment, to rush delivery of a supply of fungicides or weed-killer, and generally to keep you current on many things in the supply line. Salesmen go to conferences too and they talk to your fellow superintendents and to your members. They try to help you any way they can. Be glad to see them and get from them all the information you can. The salesman is on the firing line, an active member of the turfgrass team. Suppliers give their financial support to research. Often they do much to make it possible for the superintendents to have the group gatherings which they need and want. Frequently they pick up the tab for you and your friends. The things they sell you are designed to make it easier for you to do a good job. Remember, put yourself in the salesman's place, for he is your friend.

Your Association

Imagine how the editor of your magazine feels when he repeatedly asks for notes or articles and all he gets is silence. Put yourself in his place-- then sit down and write him about a recent job you did and how it developed. And when the president of your local association asks for help-- give it freely. It is all for your own good. Encourage someone to join MRTF. It is for his benefit.

The Research Worker

You have chosen to develop a better turfgrass. It has been 12 years since you announced the project supported by the University, assisted along the way by a couple of commercial grants of money. The superior grass still is not on the market and it may be two to three years more before anyone gets seed to plant. Are you discouraged? No! Have your turfgrass friends deserted you? Of course they haven't! Each year you have published a progress report that has kept their interest keen. You have kept their faith by keeping your sponsors informed, with their eyes on the goal, not just on the careful, slow, laborious, detailed, painstaking progress. Now, in his place, you realize that accurate, dependable research results don't happen overnight. When the results are published you know that your public will accept them with confidence because you did not try to hurry them through.

The Teacher

Now you are in the classroom. A number of superintendents have sent their sons to college to take your course in turfgrass management so that someday they can become leaders in their chosen profession. What do you do to give them inspiration and to help them realize their goal? Do you give them all practical problems to solve? Of course not. You work very hard to teach them the fundamentals of plant growth, of soils and other living things, of the background of fertilizers, equipment use and care; you teach them how to identify the things they will work with-- grasses, insects, diseases. You go even further. You try to instill into them a true evaluation of human relations-- how to get along with the other fellow-- how to work together.

You don't teach them how to be greenkeepers or golf course superintendents, athletic field or park superintendents. No! You teach them how to become successful in any phase of turfgrass management they may choose-- to learn basic principles. Some may want to take postgraduate work and to prepare themselves to be agronomists in research, teaching, extension or industry.

You will learn that you can't create good students-- all you can do is to develop what the student already has and to help guide him into the work for which he

is best suited. There will be disappointments when the son of one of your best friends fails to make the grade. Your reward will come later when you see students successfully occupying important places in the turfgrass industry.

The Extension Specialist or Traveling Agronomist

You travel thousands of weary miles visiting the folks who look to you for the latest information. You study their difficulties and, with leading suggestions, you help them to solve their problems themselves. You try to be factual and you say only the things of which you are sure. Facts, not opinions, solve problems. You speak at many meetings and freely give the latest information that you have collected from research results and from studying actual field conditions at first hand. You avoid political situations and you try to be happy with just your salary. You learn to be undismayed by the fact that your family hardly knows you when you come home, and the children say, "Mommie, who is that character with the moustache?"

It doesn't really make much difference whether you are doing extension teaching out of a college or university, a county agent's office, a private concern or an industrial firm, the pattern is the same. Your big job is to study, read, look and listen and then interpret in simple language and in a few sentences everything you have learned. Meanwhile you are always pleasant, you rub no one the wrong way, you avoid arguments, you call everyone by name and you see it that the "little fellow" gets just as much attention as the president of the association or the superintendent of the most influential club. It is a rugged life but there is never a dull moment.

The Manufacturer

This may be difficult but try to put yourself in his place. You have decided to produce a line of turfgrass management tools. You travel and you listen. You study problems and you draw sketches. You decide upon the kind of machine that you think is needed by those who manage turfgrass areas. You try to design it to meet a principle and to correct a problem or condition. The manufacturer invests many dollars in design and production and he must be quite sure he is right and that the machine will perform satisfactorily and do the job.

The manufacturer cannot build a machine that will be varied to meet special adaptations. He must develop a program of teaching, of education in proper use and in distribution. The biggest problem is the dilution of recommendations which sometimes are six times diluted-- Manufacturer to distributor to salesman to superintendent to foreman to the worker who uses the machine. It takes at least three years to launch a new machine and only in the third year can a manufacturer begin to realize a return on his investment. When you put yourself in his place you will begin to realize why he says, "Learn to use machines as they are and as they are intended to be used." When you put yourself in the manufacturer's place you begin to realize that you must be practical and you can't build a machine that will suit everyone.

Regardless of what place you are in one will encounter difficulties as well as rewards. To be a real success and to rise in your profession, these things are considered important:

- Respect the other fellow's point of view
- Put yourself in his place to understand his thinking
- Lend a helping hand
- Let others know what you are doing
- Keep a sense of humor
- Use your imagination
- Write a letter now and then, especially to your editor
- Be a good listener- a sympathetic listener
- Be simple, direct, definite and concise
- Learn to get along with people

Wm. E. Lyons, Golf Course Supt.
Firestone Tire & Rubber Co., Akron, Ohio

Mr. Don Likes, Superintendent, Hyde Park Country Club, Cincinnati, Ohio has ably presented the role of organic nitrogen in the turfgrass management program at his Club.

Mr. Bob Williams, Superintendent, Beverly Country Club, Chicago, Ill., has described the use of both organic and chemical nitrogen on the turfgrasses at his Club along with some very interesting cost figures.

At both the Firestone Public Course and the Firestone Country Club we rely solely on the various forms of chemical nitrogen. Now this is not the only way to grow grass, it is just another. We have been criticized by some who do not know our job that we do not grow the finest turf in the golf industry. It is our aim to grow the best grass possible at the lowest cost that will produce a satisfactory playing surface. (Tommy Bolt scored a 265 against a 288 par during Rubber City Open at Firestone CC 1954). Our management The Firestone Tire & Rubber Co., has been pleased with the results.

There are those who say of Nitrogen that "regardless of its source, whether applied wet or dry, that a pound of Nitrogen will produce exactly the same result." We take issue with that thinking and hereby present facts which we have gathered that gave us the key to:

1. Lower cost of Nitrogen materials.
2. More efficient application methods.
3. Results justify our procedures.
4. Less player interference.

LOWER COST of NITROGEN MATERIALS

The more units of Nitrogen per cwt of material the lower the cost per pound of N. The less the freight and the lower the handling costs. Nitrogen in the form of pelletized Urea (45% N) has been costing us about 14¢ a lb. There is more than twice as much Nitrogen in Urea than in Ammonium Sulfate (21%); nearly three times as much as in Sodium Nitrate (16% N); and more than seven times as much as in some organic Nitrogen sludge materials. (6% N.)

MORE EFFICIENT APPLICATION

From the results of plant tissue tests we are able to estimate the amount of Nitrogen, Phosphorus and Potash (K) and other elements, that the grass plant tells us it needs. This reduces the chance of errors. We then figure the amount of raw materials needed per 1,000 sq. ft. Next we blend these in batch mixes based on whether the materials are to be applied thru a 200 gallon or a 300 gallon power sprayer. 10 gallons of the solution is applied per 1,000 sq. ft.

Suppose it is July; the weather is hot but not humid. The weather report from our nearby U.S. Weather Bureau states that we can expect the same for the next 5 days. The tissue tests show the plants to be medium in N; low in P; and only med (2000 ppm) in K. Grass clip has only been 1 1/2 buckets per green. In this case the grass is not growing fast enough for our heavy play. A typical procedure to the above is to apply 1/2 lb. of N; 1/4 lb. of P; and 1/2 lb. of K per 1,000 sq. ft. (Balance the plant food.) To get this we blend:

	N	P	K
1 lb. of Potassium Nitrate (13-0-46)	.13	0	.46
1/2 lb. of Di Am Phosphate (21-53-0)	.10	.26	0
1/2 lb. Urea (Pellets) (45-0-0)	.22	0	0
Total	<u>.45</u>	<u>.26</u>	<u>.46</u>

If a 200 gallon sprayer is used multiply the weight column by 20. If 250 gallon multiply by 25; if a 300 gallon machine multiply by 30.

We use a McLain coarse plate shower nozzle on the hose from the sprayer. This mixture is physically cold enough to cool a coke but chemically hot enough to kill grass. CAUTION! When applying have one man applying water with a shower nozzle to the heels of the man applying the mix.

In the above mix there are two kinds of Nitrogen. That derived from the ammonia in the Urea and Di Am Phosphate, and Nitrate Nitrogen from the Potassium Nitrate. Both are quick acting. We like these in that it gives us a chance to estimate their release based on weather information. When we get high humidity we like the grass on tees and greens to show a little lack of plant food, especially nitrogen. There will be less sugar in the plants for the disease organisms to attack. If we miss the weather guess we can delay the intake of the applied materials by using one of the mercury based fungicides. These appear to check the activity (temporarily) of the soil organisms that are releasing some of the Nitrogen to the plants.

LESS INTERFERENCE WITH PLAYERS

It takes less than 3 minutes to apply our "slop" to a 5,000 sq. ft. green. Watering in, requires going over the green a minimum of 3 times. If greens are soil dry, 4 times. Men move fast and do the job in about 5 minutes. Players are permitted to pitch to the greens while this is being done. Putting is delayed until the job is finished. We have very few player complaints. They appreciate the effort we are putting forth to give them a continually good playing surface.

If grass blades are dry, shower lightly like dew. Do not apply any fertilizer to a soggy green. Apply before the sun becomes too brilliant. Early morning cloudy day is ideal while the dew is still on turf.

Commercial sprayers are not on the market that have large hole jumbo nozzles especially designed for applying 200 gallons per acre of any desired formulation of N-P-K to fairways. An acre can be sprayed in 20 minutes. In June we sometimes spray our fairways with 100 lbs. of ammonium sulfate; 1 lb. of 2,4-D; 1 lb. of 2,4,5T; and 1 cup of common household detergent for clover and broad leafed weed control. A light burning will show but will mow off in a week.

HELPFUL INFORMATION

In his book, "Soil Conditions and Plant Growth" published by Longmans, Sir John Russell states, "There are three possible sources from which roots can extract their nutrients; the SOIL SOLUTION; the EXCHANGEABLE IONS; and the READILY DECOMPOSABLE ORGANIC RESIDUES."

Nutrients in water quickly contact the roots. There is less fixation on the soil surface. Thus a quick response to the minerals applied in solution. Mixed commercial fertilizers carry much material that is not needed by plants and in many cases is harmful. Quite often when grass is chemically damaged, the high concentration of these harmful materials is responsible.

Jackson B. Hester, Soil Technologist, Dept. of Agricultural Research, Campbell Soup Co., wrote the following in the book, "Water and Man," published by Friends of the Land, Zanesville, Ohio, page 101, "Plants have a high requirement for Potassium, Calcium and Nitrogen and absorb these elements from the soil in relatively large amounts. They have a low requirement for sodium, chlorine, sulfur and other ions. Commercial mixed fertilizers carry large amounts of sodium, chlorides and sulfates."

Some Results Reported by Dr. Hester - Unleached soil - Tubers

KCl, (NH ₄) ₂ SO ₄ , NaNO ₃ and Superphosphate	(High Salt)	Growth Wt.	23.6
KNO ₃ , Urea, and Ammonium Phosphate	(Low Salt)	Growth Wt.	220.4

A growth increase of 933%

Surely on golf greens and tees that must be fertilized frequently we do not want the high salt accumulations and the low yield shown by Dr. Hester. What we do want is the low salt and maximum results he shows. This we can get by mixing Urea, Di Ammonium Phosphate, Potassium Nitrate and applying these in solution.

THE ROLE OF AMMONIA IN PLANT FEEDING

Gardeners, florists, nurserymen, farmers and others have always shown a high regard and preference for animal manures. The beneficial effects of natural organics on the soil organisms cannot be over estimated. The Nitrogen in all organic materials is released in the AMMONIA form in direct proportion to soil temperatures, beginning at 34 degrees and going up beyond a temperature above which soil organisms become inactive. For example a barn yard manure pile is often seen "steaming" on a cold wintery day. What farm boy has not seen "fire fanged" manure? Thus overheating may actually destroy the material.

In our work the same principle is used to chemically destroy weed seed in top-soil by the addition of Calcium Cyanamide. This too is an ammonium product.

Ammonium Sulfate (21%N) has long been used by Golf Course Superintendents. It has a high sulfur content that acidifies soil. It has a place on greens occasionally where the pH is 6.8 and up. Used all the time it produces a toxic acid condition from too much sulfur. Many commercial mixed fertilizers have Ammonium Sulfate as their source of Nitrogen.

Mr. Ethan Kirkhart, Superintendent, Youngstown Country Club, Youngstown, Ohio, has produced excellent fairways by applying Ammonium Sulfate in the fall. The effect from this is what Dr. Fred Grau refers to as "golden brown." Mr. Kirkhart literally "burns up" the clover and weeds. His fairways are mostly bent grasses. The soil is high in Calcium Silicate from the agricultural slag that has been applied.

Grass and most other plants will respond to any form of AMMONIA fertilizers be they organic, synthetic organic (Urea) or chemical. Long experience has taught the Golf Course Superintendent that those free from harmful carrier compounds are the safest to use.

Nitrate Nitrogen fertilizers have not given the results on fine turf that have come from the ammonia compounds. The combination of both the AMMONIA and the NITRATE have given excellent results. Many fertilizer manufacturers advertise that the Nitrogen in their product is from multiple sources. The theory being that each has a difference of release thus feeding the plant over a longer period of time.

Dr. G.N. Hoffer, Consulting Agronomist, Lafayette, Ind., well known to many members of this conference, is now working on AMMONIA, its effects on plants and soils. His laboratory demonstrations are most interesting and his field work on corn is most outstanding. Some of our members were privileged to see these demonstrations. One thought that Dr. Hoffer left with us of note was the reaction AMMONIA has on the clay fraction of the soil in liberating ions of elements that are needed in plant growth. This comes about in much the same way that calcium and magnesium carbonates liberate toxic hydrogen ions from an acid clay soil.

THE ROLE OF MAGNESIUM IN PLANTS

From a reprint of an article in "Better Crops With Plant Food", published by the American Potash Institute, Washington, D.C., entitled, "How Different Plant Nutrients Influence Plant Growth", Lester L. Loftin writes, "Magnesium is credited with being a companion for phosphate; it combines with phosphates so that the latter can be moved to the proper place in plants. We owe the beauty of a green world of vegetation to magnesium. It is the key element in the molecule of chlorophyll, the green pigment in plants that trap energy from the sun and make plant life possible."

It is now established that plants take up proportionately less magnesium from dolomite limestone as the pH goes up. However, the plants will absorb magnesium from the sulfate form at the higher pH levels. Having greens and tees with a pH 6.8 and up, we have been able to get more magnesium and phosphates into the plants by applying 5 lbs. per 1,000 sq. ft. of Epsom Salts (not Hadacol), thru a cyclone seeder (dry).

Dr. S. W. Melsted, Associate Professor, Soil Fertility of the University of Illinois supplied us with experimental test papers for testing the magnesium in plant tissues. Using these as a guide we have had excellent results by keeping the magnesium at 50 ppm in the plant sap. Our grasses do not show chlorosis which can happen when the magnesium supply is inadequate.

From the story published in the February 1950 issue of "What's New in Crops and Soils", we recall the article that stated that the application of 200 lbs. per acre (5 lbs. per 1,000 sq. ft.) of Epsom Salts with the fertilizer increased the yield of corn silage 68%. Is not corn a big grass plant? Bluegrass was increased 77% by the same treatment.

NITROGEN PLUS WATER ON FAIRWAYS

We only have 400 gallons of water per minute for use on two 18 hole golf courses having 45 greens and 65 tees. During the hours that water is not needed on greens and tees we try to water fairways, much to the annoyance of some players. Consequently we do not have enough water to do a good job on the fairways of one course let alone two. But at that we are perhaps more fortunate than the courses that cannot water fairways. We have to share our water sources with industry.

Watching how much better grass always grows after a summer thunder storm than after we soak the soil by sprinkling we concluded there must be Nitrogen in the rain. Checking the literature revealed that Cornell University had measured the annual amount of Nitrogen (NO₃) in rain and snow. It varies from 5 to 20 lbs. per acre in different parts of the world. Our problem then was, how to get Nitrogen into the water we use for irrigation and not damage our underground lines. It was solved by using Urea Pellets. This material flows freely when dry. By putting a small hole in a steel drum (must have a tight fitting lid) the Urea drops into our intake from the stream. One lb. of Pellets to 200 gallons of water.

We tested the results on a gravel hillside facing the sun where a soil temperature has been recorded at 127. One application of Urea in water kept the turf greener than the check where we had to sprinkle 4 times to get comparable color. It could still be seen the following spring.

For those who cannot put Urea into a city water line there is available a motorized Cyclone Seeder that can be mounted on the front of the tractor and the Urea pellets applied at the time of mowing. These can be adjusted to apply from 10 to 100 lbs. per acre. The cost is very low. "Commercial Urea," says Gilbert H. Collings in his book, Commercial Fertilizers, published by Blakiston, "is identical with the Urea found in animal urine." Every experienced gardner knows the value of this animal product. Urea is used by most manufacturers of commercial liquid and water soluble fertilizers.

THE MANAGEMENT OF BENT GRASS FAIRWAYS

O. J. Noer

Sewerage Commission of the City of Milwaukee, Wisconsin

The subject of today's discussion by me and by the panel members was not our choice. The assignment was made by Dr. Daniel. My first impulse was to demur, but on second thought the topic seemed timely. Bent grass has been condemned, mostly because of faulty maintenance. Many clubs have bent fairways and must live with them. Others should use bent until a better grass is developed. That should come, but not immediately. There is no other choice on many watered fairways for courses north of a line from New York on west through Chicago. Under proper management, golfers like bent grass fairways. Members of clubs with good ones think there is nothing better.

U-3 Bermuda grass, which Dr. Grau suggests to be called "Hall's U-3", is performing well on fairways and on unshaded tees in the belt from Philadelphia across to Kansas City. The trend is towards its use in that belt. The turf is of excellent playing quality and grows well during the warm summer weather. So far it has been winter-hardy. The story will be told after first real severe winter. Clubs north of that belt should make haste slowly with Bermuda grasses.

In this afternoon's discussion, the objective will be to cover all phases of bent grass fairway turf. My discussion will deal with the fundamentals. The panel members will tell you about their experience with this type of turf. Incidentally, today's chairman, Mr. Frank Dunlap should replace me on the program because of his fine job of renovation at Country Club of Cleveland. Besides producing good bent turf, he has subsequently maintained extraordinarily fine fairways.

Old time golfers still talk and rave about the playing qualities of the fescue fairways of their youth. In this regard the accuracy of their memory cannot be questioned. No grass makes a finer playing fairway than the chewings and creeping red fescue. Belvedere at Charlevoix, Michigan, is about the only surviving example of note on this continent. The upland fairways on that course are fescue and are of top quality, but the low-lying ones, where the soil stays moist all summer, have been taken over by creeping bent grasses. It is impossible to hold bent in check on a fertile moist soil. Just a few scattering plants are enough. Before long they will overpower fescue and Kentucky blue grass and take sole possession of the area.

The modern tractor drawn mowers doomed fescue and Kentucky blue grass along with the demand for closely shaved turf and the clamor for watered fairways. Where water only was used to grow grass, poa annua took possession in spring and fall when the weather was cool. Clover knotweed, and crab grass took possession during the hot summer months. Poa annua is at its best in cool moist weather. It fades out when weather becomes warm and dry. Frequent light watering along with the use of nitrogen fertilizer in moderation helps poa annua survive and is the method used by some. That practice is justified for tees and greens, but would not seem like the best way to solve the turf problem on fairways. Instead of depending upon a temporary thing like poa annua, the better and more satisfactory way is to get something more permanent which does not demand constant watching every hour of the day.

When watered fairways changed to bent turf without supplementary seeding, generous fertilization accompanied the use of water. The original turf contained a little bent - poa annua was never a problem. This is what happened at the Milwaukee Country Club - to cite just one example.

The bitter criticism of the entire playing membership compelled club officials to clamor for an answer to the poor watered fairways. Flowing and reseeding was ruled out.

While a graduate student at the University of Maryland Fred Grau worked part time for the U.S.G.A. Green Section. One project of his was to find something to kill weeds without destroying grass. He first devised a method for using sodium chlorate and then for arsenic acid and sodium arsenite. The chlorate was best for crab grass. The arsenicals eliminated broadleaf weeds after several treatments, and killed crab grass. Their effect on clover and knotweed was even more striking. The first large project with arsenic acid was undertaken by the Toronto Golf Club. Mr. Evan Begg, the Chairman, and Horace Purdy, the Superintendent, first visited Washington, D.C. to study the plots there, then they made test applications at Toronto and proceeded to transform the poor fairways into the equal of any on this continent. Ed. Dearie, Frank Dinelli, and William Stupple of Chicago were among the early users of these two chemicals in the United States. Dearie sprayed the 16th fairway at Oak Park and seeded with Seaside bent. The turf was outstanding until fertilization stopped. Since its resumption the turf has improved and will be as good as ever in another year.

With the discovery of 2,4-D some thought the use of sodium arsenite or arsenic acid was a thing of the past. Both have regained their rightful place in the turf maintenance field. They are best for fairway renovation and for the control of chickweed in watered fairways. Choice is a matter of their commercial availability. Clover is controlled with the fall sprayings for chickweed. Sodium arsenite is being used to check poa annua. Orville Young at Morraine Country Club in Dayton uses 1 pound per acre every seven to ten days in the spring to prevent seed formation. He is convinced that there is less poa annua now in the sprayed fairways than before. There is a difference between the sprayed and the adjoining unsprayed fairway, but results are not conclusive as yet.

Fairway renovation as now practiced is along these lines. Broad-leaf weeds are killed by spraying with 2,4-D in the spring. The time varies with the locality. Best kill is obtained when the weeds are in active growth and temperatures are above 65 degrees Fahrenheit. No more is used because 2,4-D inhibits grass seed germination if applied two to three weeks before or after seeding. Arsenic acid or sodium arsenite is applied three or four times spaced a week apart starting in July. Discoloration is most severe the first time so the rate is in the range of 1 to 1½ pounds per acre. After that the rate is increased to 2 pounds per acre especially if crab grass is present. The quantity of water does not matter except for crab grass, and ranges from 8 to 50 gallons per acre. A wetting agent is added for crab grass and some think the gallonage of water should be about 50 to insure thorough wetting of the leaves. Soil moisture to a depth of 6 to 8 inches should be at the optimum for growth, to minimize shock to the grass and speed its recovery. There should be no rain immediately after spraying, and preferably for six to twelve hours. The fairways should be watered forty-eight hours after spraying to promote recovery of the grass and weeds. Seeding can be done immediately before the last application of the sodium arsenite. This saves a week's time and gets the young grass off to a better start before the onset of winter.

Good seed bed preparation is important. Common practice is to use an aerifier, rotary hoe, or disc in several directions and then follow with a three-gang spike disc. The latter should be used in three or four directions. Some sow seed by broadcasting and others like the alfalfa and grass disc seeder. When using it, cross-seeding is advisable.

The fertilizer should be applied after aerifying but before spike discing to insure penetration of the fertilizer and mixing with the soil.

Originally Astoria bent was the favored grass for reseeding. Highland bent is finding favor and some Seaside is being included on watered courses. A common mixture now in use is 40 per cent Astoria, 40 per cent Highland, and 20 per cent Seaside. Seeding rates vary from 20 to 100 pounds per acre. Good results have been obtained even with the low rates.

On courses where poa annua has been bad, the important thing is to get the bent grass started and then encourage it by proper fertilization and management. By doing that the bent will assert itself.

Approaches to the greens often have the worst turf and respond least to renovation and re-seeding. Excessive turning with tractor and mowers bruises and kills the young grass seedlings. Mike Omelianoff at Detroit Golf Club has been plugging bad approaches with 4-inch bent grass plugs from a nursery or from nearby bent patches in the fairway. It looks like a hopeless task, but results seem encouraging, which is the answer.

A few clubs have renovated unwatered fairways successfully. Clovernook in Cincinnati is a notable example. At first they reseeded with Kentucky blue grass only. Then a little Astoria bent seed was added. These have been the best fairways. It would seem unwise to include Seaside bent in any mixture for unwatered fairways.

Up to now the use of Merion blue grass for seeding into existing turf fairways has been disappointing in most instances. More must be learned about the how, why, and when before clubs are justified in using this high priced seed on a large scale.

Mowing is an important item in the maintenance of bent grass fairways. Those who have tried cutting high enough to favor Kentucky blue grass hear complaints from the players and lose some of the bent. Players abhor lies on matted patches of bent and are quite right in their objection. It is impossible to control the shot when there is grass between the club head and the ball. Any attempt to favor both grasses is an impossible task. Bent grass fairways should be cut close always, never higher than 3/4 of an inch.

Lime usage and fertilization are extremely important. Even though bent grass withstands more acidity than some other grasses, the use of lime is justified and advisable when the soil is acid, especially in the range below pH 6.0. Aside from any direct effect on growth, lime helps turf withstand adversity. Bent grass fairways, especially the watered one, need more nitrogen than some people realize. Phosphate requirements are nominal, definitely less than for Kentucky blue grass. The trend on watered fairways is to use fertilizer quite generously in September and to wait in the spring until the early flush of growth is over. Light moderate applications are made monthly during June, July, and August.

Over-watering is the tendency. Members think it should be used continuously. No set pattern can be suggested. Water should be used to keep the grass alive and not to keep it soft and lust. A good golfer does not like that kind of grass.

Chickweed is the most troublesome weed on watered bent fairways. Fertilization helps control other weeds by increasing turf density. This is not the case with chickweed. The patches become bigger. There are two kinds in fairway turf. The mouseear and the so-called "common" variety which is the hardest to control. It was thought that 2,4-d was the answer. Those who have tried to use it several times in succession on bent fairways have learned differently - to their sorrow. The bent grasses fared badly and the chickweed survived. Chickweed is best controlled with sodium arsenite or arsenic acid. Fall is a good time to treat because discoloration of the grass is negligible. It is necessary to spray three or four times; the rate for either material need not exceed 1-1/4 pounds per acre each time. The kill is never permanent. Some clubs spray six fairways a year. In that way they get around the course in three years.

The damage caused to bent grass fairways by the promiscuous use of 2,4-D for the control of broad-leaf weeds and by 2,4,5-T for clover control is not generally realized.

When 2,4-D was announced, test plots were established along the edge of the 15th fairway at Milwaukee Country Club at a point where bent grass was present in the longer rough as well as in the fairway. Treatments were made in September. There was no permanent injury to the longer bent grass in the rough. The same thing happened on fall treated plots established subsequently and in different years. No permanent damage resulted to bent grass on spring treated plots at rates in the ranges of 1/4 to 1-1/2 pounds per acre. The bent was discolored by 1 pound per acre or more but recovered.

Because of what happened on the 15th fairway, Ted Booterbaugh never used 2,4-D as an over-all spray on the fairways while he was in charge at Milwaukee Country Club. He spot-treated broad-leaf weeds with a knapsack sprayer. Most of the dandelion were in the landing area, which simplified the task. They appeared in the divots mostly, but never affected play because the bent turf kept the plants small.

Until somebody takes the time to investigate the effect of temperature and time of spraying, it would seem wise to avoid using 2,4-D or 2,4,5-T in hot weather and in early fall on bent grass fairways. Some 2,4,5-T was used on a portion of a fairway in Chicago during a hot spell in July at one-half pound per acre only. The line where spraying stopped was apparent for the balance of the season because of the thinner turf on the sprayed plot. Some of the bent patches were injured badly, others showed no effects. The creeping bents seem to be injured more easily and more severely than the colonial types.

FAIRWAY IMPROVEMENT PROGRAM AT THE MORAINÉ COUNTRY CLUB
O. W. Young, Dayton, Ohio

Moraine course is hilly, and built on just what the word means, sand and gravel, with a very shallow sandy clay top soil deficient in humus.

Due to the members' demand for a closecut, we have been doing all we can to incorporate astoria and highland bent into our existing blue grass, bent, clover, goose grass and poa, which is a terrible trouble maker.

Visits, suggestions, letters, and ideas gotten from Mr. Noer, Mr. Daniel, Mr. Grau, turf conferences, etc., have all played a big part in the renovation of our fairways, which are slowly but surely being taken over by the desirable bents, except the par 3 holes I planted to U 3 bermuda.

Here is the program.

We do all we can to encourage the bent and discourage the poa. This is done by watering just enough to keep the bent alive and healthy. We don't aim to water to the extent that the poa is encouraged, which would give the good grasses too much competition. Here I have trouble with the members because they like to see the water system going.

The fairways get 2 to 3 light applications (1# to 1½# per A. depending on the weather, etc.) of Sodium Arsenite through April and May to help check the poa and its seeding. Another application is used in the fall, just before seeding in early September.

I fertilize twice a year; usually around June 1, after the poa has retarded, and again the last week of August, which gives the desirable grasses a boost before the poa gets a head start in the fall. Plant food used is Milorganite fortified with Sulphate of Ammonia at the rate of 400 to 600 lbs. per A. each application, preceded by a thorough rotory hoeing.

Annual soil tests indicate the Phos. and Potash levels and I use G. and F.-10-6-4; when these elements are on the border line, at 400 lbs. per A.

Crabb grass is not a serious problem as flexicombs and a cyclone fence mat dragging is a general practice. I know the arsenite; and lead arsenate used in the past also helps reduce this weed.

Goose grass is quite troublesome on the approaches. I feel the verti-cut kept sharp and set just above ground level used both ways several times just before this pest is at its peak, will help control it.

U. 3 bermuda has been planted on all the par 3 holes. They were put in last June and July and were almost solid bermuda by fall. The members love the bermuda on our tees, and I am sure they will want it on all the approaches which will most certainly take care of the poa and goose grass on these areas.

There are color slides to show this work.

EXPERIENCES WITH ZOYSIA

Frank Dinelli, Supt.,
Northmoor Country Club, Highland Park, Ill.

In the spring of 1953 I first planted zoysia from seedling in a small nursery. This was done the 9th of June. We had sod the latter part of August.

The following year I planted a small tee on the course, about 250 sq. ft., and it was cut one-half inch. We used it the last week of August and the first week of September. Players seem to like it very well.

This year I plan to put in another small tee and also to put in about 100 sq. ft. on the practice tee. It looks to me so far that the zoysia will work out all right on tees in our part of the country. On our course the tees are not used for winter play; therefore, winter color is not vital. However, only time will tell.