UNIVERSITY OF ILLINOIS
DIVISION OF UNIVERSITY EXTENSION

ILLINOIS

TURFGRASS CONFERENCE

PROCEEDINGS

December 1 and 2, 1960
in the Auditorium, Bevier Hall
Urbana, Illinois

arranged and conducted by the

COLLEGE OF AGRICULTURE

with the cooperation of the

ILLINOIS TURFGRASS FOUNDATION

This conference is presented specifically for persons interested in turf management by the University of Illinois College of Agriculture. Abstracts in this manual bring to you up-to-date information required by those who wish to maintain high quality turf-grass areas but do not constitute positive recommendations unless so stated. Statements made herein are the responsibility of either the speaker or the institution he represents. Reproduction and publication are permitted only with the approval of each author.

TABLE OF CONTENTS

UNDERSTANDING SOILS

Charles Y. Arnold

The physical and chemical properties of and their relationships to air, water, and fertilizers are too numerous and complex to cover in the next hour. Perhaps it will be enough if we can discuss a few isolated phases of this too broad subject and in doing so recognize how an understanding of each can be of value to you in the successful management of turf. The details of the examples presented are not recorded here because they and many more are comprehensively covered in a series of publications which are available to you through the University and other agencies. A list of these publications is included below in hopes that you will wish to take advantage of their availability and further your understanding of this most important subject.

A. From the Information Office, 112 Mumford Hall, University of Illinois, Urbana, Illinois.

1. Circular 758. Understanding Soils.
2. Agronomy Facts, Vols. 2,3,4,5, and 6.
   These volumes contain short articles on a variety of agronomic subjects. Many of them deal with subjects leading to a better understanding of soils. Some examples are:

   a. How are soils developed.
   b. What do we see in a soil profile.
   c. Clay minerals in Illinois soils.

   They are available at the cost of one dollar each.

3. County Soil Maps.
   These are not available for all counties. If one is available for the county you are interested in a single copy will be issued free. If several copies are desired a charge may be made. There are some less detailed maps for some counties. To find out about these you may write to the Department of Agronomy.

B. From your Congressman.

1. Agricultural Yearbook, 1955. Water.
2. Agricultural Yearbook, 1957. Soil

C. From the Department of Agronomy, University of Illinois, Urbana, Illinois.

1. Agronomy News.
   From 30 to 40 issues are released each year. They contain topics of current interest and occasionally list publications available from the Agronomy Department. You may be put on the mailing list <u>if you have an Illinois address</u>.

WHAT'S IN THE FERTILIZER BAG

Samuel R. Aldrich

To many persons the contents of a bag, barrel, or bottle of fertilizer are a deep mystery that is becoming progressively deeper because of rapid changes in fertilizer technology and constant exposure to fantastic claims in the garden section of the Sunday newspaper.

Fertilizer technology is highly complex as anyone knows who has taken a tour through a modern fertilizer manufacturing plant. But the fertilizers that are offered for sale are well known chemical compounds and mixtures that can readily be described in easily understood terms. Furthermore the fertilizer laws require the manufacturer to label fertilizers with the pertinent information to evaluate them and prohibit the manufacturer from showing most extraneous material on the label.

The information on the fertilizer bag and tag are for you. It will pay you to learn what the analysis means. Figure 1 shows you the important information that is given on the bag or tag of each bag of fertilizer.

FERTILIZERS DESCRIBED

The Fertilizer Analysis

The standard order to list the nutrients in a mixed fertilizer is nitrogen, phosphorus, and potassium. You often see them referred to as N-P-K. This is correct for nitrogen since the analysis shows nitrogen as an element. Phosphorus is shown as available P_2O_5. This is called phosphoric acid in fertilizer terminology. P_2O_5 is 43.7 per cent phosphorus. Potassium is given in terms of water-soluble K_2O. K_2O is called potash. It contains 83 per cent potassium. Perhaps at some time in the future you will find fertilizer analyses given in terms of nitrogen, phosphorus, and potassium rather than N, P_2O_5, and K_2O. To show the effect of this change the 10-20-10 in figure 1 would be 10-8.74-8.3.

Some fertilizers guarantee secondary or minor elements that are shown in the analysis. A salesman's claim that his brand of fertilizer contains minor elements means nothing unless you find the elements listed in the guaranteed analysis.

Fertilizer Ratio

The ratio refers to the relative proportions of the nutrients. A 10-20-10 grade has a 1-2-1 ratio. An 8-16-16 grade has a 1-2-2 ratio.

Paper presented at the Illinois Turf Conference, December 1-2, 1960.

A 10-10-10 grade has a 1-1-1 ratio. Choosing the proper ratio is the first important decision you have to make in fertilizing your crop.

Potential Acidity

The potential-acidity figure that you find printed at the bottom of the bag is the pounds of calcium carbonate ($CaCO_3$) needed to offset the acidity caused by 1 ton of the fertilizer. The potential or residual acidity is due mainly to the nitrogen. You can buy "non-acid" or "neutral" fertilizer which has no potential acidity. Such fertilizer is usually made by adding limestone. If you pay a premium for a non-acid fertilizer, you are paying a fertilizer price for limestone. You will find that it is more economical to buy your fertilizer and lime separately.

Color, Odor, Name

You can't judge fertilizer by color, smell, or fancy name. The color and smell are usually caused by the conditioner and have no relation to the nutrients. "Corn," "wheat," and "bean" fertilizers tell you nothing about the nutrients that are needed by your crops.

Complete Fertilizers and Materials

The term "complete" fertilizer is often used to describe a fertilizer that contains all three nutrients, nitrogen, phosphorus, and potassium. Fertilizer materials carry one nutrient. Examples are superphosphate, muriate of potash, and ammonium nitrate. A mixed fertilizer contains two or more nutrients.

High Analysis versus Low Analysis

High analysis and low analysis are relative terms. In 1950 a 10-10-10 grade was considered high. In 1960 you could buy much higher 1-1-1 ratio fertilizers. The total of plant nutrients is the basis for rating fertilizers as high or low analysis. A total of 20 units as in a 4-12-4 is about as low as you find in mixed fertilizers. To be called a high analysis a fertilizer should contain at least 30 units of plant nutrients. The highest analyses commercially available in 1960 had about 50-60 units.

Filler in Fertilizers

Manufacturers are getting away from the practice of adding sand or other worthless materials to their fertilizers as "filler." Some persons are of the opinion that you should class ground limestone as filler since it can be bought much cheaper outside the fertilizer bag.

Fertilizers have varying amounts of "conditioners." These are materials that are added to keep the fertilizer free from lumps and in good condition to drill. You can see that they are a necessary part of fertilizer and should not be called filler. New processes for making pelleted and granular fertilizers reduce the need for conditioners.

You may have wondered why you can't buy fertilizer that contains 100 per cent N, P_2O_5, and K_2O. Some people ask, "If I buy a 10-20-20 fertilizer that adds up to 50 units of plant food, isn't the rest just filler?". The answer is no. The fertilizer manufacturer can't use pure nutrients. The most concentrated source of nitrogen is anhydrous ammonia, which has 82 per cent nitrogen, and the manufacturer can put only a small amount of it into your fertilizer. The other nitrogen compounds that he has to use contain a lower percentage of nitrogen. The most concentrated source of phosphorus for mixed fertilizers is double or triple superphosphate at 46 per cent P_2O_5. Muriate of potash runs as high as 61 per cent K_2O. The part of these materials above the percentages shown is in no sense "filler."

MINOR ELEMENTS

You can't draw a sharp line between major elements and minor, trace, or secondary elements. So-called minor elements are just as essential for normal crop growth as major elements. They are called minor, trace, or secondary elements for one of the following reasons:

1. Smaller amounts are used by plants. For example, a 100-bushel corn crop contains in the plant and grain about 150 pounds of nitrogen but only 1/20 pound of boron.
2. Not so many soils lack the minor elements for normal crop growth.
3. Small amounts correct deficiencies where they occur. For example, you apply 20 to 200 pounds of nitrogen per acre but only 1 to 5 pounds of boron.
4. The range between too little and too much is less than in the case of major elements.
5. Except for iron, soils contain only small amounts of minor elements, but they often contain more than materials that are sold as sources of minor elements.

LIQUID MIXED FERTILIZERS

Liquid mixed fertilizers are now widely available to Illinois farmers. The relative place for liquid and dry fertilizers depends upon:

1. Agronomic considerations
2. Cost of nutrients applied on the field
3. Availability of equipment to handle, store, and spread
4. Ease of handling

This statement deals only with the agronomic factors, since the others can best be determined by the farmer for his own special situation.

For most farm situations in Illinois liquid and dry mixed fertilizers may be assumed to be equal in performance. Where differences occur, they are not likely to consistently favor either form. Farmers may therefore select on the basis of cost per pound of nutrients, plus special considerations in handling, storing, and applying the two forms, and services available from the supplier.

Kinds of Liquid Fertilizers

There are several kinds of pressure and nonpressure types of liquid carriers of nitrogen. A more recent development is the introduction of liquid mixed fertilizers mainly since about 1954. These are nonpressure, nonvolatile fertilizers containing nitrogen and phosphorus or nitrogen, phosphorus, and potassium in solution form. This statement deals with the comparison of liquid mixed fertilizers and dry mixed fertilizers.

Chemical Forms of Nutrients

Fundamentally, the nutrients are frequently similar in liquid fertilizers and dry mixed fertilizers of the same approximate analyses. There are several possible ways to supply the nitrogen in both liquid and dry mixed fertilizers, but in the final product as used by the farmer the nitrogen occurs as an ammonium salt, urea, cyanamide or nitrate. Some fertilizers, both liquid and dry, contain two or three forms. There is no special advantage of either liquid or dry fertilizer with respect to forms of nitrogen.

The phosphorus in liquid fertilizers is supplied entirely by phosphoric acid and is neutralized by the ammonium hydroxide of the nitrogen source (for example, ammonia, NH_3, in water produces ammonium hydroxide, which neutralizes the acidity). The phosphorus thus occurs as ammonium phosphate and is therefore all water soluble.

The phosphorus in dry mixed fertilizers is the result of treating phosphate rock with sulfuric, phosphoric, or nitric acid. This in turn may be ammoniated to different levels of nitrogen. A still newer process, patented in 1958, involves hydrolyzing calcium metaphosphate so that it may be ammoniated. Thus, the phosphorus in dry mixed fertilizers may be in several forms differing mainly in their water solubility. The water solubility ranges from about 10 to nearly 100 per cent. Whether or not this is significant in the field depends upon several factors.

High water solubility is not an advantage for broadcase applications. Triple superphosphate and ordinary superphosphate are about as high in water solubility as liquid fertilizers.

The potassium in liquid and dry fertilizers is in the same form, muriate (potassium chloride, KCl). A small amount of sulfate of potash is available, but the potassium chloride form supplies most of the potassium in the United States.

Availability in Dry Soil

It may at first thought seem logical to expect that nutrients which are supplied in liquid rather than dry form would be more readily available in a dry soil. In practice there is not likely to be a measurable difference. The water in liquid fertilizer when put on an acre basis is negligible. Dry fertilizer absorbs moisture and goes into solution unless the soil is very dry. Liquid fertilizer, on the other hand, would soon lose moisture and crystallize out in a very dry soil.

No practical difference in rate of availability is expected in a moist soil because a significant amount of the water soluble nutrients in a dry fertilizer will go into solution within a matter of hours, or at most a few days.

Limitations on Ratios and Analyses

With presently available materials, the possible range in ratios is somewhat more limited with liquid fertilizers than with dry mixed fertilizers. All liquid fertilizers carry some nitrogen because ammonia is used to neutralize highly corrosive phosphoric acid. It is not necessary in dry fertilizers.

Higher analyses are possible in dry than in liquid fertilizers. The practical limit of $N + P_2O_5 + K_2O$ in liquid mixes has been about 32 per cent before "salting out" (crystallization) occurs if the temperature falls to the freezing point (32°F.). The development of a new process to produce superphosphoric acid opens the way to higher analyses in the future. Dry mixed fertilizers are now offered with total nutrient contents above 50 per cent. This advantage in higher analysis is somewhat offset by the ease of moving liquids by pumping.

Minor Element Content

Liquid fertilizers carry less minor elements than dry mixed fertilizers because high purity furnace acid that is low in trace elements is used. This is not considered to be significant, since deficiencies are so uncommon and, where present, would not be effectively corrected by the minor elements that naturally occur in dry fertilizers.

Yield Results and Research in Progress

Yield results in Illinois and other states have usually shown small differences that have not consistently favored either liquid or dry fertilizers when the same amounts of nutrients were applied.

UREA-FORM FERTILIZERS (L. T. Kurtz)

Urea-form is the name of a class of nitrogen compounds formed by reacting urea with formaldehyde. These urea-form fertilizers are intended to provide a synthetic nitrogen carrier that has low water solubility and will release nitrogen slowly through the growing season. Examples of urea-form fertilizers now on the market are Nitraform, Bordens "38", and Uramite. All of these contain 38 per cent of nitrogen.

Nitrogen in urea-form fertilizers costs three to four times as much per pound as that in the regular synthetic nitrogen fertilizers. Consequently, urea-form is not likely to find extensive use on Illinois field crops under present conditions. It is now used chiefly for turf, ornamentals, and some vegetables, and in some other situations where a continuous, moderate release of nitrogen is desired from one or two applications during the growing season.

Urea

The usual synthetic nitrogen fertilizer is water-soluble and almost immediately available. It is argued that unless small, frequent applications are made, some of this nitrogen may be denitrified, leached, taken up by weeds, or otherwise unused by the crop. Furthermore, a large amount of nitrogen is present for the small crop at the beginning of the season, but little may be left later in the season for the larger crop. Consequently, a nitrogen material like urea-form that has low immediate solubility but releases nitrogen gradually would have advantages under some conditions. In addition, such a material should neither injure germination if applied too close to the seed nor burn leaves if applied in contact with the plant.

Different urea-forms have been prepared and tested, but all those marketed at present meet the definition of the American Association of Fertilizer Control Officials which states, "Urea-formaldehyde fertilizer materials are reaction products of urea and formaldehyde containing at least 35 per cent nitrogen largely in insoluble but slowly available form. The water-insoluble nitrogen in these products shall test not less than 40 per cent active by the nitrogen activity index for urea-formaldehyde compounds as determined by the appropriate AOAC methods."

ARE NITROGEN, PHOSPHORUS, AND POTASSIUM FERTILIZERS OLD-FASHIONED?

Fertilizer vendors are being bombarded with leaflets and sales talk that make fantastic claims for soil treatment materials that will stimulate the release of the locked up nutrients in the soil, feed the soil bacteria, condition the soil, even guard against drouth, and in general supply nutrients to crops far more efficiently than conventional fertilizers that supply nitrogen, phosphorus, and potassium must be out-of-date.

You might conclude that NPK

The following excellent statement relating to uproven sources of nutrients is reproduced with permission of the authors.

"IT'S YOUR MONEY"

Milton Fireman and Albert W. Marsh, University of California
February, 1960

As would be expected in these changing times, new products for agricultural use appear on the market in a steady stream. Many of these have real merit; they do a job for you and help you make a profit. They have contributed much to recent important advances in agriculture.

But other products may be of questionable value. Or they may be grossly overpriced. Or both. These are often sold by honestly enthusiastic persons who use scientific sounding sales talk, promising great benefits hitherto not available. They promise benefits based on "knowledge" which is often the product of pure fancy.

Just about everybody would like to get something for little or nothing, and it is human to hope that science will provide an easier

or cheaper way of solving our farming problems. Maybe some new truth not yet fully appreciated has just been brought into use and we can "get in on the ground floor." Promoters capitalize on these hopes.

Products of questionable value are seldom entirely worthless, but they may be worth very little in relation to their cost. They often carry an enormous mark-up to pay for the great sales cost. Rarely do they prove to be a profitable investment. If you can't make a profit on what you buy for your farming operations, you can't stay in business very long.

How do we go about determining which products we should be wary of buying? What clues should we look for? The promotional pattern is likely to include several, if not all, of the following selling angles.

1. The product is said to contain a secret or unknown ingredient, very potent, almost magical in its benefits. You get more than your money's worth and rake in the profits!
2. It produces such remarkable results because it operates on a "newly discovered, secret principle." Or it involves an entirely "new approach" to soil chemistry, or some other aspect of agricultural production fertility. Or it operates by action of mysterious forces: magnetism, catalytic action, activation, release, enzymatic processes and the like - all described in "scientific" language, persuasive perhaps to potential buyers, but meaningless to reputable scientists.
3. The discovery is so new that most scientists haven't heard about it yet. Or it is claimed that scientists with universities and the United States Department of Agriculture refuse to conduct research on the product.
4. Tests under controlled conditions in laboratory or field are generally played down as not showing the benefits obtained in "practical" agriculture.
5. Use of the product gives numerous beneficial side effects - extra dividends, all highly desirable but well clothed in words of mystery.
6. Benefits claimed are supported by large numbers of testimonials - "unsolicited" of course. Claims are largely opinions, not supported by data developed from research or trials conducted by responsible investigators.
7. Instructions ordinarily strongly recommend the use of standard practices of good management which by themselves might well produce all the benefits that can be seen or measured. In other words, the advice you get on the label may be worth more than the contents of the package!

Suppose you are tempted to buy or use a product having some of the promotional features listed - you may save yourself time, money and disappointment if you will do the following:

* Don't decide in a hurry. Consult a responsible, experienced person before you commit your dollars.

* Have your soil or plants tested. The soil may already contain enough of the ingredient being sold. The plant may show that it does not need the product.
* If you decide to try the product, buy just enough to treat a small portion of your land (one acre or less). Compare results with a nearby plot of equal size on which the product is not used but on which all other operations and conditions are identical. Then compare yield records or results.

Carefully evaluate all new products. Demand adequate proof of their value under your own conditions of operation.

Before you invest - Investigate! AFTER ALL, IT'S YOUR MONEY.

* * * * * *

Most fertilizer manufacturers are highly responsible companies that refrain from making statements which are not theoretically sound nor based upon unbiased research.

Illinois residents can always consult the county extension representative, the farm adviser, for an unbiased statement about unusual fertilizer or soil treatment materials If the farm adviser is in doubt he can contact the appropriate person in the College of Agriculture.

Persons who are considering the purchase of new and unusual materials for soil treatment are urged to:

1. Study the specific claims made.
2. Inquire as to the chemical composition of the material and ask specifically about the availability of elements that are claimed.
3. Ask whether the material has been included in research conducted by an unbiased research institution such as the State Agricultural Experiment Station.
4. Compare the cost of actual plant nutrients in fertilizer materials with the cost of equal nutrients in standard fertilizers.

ORGANIC FARMING

A group who call themselves organic farmers or organic gardeners have been attacking the use of commercial fertilizers. They claim that chemical fertilizers are harmful to soils, crops, and the health of animals including man. They maintain that the proper use of "natural organic materials" will produce higher yields, food that is more nutritious, and plants that resist insects and diseases. Most trained scientists do not accept the evidence presented to support these claims. The high crop yields, good health, and long lives of people in countries that use the most commercial fertilizer is highly significant.

Organic matter is essential to profitable farming, but there isn't and never can be enough of it to meet the fertility needs of crops on a field scale. Without commercial fertilizers the amount of organic matter on farms would be far less than it is.

OPPORTUNITY FOR SERVICE

Those who supply fertilizers for turf have a unique opportunity to offer a service of the highest type. Frequently, in fact usually, the person who purchases the fertilizer or a turf management service has little information about the subject. He is, therefore, easy prey for the shyster. Those who develop a sound service of high integrity should find a rapidly expanding demand for their service. Homeowners, industries with substantial ground areas, managers of school grounds, parks, and other public property are becoming increasingly aware of the desirability for maintaining attractive turf. The department of agronomy at the University of Illinois is anxious to promote this through effective assistance with soil and fertilizer problems.

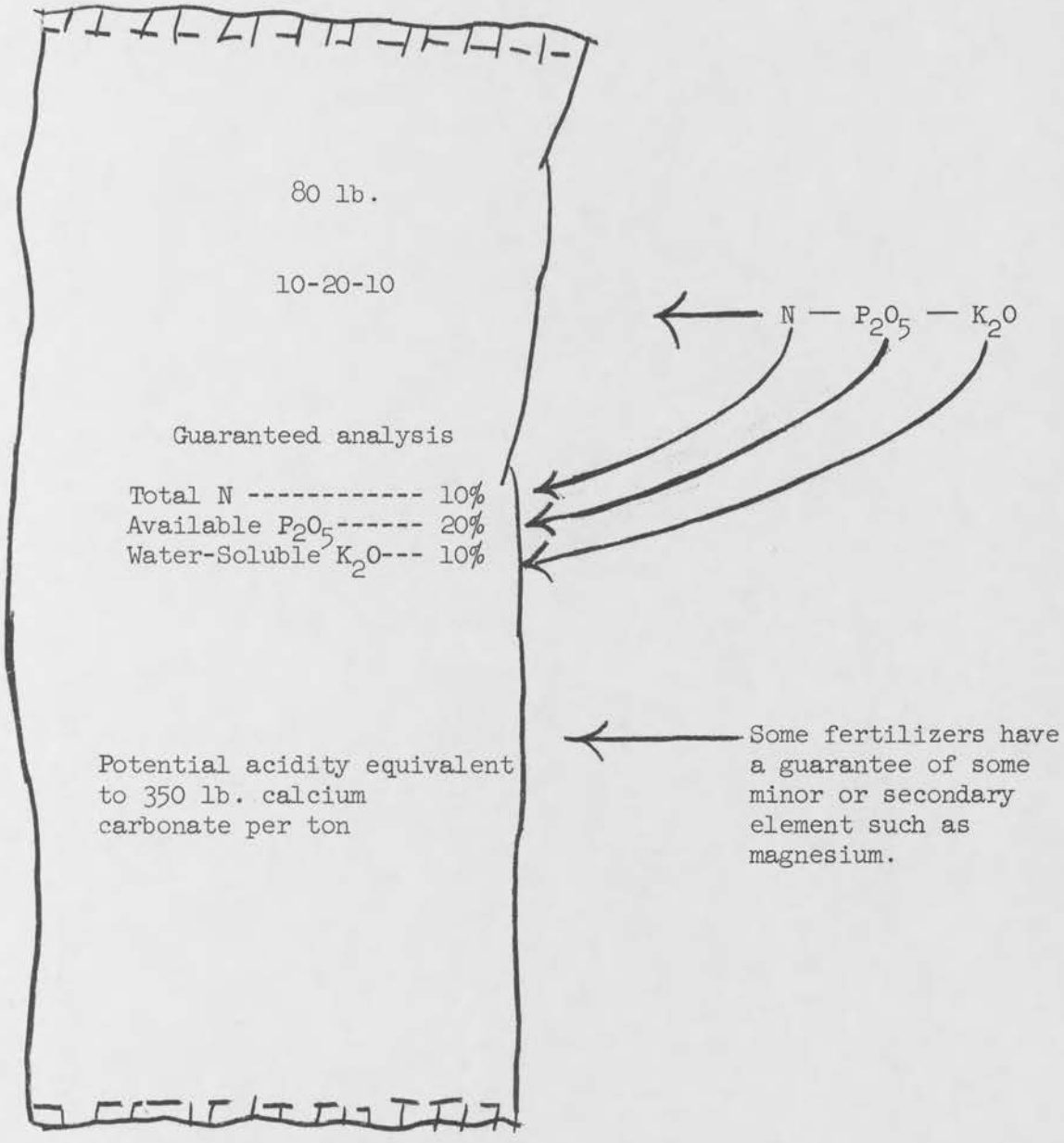


Figure 1. Diagram of a fertilizer bag to show the important information that is needed to evaluate the fertilizer. This information is often given on a tag attached to the bag.

STEPS TOWARD THE BEST IN TURF

1. USE ADAPTED GRASSES - i.e., grasses that have been grown here before.

2. MOW REGULARLY AT FAVORABLE HEIGHT - 2" bluegrass, fescue; 1/2" Zoysia bent.

3. FERTILIZE TWO OR MORE TIMES ANNUALLY.

4. KILL BROADLEAF WEEDS - every two years with 2, 4-D.

5. WATER WELL TO MAINTAIN GREEN LEAVES.

6. REDUCE CRABGRASS COMPETITION - prevent or kill.

7. PREVENT INSECT DAMAGE - to leaves or roots.

8. MAKE ROOM FOR NEW LEAVES - Remove excess clippings.

9. PROTECT FROM DISEASES - that kill leaves.

10. AERIFY AND SPIKE - (topdress)

11. KILL UNWANTED PATCHES of small grasses, clover.

MANAGING GOOD TURF

Talk presented at Illinois Turf Conference, December 1, 1960, W. H. Daniel, Purdue University

To this group managing good turf sounds easy; in fact, why pick such a subject? At this Conference you have talks being presented on soils, fertilizers, weed control and diseases. How do they fit together?

One attempt to this has led to the development of a chart, "Steps Towards Better Turf." With this we can recognize our products, procedures and techniques into an ascending order of steps. Obviously the lower steps are more basic than those higher. For example, disease control - step 9 - is less of a need than is weed control, step 4. A good rootzone for adequate moisture and nutrient storage supports all steps, and when adversity occurs the poorer rootzone may be most affected.

In these steps, Use Adapted Grasses is most basic. Today we are hearing more about bluegrasses, but any of us could grow a ground cover of bluegrass with most any selection if it were not for disease. There would be a difference in vegetative turf character, but the basic questions of disease susceptibility, tolerance or resistance is the key to further improvement. In the northern part of Illinois Merion has performed quite well. Recent studies utilizing C-1 Newport, Delta, Park and others indicate that their best use may be in blends with Merion in its zone of adaptation.

Until we have, through research, made many improvements in disease tolerance it would be wise to consider using blends of bluegrasses with the favored ones predominating. With a blend you can secure greater disease tolerance, and when one is susceptible to one disease, another because of some tolerance or resistance may help to mask over the damage.

Not much is being done on red fescues, or ryegrasses. They often contribute to the early stand of turf as a component of mixtures, but bluegrass is the key.

Step 2 - Mowing regularly at a favorable height. Remember mowing is a means of grooming, and mowing is a means of escaping adversity of disease, drouth, wear. Generally 2" has been a satisfactory height for bluegrass, but Zoysia and bent should be cut as close as the mowers can be set. Some day we will learn that bluegrass should have an interval between mowings - 3 to 5 days - in order for it to transfer reserves within the plant and maintain rhizome vigor.

For Step 3 - Fertilizing - there has been excellent progress. Today there are several fertilizers available with high nitrogen, low phosphorus and medium potash. Ratios such as 4:1:2, 3:1:2, 2:1:1; analysis such as 12-3-6, 10-3-7, 16-8-8, 12-6-6 offer the consumer products that can be repeatedly used on lawns, shrubs, trees, applying

as much nitrogen material as growth response is wanted. Such products should maintain a reserve of phosphorus and potash well above efficiency levels.

In our long term test I have been pleased with the residual performance of the urea-form fertilizers, especially those made in closely controlled manufactured processes, such as Uramite and Ureaform. These are often blended into mixtures, which, available at a premium, offer longer residual and longer availability. Regardless of the material used, applications twice a year or more are desired.

Step 4 is Weed Control. Generally killing broadleaves with 2,4-D every two years is good management. Remember, there is always the possibility of germination of weeds during moist periods which will later show up as damage to the turf. Only the densest of turf will reduce weed infestations to the point where sprays are not needed.

Step 5 is Water to Maintain Green Leaves already produced. Notice the stress is on just maintaining not growing new leaves. In some seasons even two timely waterings may save that crop of leaves and provide continued greenness rather than have a two weeks lag while new leaves are being produced. Some people attempt to substitute water applications for fertilizer applications. Fertilizer applications can make up for water applications to some extent. Water cannot make up for fertilizer.

Here in 1960 it seems more than just five years ago when DSMA, the first organic arsenic, was sold for crabgrass control. Today if one wishes to spend the money and take the time, selective crabgrass killing is certain. The turf manager must plan the work, must use the technical materials correctly. In fact, the crabgrass killers will kill several of the annual weeds infesting new lawns or sparse turf areas.

It was less than five years ago when crabgrass pre-emergence began to be acceptable. In fact, many thought there was no sale for a product preventing crabgrass and people wanted the pest present so they could "watch it die a slow and painful death." How wrong we were! Pre-emergence has been very acceptable. There are numerous products on the market and others will be coming up.

Originally 20 lbs. of lead arsenate per 1,000 was considered a standard. Then calcium arsenate 12 lbs. per 1,000 was a cheaper material, having some more problem in its use. This last year we tested several organic arsenics and one, AMA 41, not yet trade named, should be on the market in 1961. The interesting thing is it is taking less than 2 lbs. formulation per 1,000 to serve as a crabgrass preventer or killer. The products that have calcium arsenate on vermiculite have been very acceptable and more companies are coming out with these.

The big improvement has been in the non-arsenicals. Rid was a sensation for it was the first new, effective material. Chlordane had been on the market and when used at rates 80 lbs. or more worked satisfactorily when applied in the spring just ahead of crabgrass germination. The reason for this is Chlordane will leach downward and

may lose toxicity at the soil surface after an interval. The crabgrass killer utilizing Zytron of Dow will be on the market in 1961 on a wider basis. Other products from other companies may be offered in 1961.

With all crabgrass preventers timely application is a necessity for all preventers are based on the chemical affecting the young seedling as and after it emerges. Therefore, something to prevent survival of the seedlings means that it must be there whenever the seedling germinates.

Our tests show that although you may apply seed at the time of using crabgrass killers, this does not mean you will get seedlings established and surviving. Only the AMA 41 compound seems to be selective enough to anticipate a stand of bluegrass with the prevention of crabgrass. Certainly with chlordane, Zytron, Dachtal, or Lilly experimental, all grass seedlings have been restricted and killed when the products were used at toxic rates. But really the key purpose in using a preventer is to protect the grasses already there, and we assume without crabgrass competition the vigor of the established desired grasses will fill in and make better turf.

Step 7 - Prevent Insect Damage is not difficult, but sometimes we forget that maintaining good turf means preventing the possibility of severe insect buildup and thus turf damage. Very often in turf areas receiving irrigation and better maintenance, insects become a major problem during the third summer. Many insecticides are available and they should be used early and correctly as protection.

For the homeowner and the small lawn, Step 8 - Make Room for New Leaves may be the newest point today. Golf course superintendents have long practiced renovation of putting greens, topdressing and those procedures designed to reduce the mat and thatch of material. Now with better, faster growing grasses available, periodic - for example, spring and fall removal of the old clippings, old leaves and stems may provide the new growth opportunity to be greener and closer to the ground. All of us have seen turf so dense that the old brown leaves actually reduce the greenness and uniformity.

I call this process of vertical mowing, manicuring - grooming, and also just good common sense. It takes machinery. Fortunately there are several today on the market which are designed to remove unwanted grasses and unwanted material even to the ground if necessary. For good bluegrass vertical mowing in the fall is very practical.

Disease may sometime be a severe problem, but is placed as Step 9, for only after all the other things below it are accomplished is it the most practical way to produce improved turf. There is a need for protection on many lawns, but the amount of effort involved to maintain leaf protection places it as one of the final steps towards better turf, at least for homeowners.

Again Step 10 - Aerifying and Spiking - has long been practiced by turf managers. The practice of topdressing sometime substitute for either Step 10, or Step 8. However, there has been a constant increase in the amount of aerification being done. On soils that are

hard, where there are layers of material, or where special problems arise, turf cultivation may greatly improve the penetration of water and air so necessary for continued growth.

Step 11 - Kill Unwanted Patches will always be a problem. Many of you wish to kill creepingbent in Merion - some wish to kill clumps of tall fescue in bluegrass. Those who wish to kill clover can with 2,4,5-T, or 2,4,5-TP. We are testing the possibility of using soluble fertilizer as a foliage wetting operation, then immediately cover the areas of creepingbent with plastic sheeting which is held in place by hose, pipe or soil. After two days remove the plastic and reseed the area, if necessary. Bluegrass rhizomes survive such treatment enough to produce some new growth. This has been successful as a way of spot killing creepingbent.

We have no selective control for tall fescue, timothy or other perennial grasses. Vertical mowing - Step 8 - may help to contain these, or reduce their obnoxious looks.

Eleven steps - you might add more, or take off one or two of these, but when trying to maintain and manage good turf there are many products and materials available to aid you in procedure, applying the principles involved here.

THE ESTABLISHMENT OF GRASS ON NEWLY GRADED AREAS

J. A. Jackobs

The low nitrogen and organic matter content of the soil material on newly graded areas makes the establishment of perennial grasses more difficult than it is on normally developed soils. Frequently other nutrients such as phosphorus and potassium are very low. The nutrients can be supplied through various fertilizers and organic matter can be added in the form of manure, straw, etc. but the physical condition of the soil can only be improved over a period of years. By necessity, the grasses are planted in a soil that dries out rapidly on the surface, and that is likely to form a heavy crust when it dries out following a rain. Soil erosion is also a problem in sloping areas because of the slow infiltration of water and the lack of soil structure due to the low organic matter of the soil. The problem then is to create conditions so the seeds can germinate, the seedlings emerge, and the established plants receive the nutrients necessary for vigorous growth while serious erosion is held in check until the grasses become established.

Whenever possible the top soil on an area to be graded should be "stock-piled" and distributed on the surface after the grading is complete. Soil development is a slow process so several years are gained if the original top soil is put back on the surface.

A soil test is very important before any seeding is made but it is especially important if it is to be made in a disturbed subsoil. The nutrient condition of a subsoil may be entirely different from its surface soil. One half of the fertilizer and lime called for by the soil test should be applied on the leveled surface before seedbed preparation (Lime is very seldom required in Illinois subsoils). One hundred and twenty pounds of ammonium nitrate or its equivalent (40 lb. of N per acre) of other nitrogen carriers should also be applied at this time.

In seedbed preparation the soil should be worked and the fertilizer including another 40 lb. of nitrogen per acre, mixed to a depth of four inches. This can be accomplished either by plowing or heavy discing. The remaining fertilizer should be applied following this deep tillage and the surface leveled with a harrow or plank. Before seeding a heavy corrugated roller should be used to compact the seedbed.

The grass seed can be broadcast on the surface and covered by rolling or it can be drilled if a precision planter is available which will place the seed not more than one-half inch deep. Chopped straw at the rate of two tons per acre should be spread evenly over the surface. In particularly critical areas some provision for holding the straw in place by means of adding asphalt with the straw or putting one of the mesh materials that are available commercially over it.

The most favorable time to establish grass in Illinois is in the late summer or fall. Seeding should not be attempted before

September 1 or later than October 15.

If sprinkler irrigation is possible, its proper use can nearly guarantee successful stand establishment. It is not necessary to use it during seedbed preparation unless the soil is too dry and loose to compact. The first irrigation after the seeding operation is complete should be enough to wet the soil at least a foot. This should be followed by frequent light irrigations to keep the soil surface from drying out more than one-quarter of an inch. After the seedlings have emerged, less frequent and heavier irrigations can be applied.

The selection of species to seed will depend on the ultimate botanical composition desired, the urgency of soil stabilization, and the feasibility of irrigation. Most frequently the objective is to achieve a turf composed of one or two species that meet certain requirements in regard to appearance and durability. The high quality turf grasses are slow to become established. If there is an erosion problem or if the soil is in poor physical condition, they do not give complete cover soon enough to stabilize the soil and check erosion. Therefore, short-lived species, both grasses and legumes, may be included in the seeding mixture along with the long-lived perennial grasses. The short-lived species have more seedling vigor and will give ground cover rapidly. When they die out, the perennials usually spread and fill in the stand. However, the stand will not be as uniform for a number of years as where the seeding mixtures do not contain the short-lived species.

GROUND COVER PLANTS OTHER THAN GRASSES -- WHERE AND WHY

by H. R. Kemmerer[1/]

Scientists, home owners, and others have for many years been looking for the ultimate in ground cover (i.e., plants that can be planted easily, will grow rapidly, not require any mowing, fertilization or other maintenance, are relatively insect and disease free, will not spread beyond the area designated, will withstand a lot of traffic, prevent erosion immediately after planting, and can be closely clipped). Naturally the ultimate has not been found. The nearest has been grass and it has become the most common cover for soil areas and serves as the canvas upon which a landscape design is developed. However, grass has its limitations and on occasion a plant other than grass is needed to either complete the transition between grass and shrubs or to provide a cover in areas where the use of grass is not feasible.

Plants generally used for cover purposes are collectively known as ground cover plants. They can be defined as being low growing, mat-forming plants, usually with trailing branches which give a two dimensional effect to the landscape. Spread is by rhizomes, stolons, or formation of roots along the trailing branches.

Many Special Uses

Ground cover plants may be successfully used on steep slopes where mowing is dangerous, difficult or impossible. Some types, such as purpleleaf Euonymus, can be used in deep shade where grass will not grow. Other uses include planting in areas where mowing is difficult for example beneath trees with low hanging branches, or between the house and walk where the maneuvering of a mower is difficult or a lot of hand trimming is involved. When used in shrub borders, they serve as an effective means of tying the shrubs into one harmonious unit.

Additional Value

An added bonus with the use of ground covers is the fact that they provide ornamental values to the landscape setting. For example, the violet-like flowers of Periwinkle add a carpet of blue to the ground in May. Flowers of Halls Japanese honeysuckle provide a sweet scent reminiscent of the deep south. The orange fruit of Bigleaf wintercreeper against the glossy green persistent foliage adds a late fall and early winter effect which is very striking. Purpleleaf Euonymus with its change in foliage color from green to purplish red in the winter is interesting. Other characteristics such as texture contrast, and variations in height, all help make the landscape setting more attractive and stimulating.

1/ Assistant Professor of Horticulture, Department of Horticulture, University of Illinois, Urbana, Illinois.

This speech was presented at the first Illinois Turfgrass Conference, December, 1960.

Some Problems

Initial expense is probably the most important reason that ground cover plants are not used more extensively. This includes the cost of plants and the labor needed to get them into the ground. The minimum cost per yard covered would probably be about the same as the purchase price and labor cost for laying a square yard of sod. With the use of large specimen narrowleaf evergreens, the price could go as high as six or eight dollars.

Another problem is time required for establishment. Usually at least one growing season is necessary for the plants to make a complete cover. It takes longer if soil and moisture conditions are not optimum. Quicker cover can be obtained by the use of large plants, but that also increases the price.

Associated with establishment is the weed problem which exists until such time as complete cover is obtained. Mulches, especially cracked corncobs help and in the future pre-emergence weed killers may eliminate or at least greatly reduce the problem. However, for the present hand weeding is still a necessity.

Accumulation of leaves, paper and other trash in a ground cover planting is usually not serious but it is more difficult to remove them from ground covers than from turf.

Ground covers do not tolerate much traffic, but most of them can be walked on to remove leaves, etc.

Planting Techniques

Many ground covers can be planted during the spring and/or fall planting season, while others should be planted in the spring only. Potted plants can be set any time in the summer if water is available to keep the ground moist. Local nurserymen can suggest the best planting time.

When planting it is advisable to work up the bed area to a depth of six inches. A well worked bed makes for easier and quicker planting. Use of peat or other soil conditioner will help growth and improve soil. Spacing varies with the size of plants. Starting with 8" o.c. plants can be handled bare root, B & B, or potted (includes cans, peat pots, wood bands, and clay pots). Potted materials are the most expensive. They also are most likely to survive transplanting. Planting must be done by hand, another reason why covers are not used more extensively. A small hand trowel works well if the soil is loose. Mulching after planting will help conserve moisture and reduce the weed problem (if the mulch is thick enough). Cracked corncobs will serve to greatly reduce erosion when used on slopes. In addition to cobs, peat, straw, and sawdust can be used. There is also a commercial woven Jute material that is good for erosion control purposes.

Watering after planting is essential. If planting is done in isolated areas, water should be hauled to the plants. The soil should

be kept moist but not soggy. Complete inorganic fertilizers with high nitrogen content should be applied in the spring. Use 2 lbs. per 100 sq. ft. of bed area. Liquid fertilizers work best but granular material can be used if the material is washed off the foliage.

Weeds should be removed whenever they appear. Grass types are the biggest nuisance. In rough areas when weeds are not objectionable they can be allowed to grow.

Some of the more aggressive covers like Halls Japanese honeysuckle will in time suppress the weeds. Cutting off the tops of weed plants will help prevent seed formation.

Where To in the Future?

Ground cover planting will undoubtedly become more prevalent in the years to come. Here is why. First, increased interest in landscaping. Second, development of chemicals such as Simazine to control weeds. Third, development of machines that will make mechanized planting possible. Fourth, new planting techniques such as use of seed and handling of solid mats of the cover in the same manner as grass sod is handled. The latter has possibilities because it would greatly reduce weed and erosion problems. Cost of production would be feasible if a field that was stripped had a sufficient number of rhizomes left in the field to enable redevelopment of foliage without replanting. There are indications that several ground covers can be handled in this manner.

Many Types to Choose From

Long lists of ground covers are given in garden books. Some are good, others should not be used in Illinois. Before selecting a plant, be sure it is hardy in your area. Consult University of Illinois Circular 715 for Illinois hardiness zone map and lists of plants with zone classification.

Next to hardiness comes ability to survive under existing soil conditions. Some, like purpleleaf Euonymus and Polygonum reynoutria, will grow in wet or dry, poor or rich soils. Others are more exacting in their demands. Remember too that sun and shade conditions will influence selection. Japanese Spurge will grow only in deep shade.

Species selection is also made for the degree of finish desired in the landscape area. Periwinkle is neat and uniform, while honeysuckle is rather wild and rampant and has a tendency to spread into surrounding areas unless especially controlled.

Rate of growth, as well as disease and insect resistance, should be considered.

And don't forget the ornamental characteristics. Here the choice is almost unlimited. Based on form, four types are available - herbaceous, day lily; deciduous, bittersweet; broadleaf evergreen, wintercreeper; and narrowleaf evergreen, Juniper. Within these groups further selections can be made for height, foliage color, flower color, season of bloom, fruit color, etc.

List of Ground Covers

A few of the many ground covers adapted for planting in Illinois are given in the following list. Others equally as good could have been included.

GROUND COVERS

	Name	Height	Planting distance apart	Exposure	Soil	Ornamental characteristics	Cultural characteristics	Zone
1.	Purpleleaf euonymus (Euonymus fortunei coloratus)	1'	15"	Sun or shade	Any Moist or dry	Leaves green in summer, turn purplish-red in fall and winter. Leaves remain on plant year round.	Some stems may want to grow erect. To keep plant compact, cut them off.	1-6
2.	Myrtle (Vinca minor)	6"	1'	Sun or shade	Not sandy or other soil that dries out	Green color year round. Little blue flowers in late spring	Some leaves may turn brown in winter if exposed to direct south sun - not serious.	1-6
3.	Prostrate Japanese juniper (Juniperus chinensis japonica)	1'	4'	Sun	Does well in dry soil	Narrowleaf evergreen. Fairly expensive		1-6
4.	English ivy (Hedera helix)	6"	1'	Sun or shade		Bluish-green broadleaf evergreen foliage. Looks like house ivy.	When planted close to shrubs, remove branches that tend to climb. Leaves may burn if exposed to direct south winter sun.	3-6
5.	Halls Japanese honeysuckle (Lonicera japonica halliana)	1'	15"	Any	Any	Retains its leaves thru winter in Region 4 & south. Fragrant white flowers. Somewhat rank. Use for bank or other large area planting.	Keep twining stems from shrubs & trees.	1-6

WEED CONTROL IN LAWNS

Dr. F. W. Slife

The average lawn owner probably spends more time trying to control weeds in his lawn than he does on other management practices. In many cases, he would be better off to concentrate on practices that lead to a better growth of turf grasses which, in turn, makes it more difficult for weeds to grow. The height of mowing, fertilization, and watering not only affect the growth of turf grasses but affect the weed population. These management practices can be used in such a way that weeds benefit more than the turf. Proper turf management is the first step in a weed control program and, in a few cases, they are the last step because they control weeds adequately.

Many new chemicals are now available to aid the turf owner. If properly applied, they can be of tremendous benefit. If improperly applied, they fail to control weeds or injure the turf.

Broadleaf weeds are still a major problem in many lawns, even though 2,4-D has been available for over 10 years. Most of the common broadleaf weeds can be controlled with 2,4-D. It would appear that little more than half of the lawn owners use 2,4-D. Some prefer to dig out dandelions and plantain or simply let them go to seed. The formulation of 2,4-D to use is especially important in turf areas in order to avoid damage to ornamentals, flowers, and garden crops. The amine salt is the only liquid formulation that is safe to use and it is safe only if it is applied on a quiet day. The granular forms have been performing quite well with a minimum amount of injury to desirable plants.

Chickweed and henbit are two broadleaf weeds that are not sensitive to 2,4-D but fortunately 2,4,5-TP is available and gives excellent results. Since both of these weeds grow late in the fall and early in the spring applications of 2,4,5-TP must be made at this time.

Knotweed is especially bad in wet years but seems to be present every year in some lawns. Satisfactory results are obtained with 2,4-D if applied when the plants are small but Endothal has been outstanding at any stage of growth.

Grass weeds are the major weed problem in most of our turf areas and particularly crabgrass. There are now two chemical approaches to this problem. They are post-emergence or pre-emergence treatments. If post-emergence treatments are used, the lawn owner must be able to distinguish crabgrass seedlings from turf grasses and be observant enough to repeat applications as they are necessary through the crabgrass season. The arsonates are highly effective as post-emergence sprays and appear to be much more reliable than potassium cyanate and the mercuric acetates. Although bluegrass has considerable tolerance to the arsonates, it is occasionally injured because too heavy a rate is applied.

Pre-emergence chemicals are applied in late fall or early spring and a number of these compounds are giving good results. Calcium and lead arsenate, chlordane, Dacthal, and Zytron seem to be the most consistent.

Nimble will, a perennial grass weed, seems to be spreading at a rapid rate. Post-emergence arsonate sprays are not effective but Zytron and Endothal applied as post-emergence sprays have some possibilities. Although the results have been variable, they offer out best possibility for the control of this pest.

Silver crab or goose grass is more difficult to control than the two common crabgrass species. Post-emergence sprays of the arsonates are not highly effective but the pre-emergence chemicals do a reasonably good job.

Chemicals are an aid to good management practices for weed control. They are not a substitute and, in general, without good management, give only temporary relief to the weed problem.

2nd level — 1 lb in 3 gal water - Dalapon - center of clumps

Weed Pest	Chemical	Trade Name	How Used	Remarks
Chickweed & Henbit	2,4,5-TP	Numerous	Post-emergence Fall and/or early spring applications	Controls most weeds susceptible to 2,4-D
Crabgrass	Dacthal	RID	Pre-emergence	- - - - - - - - - - - - - -
	Calcium Arsenate	Numerous	Pre-emergence	May thin grass
	Lead Arsenate	Numerous	Pre-emergence	- - - - - - - - - - - - - -
	Chlordane	Halts, etc.	Pre-emergence	Reduces mole activity
	Zytron	Zytron	Pre-emergence	- - - - - - - - - - - - - -
	Disodium methyl-arsonate & related arsonates	Sodar, Methar, DSMA, Benzar, DiMet, AMA, Clout, etc.	Post-emergence Spray or granular	Rate must be reduced under high temperatures and drought conditions
Dandelions, dock, plantains, and most other broad-leaved weeds	2,4-D	Numerous	Post-emergence Spray or granular application. Fall and spring applications required	Will injure flowering and vegetable plants and ornamental shrubs. Use only amine salt
Foxtails, barnyard grass and other annual grasses	Disodium methyl-arsonate and related arsonates	Sodar, Methar, DSMA, DiMet, AMA, Cloud, Benzar, etc.	Post-emergence	Two applications at weekly intervals usually necessary
Knotweed	2,4-D	Numerous	Post-emergence while knotweed is young	Use amine at 2X rate for dandelions, etc.
	Endothal	Penco Endothal Turf Herbicide	Post-emergence	Knotweed is difficult to wet. Add additional wetting agent.
Nimblewill	Endothal	Penco, Endothal Turf Herbicide	Post-emergence	Two applications needed at 10-day intervals (results variable)
	Zytron	Zytron	Post-emergence	Two appl. needed-results variable
White Clover	2,4,5-TP	Numerous	Post-emergence	Repeated applic. may be necessary for eradication
Wild Garlic and onions	2,4-D	Numerous	Post-emergence Fall and spring applications	Use low volatile ester at 2X rate for dandelions. Will require three or more years to eradicate

Poa annua interested in Carbs —

** NOTE **

READ THE LABEL. FOLLOW MANUFACTURER'S DIRECTIONS CAREFULLY. EXCESSIVE RATES WILL CAUSE INJURY TO LAWN GRASSES.

TURF DISEASES

M. P. Britton

The continually rising standard of excellence in the maintenance of home lawns and other fine turf areas constantly confronts the home owner and turf manager with new problems. Not the least of these is the problem created by the more than 100 diseases of turfgrasses.

Turfgrasses are attacked by four typical disease-producing agents: fungi, bacteria, viruses and nematodes. The seven or eight important diseases known to occur in Illinois are all caused by fungi.

Injuries from turf diseases vary greatly from year to year and even within a given season. The reason for this is due, in part, to the variability of climatic factors such as temperature, humidity, and rainfall. However, improper watering, fertilizing, soil drainage, mowing, and a lack of light and air circulation also contribute toward disease development.

Generally speaking, well managed vigorously growing turf is less apt to be severely damaged by disease attacks than poorly managed turf. The need for fungicide treatments can be kept at a minimum by carrying out the following management practices:

1. Provide adequate drainage when establishing new lawns.
2. Mow at a height recommended for the grass species being grown. Many of the fungi causing disease live equally well on clippings or living grass; therefore, remove the clippings, if possible.
3. When watering, leave the sprinkler in one place for 3-4 hours or until the soil is wet to a depth of 5-6 inches. Wait one to two weeks before watering again. Water early in the day so that the grass will dry. (This does not apply to bent grass putting greens).
4. Follow a recommended fertilizer program based on soil tests. Avoid high nitrogen levels during hot weather.
5. Improve light and air circulation by pruning or removing dense trees and shrubs that shade or border the lawn.

If fungicides must be used, identify the disease correctly and apply a recommended fungicide beginning when symptoms are first evident. Spraying is the preferred method of applying fungicides. Add a wetting agent to the spray solution so that complete coverage of leaves is obtained. Several spreading and sticking agents designed for use with fungicides are available (do not use with liquid fertilizer). Household detergents are satisfactory wetting agents; add 1 teaspoonful of liquid detergent or one tablespoonful of powdered detergent to each gallon of spray solution. To avoid turf injury when using mercury fungicides in hot weather, increase the gallonage of water used per 1000 square feet and make applications in the evening. Be prepared to make several applications of fungicides at 7-10 day intervals. Under ideal conditions for disease development, applications may have to be made at 3-4 day intervals.

Symptoms of Common Diseases in Illinois

PINK SNOW MOLD - First appears as circular patches 1 to 2 inches in diameter with a fringe of white or pink fungus growth. Diseased areas may enlarge up to 12 inches in diameter and coalesce to cover large areas. The disease usually occurs at the edge of melting snow, or during cold rains; it occasionally occurs under the snow.

GRAY SNOW MOLD - Symptoms are similar to pink snow mold, but diseased areas become larger. White, blue-gray, or black fluffy fungus growth is usually present over the entire area. Injury occurs under snow and at the edge of melting snow.

LEAF SPOT AND FOOTROT - Leaf spots are purple to brown, often have tan centers and purplish margins, may become $\frac{1}{2}$ inch in length. Diseased leaves turn yellow and finally brown when infection girdles the base of the leaf or sheath. Crowns, stems, roots, and rhizomes turn brown and rot (footrot). Large areas of grass may be killed by May or June as a result of root and crown rot.

DOLLAR SPOT - Small, round, tan, spots suddenly appear in mild (60-85°F.), humid weather. In the very early morning a cobweb-like mold growth is visible on the grass leaf blades. When numerous spots run together, large, irregular, straw colored, sunken areas develop. This disease is more prevalent on bent grass than on other lawn species.

RUST - Reddish-brown, powdery pustules on leaves. Infected grass blades turn yellow, shrivel, and die. This disease is serious only on Merion bluegrass during hot, dry weather when the grass is making little if any growth.

BROWN PATCH - First appears as roughly circular patches of wilted, dark-colored leaves. Later, when the grass leaves dry, the diseased areas become light brown. Sometimes the central portion of the diseased area will be brown and the margin bluish-green. This disease is far more important on bent grass than on bluegrass lawns.

HELMINTHOSPORIUM AND PYTHIUM BLIGHTS - These diseases are indistinguishable except by microscopic examination. Both diseases become severe when air temperatures rise above 90°F. on several successive days. The first evidence of disease is the appearance of small circular patches of wilted grass that are bluish-gray in color. The leaves die rapidly and turn tan or brown. Individual diseased areas often coalesce to form large, irregular dead areas. These fungi first attack the crowns, roots, and rhizomes; leaf symptoms appear only after most of the roots are dead. These diseases may be confused with grub damage.

POWDERY MILDEW - White fungus growth (mildew) on the leaf blades of the grass. The disease first appears in heavily shaded areas.

FAIRY RINGS - Show up as circular dark green rings of grass in which toadstools may form following wet weather. A ring of brown grass is often found just inside the dark green ring. During dry weather a brown ring may form outside of the dark green ring.

Table 1. Turf Disease Control Timetable for Illinois

Disease	Time of Occurrence	Suggested Fungicides or Control Measures	Rate per 1000 Square Feet	Intervals Between Applications
Snow molds	Dec.-Apr.	Mercury chlorides	1-4 oz.	Apply in November before the first snow.
		Thiram	6-8 oz.	Reapply during winter or spring as snow
		Cadmium compounds	See label	melts if disease is present.
Leafspots and footrot	Apr.-June	Organic mercury	1-1½ oz.	Make the first application in late April--reapply twice more at 14-20 day intervals.
		Cycloheximide	½ oz.	
		Zineb	4-6 oz.	If disease still becomes serious, reduce
		Phaltan	2-4 oz.	interval between sprays to 7-10 days.
		Captan	2-4 oz.	Merion bluegrass is resistant to leafspot
		Cadmium compounds	2-6 oz.	and footrot.
Dollar spot	June-Sept.	Cadmium compounds	1½-2 oz.	Two or more applications at 5-7 day intervals. Maintain adequate nitrogen levels for good grass growth. Use tolerant strains of creeping bent grass.
		Mercury chloride	1-1½ oz.	
		Organic mercury	1-1½ oz.	
		Cycloheximide	½-1 oz.	
Rust	July-Nov.	Keep lawn fertilized & watered to produce at least 1 inch of new growth per week.		Do this even if fungicides are used.
		Cycloheximide	½-1 oz.	3 applications at 7-day intervals
		Zineb	2-3 oz.	
Brown patch	June-Sept.	Mercury chlorides	1½ oz.	Repeat at 7-day intervals until diseased leaves are removed by mowing.
		Thiram	4-6 oz.	
		Thiram + mercury chlorides	2 oz. + 1 oz.	
		Cadmium compounds	2-6 oz.	
Helminthosporium blight and Pythium blight--also called Curvularia blight	July-Sept.	Zineb + thiram	2 oz. + 2 oz.	Two applications 3 days apart. Repeat applications at 3-7 day intervals if disease starts to spread again. Small dead areas recover over winter from rhizomes; reseed large dead areas in September.
		Zineb	2-6 oz.	
		Cycloheximide	½-1 oz.	
		Cadmium compounds	2-6 oz.	
Powdery mildew	June-Nov.	Dinitrocaprylphenyl	½-1 oz.	Two applications 10 days apart.
Fairy rings	----	No good control measures. Try: Loosen soil in ring with a spading fork. Drench the loosened soil with mercury chloride or organic mercury fungicides mixed with household detergent. Apply 2 times at 10-day intervals, using at least 1 qt. of solution per sq. ft. of soil surface.		

Table 2. Recommended Fungicides for Turf Diseases

Fungicide	Trade Names
Mercury chlorides	Calo-clor, Calocure, Calogreen, Fungchex, Woodridge Mixture 21, Bi Cal
Cadmium compounds	Kromad, Formula Z, Cadminate, etc.
Thiram	Tersan 75, Spotrete, Arasan 75, Panoram Thiram, Kromad, Formula Z
Organic mercury	Puratized Agricultural Spray, Tag, Semesan Turf Fungicide, Liquiphene Turfgrass Fungicide, Merbam-10, PMAS, PMA, Panogen Turf Spray, etc.
Cycloheximide	Actidione-Ferrated, Actidione RZ, Acti-tabs
Zineb	Parzate Zineb Fungicide, Dithane Z-78, Fungicide A, Blightox 65-W, etc.
Captan	Captan 50-W, Orthocide 50-wettable, Orthocide Garden Fungicide
Phaltan	Ortho Phaltan 50-W, Phaltan 50-W
Dinitrocaprylphenyl	Karathane WD

Helminthosporium

1/10,000

RELATIONSHIP BETWEEN FOLIAR AND ROOT DEVELOPMENT OF TURFGRASS SPECIES AND STRAINS

by

Dr. Eliot C. Roberts
Turfgrass Specialist
Iowa State University
Ames, Iowa

All concerned with the maintenance of fine turf are aware of a constant struggle to produce a ground cover suitable for one or more of a variety of uses. Use specifications in most cases require the continued production of foliage and roots which build a turf suitable for ornamental, sports, and/or soil stabilization purposes. Emphasis is placed on the long term use requirements of a turfgrass stand. A turf which results in a high quality cover for only short periods of time or is not persistent over a number of years is of little value. It should be recognized that regardless of an area's use specifications foliar production or yield in itself is a poor indication of turfgrass quality. In the same respect a dark green color in itself is not a reliable indication of quality turfgrass. It is necessary to look deeper within the growth characteristics of the grass to determine what makes a turf which is consistently high in quality. Research studies indicate that the balance between foliar and root production is the most reliable measure of turfgrass vigor and persistence and consequently a good indicator of the quality of the stand. A review of the factors affecting foliar and root development and a discussion of the functions of these plant parts will emphasize the importance of this proper balance.

CLIPPING EFFECTS ON FOLIAR AND ROOT DEVELOPMENT

All turfgrass species and strains respond to frequent and close defoliation by exhibiting restrictions in foliar and root growth. These responses vary in degree with different species and strains of grass. In most cases the reduction in root development becomes progressively greater as the height of cut is lowered. Moderate clipping stimulates sod production since rhizome and stolon development is favored and a general increase in the tillering or stooling growth habit is noted. In some cases where records are kept over an entire growth season foliar development is also increased by moderate clipping practices. More often than not; however, turf is clipped too close and the result is a gradual restriction of foliar and root systems. This leads to a starvation of the turf. The plant deteriorates for two reasons. First photosynthetic capacity is cut to the point where organic substances essential for growth become limiting, and second reduced root systems make it difficult for the plant to obtain necessary quantities of water and nutrients for further development. It should be emphasized here that despite the importance of water and plant food a point is reached in extremely closely clipped turf where the plant will fail to respond even under the most fertile soil conditions possible. Clipping, then, must be viewed as a necessary liability in the development of fine turf. The clipping practice is the essential difference between management of pasture stands and turfgrass areas. It makes a grass stand into a turf;

however, in doing this the effect on the vigor and persistence of the grass is often great. In general, bluegrasses and red fescues will tolerate clipping heights of 1 1/2 inches under minimum maintenance conditions. Where lower heights of cut are required the intensity of maintenance operations should be increased. Bentgrasses will tolerate heights of cut as low as 3/16 inch when properly managed. Coarse rough textured grasses generally require heights of cut within the range of 2 to 4 inches in order for them to produce satisfactorily.

FERTILIZATION EFFECTS ON FOLIAR AND ROOT DEVELOPMENT

Turfgrasses because of their continuous vegetative stage of development are constant feeders. This means that a turf which is clipped regularly does not mature but tends to maintain high requirements for nitrogen, phosphorus and potassium. These nutrients plus calcium, magnesium and sulfur must be in the proper balance in order to produce a quality turf. Excess nitrogen in relation to other nutrients stimulates foliar development at the expense of root growth. Excess phosphorus in relation to other nutrients stimulates root development and retards foliar growth. Imbalances of other nutrients have similar effects on the vigor of various plant parts. An extensively developed root system at the expense of poor foliar growth does not result in serviceable sports turf. In a similar way the production of lush foliage while root development is ignored seldom results in quality turf. The nutrition of the grass must be controlled to provide for optimum development of both foliage and roots. The use of slowly available natural organic or synthetic organic nitrogen fertilizers is of value in the fertilization of turf which is to be maintained at standards of high quality. Frequent applications of inorganic nitrogen materials or urea in small quantities are also effective in quality turfgrass production. Other nutrients should be added to the soil in amounts indicated essential by a reliable soil test. This procedure should be followed both during construction of new turf areas and in the maintenance of established turf.

SOIL-AIR AND WATER EFFECTS ON FOLIAR AND ROOT DEVELOPMENT

Neither foliar nor root growth will take place where oxygen and water are lacking in the root zone. Poorly drained or water logged soils are just as detrimental to the production of quality turf as excessively drained sandy soils. It is unfortunate that many turf managers fail to maintain quality turf primarily because of the improper use of water. It should be emphasized that overuse is just as harmful to the turf as under use. Too much water saturates the soil and excludes oxygen from the roots. Oxygen is essential in a process which transforms organic reserves within the root into energy needed to support life and growth. Root development suffers first from low oxygen levels in the soil; however, foliar growth is also restricted if these unfavorable conditions persist for long periods of time. Water is essential as a medium for conducting all sorts of substances within the plant. Where it becomes lacking this conductive system breaks s down and all growth ceases as the plant wilts and dies. For optimum growth of both foliage and roots there must be a good balance between soil air and soil moisture. In providing these conditions there is no

substitute for the proper construction of the turfed area. Where soils are extremely light or heavy the texture should be modified during construction. Improving soil structure is also of value. Where the grass is established soil cultivation by spiking and aerification is essential under many conditions.

SOIL ACIDITY EFFECTS ON FOLIAR AND ROOT DEVELOPMENT

The effect of soil acidity on foliar and root development is an indirect one for the most part. Acid soils generally have a poor structure with accompanying poor soil-air-water relations. Availability of mineral nutrients essential for plant growth are also affected by soil pH. Highly acid or alkaline soils often contain nutrients which are difficultly available to the plant. It is true that bentgrasses tolerate acid soil conditions better than fescues and bluegrasses, however, it is not certain whether this is a direct response to soil pH or the result of secondary or related causes. Observations that root development is greater under acid soil conditions are more likely to be the result of slower decomposition of organic matter than to be due to a stimulation in root growth. In general foliar development under either acid or alkaline conditions is restricted in accordance with a reduction in the vigor of the plants. In general turfgrass should be maintained within the pH range 6.0 to 7.5.

TEMPERATURE EFFECTS ON FOLIAR AND ROOT DEVELOPMENT

Root zone temperatures are influential in the formation of new roots. Cool season grasses are sensitive to hot temperatures and produce few roots during the warm summer months. As the critical temperature is reached root development slows down to the point where further growth ceases. Root development is not resumed again until the temperature reaches the range favorable for growth response. Species and strains of grass differ in their temperature requirements for optimum root growth so that it is difficult to make a general statement regarding this response. It is important to note that fall and spring seasons of the year are best suited for turfgrass renovation or rejuvination because improved conditions in the root zone at these times are particularly favorable to increased root production. Since turfgrass species loose approximately 1/2 of their total root weight each year through decomposition at times when conditions are not favorable for continued growth, it is clear that a poorly maintained turf may deteriorate rapidly as its root system is destroyed.

Just as temperature has an effect on root growth, it also has a regulatory effect on foliar production. Extremes of high and low temperature slow down foliar development. Grasses such as Kentucky bluegrass are capable of adjusting to high temperatures and low moisture levels by becoming dormant. Bentgrasses do not make this adjustment as easily and frequently wilt and die during hot dry weather.

SUMMARY

Since optimum production of both foliage and roots is possible only during spring and fall growth seasons because soil temperatures

are unfavorable at other times it is important to keep all factors which effect growth processes favorable during these periods. It is recognized that the potential of the grass plant for foliar development is great under moderate clipping practices and under favorable conditions of soil fertility. It is also true that the potential for root development is great. This latter response is not as easily recognized because it is more difficult to adjust soil and climatic conditions to favor maximum root growth than it is to develop maximum foliar production. In order to obtain optimum root growth which is so important in the production of quality turf the following conditions must be carefully adjusted: First, the height of cut must be as high as possible without reducing the surface qualities of the turf for its specific use. Second, nitrogen must be kept as low as possible without slowing growth to the point where the turf loses vigor and becomes slow to heal from injuries or more susceptible to disease infections. Third, phosphorus must be available in adequate quantity throughout the entire root zone. Fourth, other essential major and minor elements must be available in adequate but not excessive quantities. Fifth, soil pH and soil-air and water relationships must be such that optimum root development is possible.

INSECT IDENTIFICATION AND CONTROL

by H. B. Petty

Several species of insects present problems in the establishment and maintenance of turf in large expanses of sod (parks and golf courses) as well as in the small home lawn. These problems range from insects as a nuisance, to insects as damaging pests. These pests can be divided into two general groups, subterranean and aerial pests. Identification of the damage and the pests is essential to determine control measures. The following pests are common in Illinois.

Major Subterranean Pests

Grubs: This general category includes the white grubs, annual white grubs, Japanese beetle larvae, and green June beetle larvae. With the exception of the latter, these grubs eat the roots and the sod dies out in patches and literally can be lifted out in chunks. The green June beetle larvae can ruin new seedings and in established turf they raise small mounds of soil that kill out grass. Green June beetle larvae will come to the surface after rains and crawl on their backs.

These grubs can be distinguished by the arrangement of the spines on the underside of the last abdominal segment. The Japanese beetle larva has a v-shaped arrangement, the true white grub has two parallel rows of a single set of spines, the annual white grub has no special arrangement, and the green June beetle larva has two parallel rows of several sets of spines.

Nuisance Subterranean Pests

Ants: These pests build small mounds which smother out grass and ruin turf.

Earthworms: Good in many respects, earthworms can be a nuisance. Each little tunnel has its little mound of mud to be tracked into the house. In some instances, night crawlers are so numerous that the mounds of mud cause the lawn to appear spotty.

Cicada-killer wasps: These large yellow insects with brown or black markings are about 1½ inches long and vicious looking. They make burrows in lawns, throwing up small mounds of dirt. Into these burrows they bring cicadas that have been paralyzed by stinging. They lay eggs in the cicadas. These eggs hatch into wasp grubs that feed inside the paralyzed cicadas. When the grub becomes full grown, the cicada dies, the grub pupates and emerges the following year as the cicada-killer wasp.

Major Aerial Feeder Pests

Sod webworms: Damage first appears as uneven brown spots, and the webworms are difficult to find because they are camouflaged in a silken case either on the soil surface or in the soil. This case is covered with little pieces of grass and soil. When found, the worm is

dirty green to grey with black spots and, when full-grown is about 3/4 inch long. The webworms feed on the grass blades, not cutting the roots; a blade of grass is cut off and pulled into the silken case where it is consumed.

Armyworms and cutworms: These worms often curl up when disturbed. They are grey to brown, occasionally almost black with or without stripes. They eat the plants down to the ground or cut them off at or below ground level. Damage usually appears as small circular bare areas that gradually enlarge as the worms grow and need more food.

Chinch bugs: Literally thousands of these bugs may be present in spots. Usually the plants begin to turn yellow and then die, leaving a brown, dead area. Spots may enlarge rapidly as the bugs get larger and migrate in search of more food. These sap sucking bugs are tiny red insects when first hatched but soon take on a brown color and later black.

Leafhoppers: Swarms of tiny wedge-shaped insects may swarm up out of turf as they are disturbed. They are often mottled or speckled and may be green, yellow, or brown in color. In established turf, whitened areas may appear but in new seedings whole areas may be killed out.

Mites: These tiny, almost invisible-to-the-naked-eye pests rasp the surface of blades of grass giving each blade a speckled appearance. With extremely severe infestations, webbing may be apparent.

Thrips: Tiny bristle-winged insects feed on the blade by rasping the surface and taking up the sap which exudes. Rather than tiny individual white spots on a blade, as is the case with mites, the thrips rasp out a more or less longitudinal area on the leaf.

Nuisance Aerial Pests

Chiggers: Tiny mites, seldom seen but often experienced, need no description.

Slugs and snails: These animals leave silvery slimy trails in lawns and gardens.

Sowbugs: These brown to slate-grey pests have 7 pairs of legs and their bodies are segmented. They may eat blades and roots of grass but are seldom a nuisance. They are most common in damp areas under boards and other similar protection.

INSECT PESTS OF TURF

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lbs. of active ingredient per 10,000 sq. ft.	Lbs. of active ingredient per acre	Placement	Timing of application
True white grubs	23	May-October	aldrin	0.75	3.0	On soil surface	Established sod: If used as a spray, water in thoroughly. Granules need no watering. Apply preferable early spring or late fall. New seeding: mix in soil prior to seeding.
Annual " "	23	May, Aug.-Oct.	chlordane	2.5	10.0		
Japanese beetle larvae	32	" " "	dieldrin	0.5	2.0		
Green June beetle larvae		" " "	heptachlor	0.75	3.0		
Ants		May-Oct.					
Cicada killer wasp	79	June-Aug.	.....as for grubs.....			On soil surface	As for grubs. For individual nests pour 3% chlordane in nest after dark. Seal in with dirt.
Earthworms		April-July	chlordane	2.5	10.0	On soil	As for grubs.
Sod webworms	42	July-Oct.	DDT	1.25	5.0	On grass	The more water used, the better the control.
			chlordane	0.6	2.5		
Armyworms and cutworms	21	May-June &	dieldrin	0.125	0.5	On grass	As spray or granules.
	77	Sept.-Oct.	toxaphene	0.50	2.0		
Chinch bugs	35	June-August	dieldrin	0.125	0.5	On grass	Sprays or granules. Use plenty of water as a spray.
Leafhoppers	22	July-Aug.	DDT	0.25	1.0	On grass	As a spray.
Mites	58	July-Sept.	kelthane	0.125	0.5	On grass	Thorough coverage needed. 75 to 100 gallons of water per acre.
			malathion	0.3	1.25		

Insect Pests of Turf

Insects	NHE No.	Approximate time of attack	Insecticides: Name	Lbs. of active ingredient per 10,000 sq. ft.	Lbs. of active ingredient per acre	Placement	Timing of application
Chiggers		May-July	kelthane	0.125	0.5	On grass	Good coverage required. Use minimum 20-25 gals. water per acre.
			dieldrin	0.2	0.8		
			lindane	0.125	0.5		
			toxaphene	0.5	2.0		
Thrips		July-Sept.	DDT	0.5	2.0	On grass	Control rarely needed.
Slugs	84	June-Oct.	.....Slug baits.....			Scatter in grass	Where slugs are numerous.
Sowbugs		June-Oct.	DDT	0.5	2.0	On grass	Lots of water needed. Control rarely needed.

PRECAUTIONS: Most insecticides are poisonous. Be sure that insecticides are clearly labeled. Keep them away from children and pets. After an insecticide has been applied, do not permit children and pets on the lawn until the insecticide has been washed into the soil by sprinkling, and the grass has dried completely. To protect fish and wildlife, do not contaminate streams, lakes, or ponds with insecticides.

One gallon of 25% DDT, Aldrin, or Heptachlor contains 2 lbs. of the active ingredient; 1 gallon of 45% chlordane contains 4 lbs. of the active ingredient; 1 gal. of 15% dieldrin contains 1.5 lbs. of active ingredient; 1 gal. of 55-57% malathion contains 5 lbs. of active ingredient; 1 gal. of 18½% kelthane contains 1.5 lbs. of active ingredient; 1 gal. of 60% toxaphene contains 6 lbs. of active ingredient; 1 gal. of 20% lindane contains 1.6 lbs. of active ingredient.

Prepared by entomologists of the Illinois Agricultural Extension Service and Illinois Natural History Survey. For additional copies see your county farm adviser.

Cooperative Extension Work in Agriculture and Home Economics, University of Illinois College of Agriculture and the United States Department of Agriculture cooperating. Louis B. Howard, Director. Acts approved by Congress May 8 and June 30, 1914.

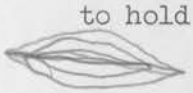
OBSERVATIONS OF A FERTILIZER AND GRASS SEED SALESMAN

Joseph B. Kelly
13 yrs

It is well established that in maintaining turf, dollar for dollar your best buy is fertilizer. This is certainly true, but one might ask the question: What kind and what analysis?

Turf grass fertilizers generally come under the category of "Specialty" plant foods and differ from what we call field grade or farm fertilizer. Specialty fertilizer is also sold by suppliers who understand your problems and your needs and most generally offer more than merchandise to the user. In the turf grass market we cannot sell the quality of our product based on bushels per acre. We can only sell the means whereby better turf is obtainable. This makes for more beauty, better recreation facilities and lower costs for overall turf maintenance--less weeds, less disease, lower water requirements, less seed and on golf courses, better golf.

Correct usage of nitrogen is the key to satisfactory turf grass management. Nitrogen produces the leaf growth and the green color of the grass plant. Since nitrogen is the key to turf grass management, how should it be used and in what form? We realize to arrive at the correct amount of nitrogen, we have to know the needs of the grasses to be fed and soil types. Soils high in organic matter tend to hold greater amounts of available plant food than do mineral soils.



Chemical nitrogen is derived from sulphate of ammonia (the most common form used in complete fertilizers), ammonium nitrate and nitrate of soda, to mention a few. These are soluble forms and are more readily available than organic forms of nitrogen. When nitrogen is applied either alone or in complete fertilizer form, some is held in the soil and some is leached through the soil out of reach of the roots of the plant. The properties of nitrogen availability and of leaching are governed by the form of nitrogen used. Organic nitrogen is slowly available and in cool soil temperatures is too slowly available. In the organic category are sewerage sludge, soybean meal, corn gluten, tankage, urea-formaldehyde and others.

A good rule of thumb is never to apply more than one pound of actual nitrogen per thousand square feet of putting green at one time. This could be increased to one and one-half pounds on bluegrass fairways or on general utility turf for one application. For example, using a 10-6-4 fertilizer you would apply 15 pounds per thousand square feet or about 650 pounds per acre. Using an organic sludge type fertilizer you would apply 1000 pounds per acre on fairways or general turf areas. In order to maintain healthy vigorous turf throughout the growing season 3 to 5 pounds of actual nitrogen are required on Kentucky bluegrass, fescues and general utility type turf areas, requiring 2 to 3 applications per year. When managing for specialty turf such as bents or Merion Kentucky bluegrass, 6 to 9 pounds of actual nitrogen are required per thousand square feet per year. Phosphorus and Potash requirements are approximately half that of nitrogen. Therefore when arriving at a fertilizer program, make sure that the requirements of the turf, for these essential elements, are adequately supplied.

Soil organisms or bacteria must decompose organic matter to release the nitrate form that the roots take up thereby feeding the grass plants. The more complex the organic matter, the slower the decomposition. Soil temperatures, moisture, and availability of oxygen are all governing factors in the length of time it takes to make organic nitrogen available in a form that the plant may take up as nutrient.

Most of us think of organic nitrogen as a non-burning type. Some will tell you that urea-form organic nitrogen offers controlled release of nitrogen but again this is dependent on soil temperatures, oxygen supply, etc. It is entirely possible to have more than adequate urea-form nitrogen on a putting green in wet, cool weather and still have symptoms of nitrogen deficiency (little or no growth and often dollar spot which is normally taken as a visual sign of low nitrogen). When soil temperatures warm up the urea-form often releases nitrogen too fast, producing lush tender growth which is more susceptible to brown patch.

Inorganic fertilizer will burn grass only when applied at too heavy a rate or on wet grass. A combination of the two, organic and chemical, is a desired form used in complete fertilizer and has gained much popularity. In combination of the two forms of nitrogen, the fast acting property of the chemical and the slow release, longer lasting form of organic, combine for a wider range of adequate nitrogen availability.

This brings us to particle size of plant foods which is more varied now than ever before in the fertilizer industry. Usually a combination of inorganic and organic nitrogen, contained in a complete fertilizer, comes in what is known to the trade as "meal" form. Pelleted or granular forms of plant food are becoming more and more in demand with the use of the broadcast type of fertilizer spreader. There is a small model for greens and home lawns and a large, 1400 lb. capacity model with engine driven dispensing fans for use on fairways and large acreage turf areas. The larger machine will broadcast pelleted material 40 to 60 feet depending on the density of the material.

One fertilizer problem peculiar to golf course turf management is directly affected by the wide variance of fertilizer particle size. For applications of a complete fertilizer on putting greens, we find a need for a "meal" form, or small particle size material. The greensmower picks up a portion of pelleted fertilizer applied on putting greens, the amount depending on the pellet size. This is sometimes solved by mowing the first time after the application, with the grass catcher removed. A combination organic and inorganic formula of the meal type is usually the first to be applied on putting greens in the spring and is easily watered into the dense bent turf. Any fertilizer containing a chemical should be watered in immediately after applying, not only to avoid burn but to disperse the material evenly over the area, where overlap or skipped portions may be a problem. This will usually prevent a stripe pattern of varied color and growth. One word of caution--never apply fertilizer containing a chemical until the watering system has been turned on and is ready to use for watering in of material. Never depend on a late snow to take the place of

watering in. This can result in a chemical reaction on the putting surface rather than in the soil, since the snow can melt from the ground up as well as from the upper surface, burning the turf at once or in a delayed reaction.

Meal forms of mixed, complete fertilizers are almost always cured and the longer the curing process, the better the mechanical condition of the fertilizer when applied. My experience has been that the fertilizer plant fills its curing bins at the end of the fall fertilizer season and starts shipping out fertilizer for spring needs in December. The fertilizer shipped in December is usually the longest cured fertilizer that the plant will ship at any time throughout the year, and in the best mechanical condition even if held until April or May before applying.

Phosphorus and Potash needs for turf grass management are usually best determined by taking soil tests. The test plugs should be taken from the top two inches of the soil, marked for identification in small kraft paper bags and sent to a laboratory for testing. Adequate amounts of phosphorus are of great importance in the early growth of the grass plant. The need in mature plants is less, but more important than most of us think. As a matter of fact research has shown that phosphorus is more important than nitrogen on new seedlings. Seedlings will actually develop more rapidly if the nitrogen supply is limited. Therefore a fertilizer of a 1-3-1 ratio or a 4-12-4 complete plant food is actually more suitable than a 1-1-1 ration or a 10-10-10 fertilizer for the development of new seedings. Excess readily available nitrogen will discourage vigorous activity of the root system of new seedlings.

Potash is coming into the picture more and more as an important element in turf grass fertilizer. Potash is a catalyst, making for better utilization of the other elements. Strong stems of turf for a better golf lie are possible with adequate fertility level of potash. Potash also enables turf to withstand heavy traffic and improves inherent disease resistance in turf. For turf density, which to me is turf quality, potash is an important factor. Large amounts of potash are found in the clippings removed in grass catchers on putting greens and where this practice is followed on home lawns. Higher potash applications are necessary where clippings are removed. This is somewhat true with all three elements but to a greater degree with potash. Light sandy soils require greater amounts of potash as it is easily leached through the soil, out of the reach of the feeder roots of the grass plant.

Dollar for dollar, whether you are growing turf or selling turf supplies, fertilizer is a very important factor.

In relative importance in turf maintenance is grass seed. There are many new developments and new strains of seed and research has been active at the University level and with the grower.

Some show much promise and some have faded out of the picture just as fast as they appeared. Remember research can go so far and

then the problems rest with the golf course superintendents, the landscapers, the physical plant staffs, the sod growers, etc. You people are in research whether you know it or not and are a vital part of it. Look, for a moment at the strides made in the sod business in the past decade. Their research has had a great impact on the turf grass industry and the sod producers have proven or disproven the value of new strains and new ideas.

Grass seed in a sales line is an intangible. Few of us carry samples and they would actually serve little purpose. Lot numbers and analysis on seed tags to me take grass seed out of the intangible class and are like the 4 month warranty, the horse power, the wide track and torsion bars of todays automobiles.

In today's market, we have seed from Oregon, Washington, Missouri, Kentucky, Illinois and many other states. We have seed imported from foreign countries. We have quality control, we have growers co-ops and many ways of improving the seed you people will be buying. There are shady operators in the seed business just as in any other business and we must know the danger signs if we are not to be duped into buying for price regardless of quality. What is quality in grass seed? Well, it's quality in turf. You reap what you sow.

Let's look at an analysis tag on seed

Merion Kentucky Bluegrass		Delta Kentucky Bluegrass	
Purity 98.69%	Inert 0.97%	Purity 98.96%	Other Crop Seeds .00
Weed 0.07%	Crop 0.27%	Inert 1.04%	Weeds .00
Germination 80%	Tested July, 1960	Germination 80%	Tested 7-60
		Origin Washington	

Kentucky Bluegrass	
Pure seed 85-45%	Crop seed .15
Inert 14.23	Weed .17
Germination 80%	Tested 9-60
Origin South Dakota	

Let's say we have 90% purity on a tag and 85% germination on Kentucky Blue. That means we have 76 and one-half pounds of seed that would make grass plants under laboratory conditions. What happens under general conditions in average seeding practices. Right off the bat 50% of that 76½ lbs. of seed does not make grass plants due to mortality caused by diseases, dessication, etc.

The tag on an average Kentucky bluegrass would read 85% purity, 75% germination which means that only 32 pounds of the 100 pounds of seed would produce grass plants.

Watch that tag and buy the quality. As Bill Daniels says--it's "Yours for better turf."

PROBLEMS IN GOLF COURSE MANAGEMENT

James Brandt

Rhizoctonia solani, Sclerontinia homoeocarpa, Greek to you? No, this is the Latin name for the causative organisms of brown patch and dollar spot. We might impress the uninformed by using these names to explain the spots on our greens. I am sure that a golfer would be more impressed by the lack of diseased spots on golf greens. We are here today not to impress but to find an answer to some of our problems in turf grass management. My purpose is not to answer these problems but to present some of the more important problems confronting the golf course superintendent.

We are located in a section of the country known as the blue grass belt. Much of the wealth of the nation is concentrated in this area. Also a large portion of the nation's golf courses.

In this area our greatest concern on golf courses is in the development of a good fairway turf. On unwatered fairways, blue grass is the predominant turf. On irrigated fairways bent grass and poa annua are the predominant species.

The requirements of a good fairway turf are:

1. close cut one-half to 3/4 inches being the maximum height.
2. close knit and firm. The ball should sit on, not nestle down into the turf.
3. The grass should be pleasing in appearance.
4. should be relatively free from disease.
5. should be at its best during the season of heavy play.

Let us see how blue grass compares with the fairway that the golfer desires. Blue grass looks very nice and green in early spring. It grows so fast in early spring during rainy periods that it is usually too long for good play. The blue grass is invaded by leaf spot that thins out the turf and leads to invasion by crab grass and weeds. If we go to great expense to control the weeds and crabgrass, heat and lack of moisture cause the blue grass to become dormant, leaving a poor playing surface. Attempts to water blue grass have met with very limited success.

Blue grass will not tolerate the close cut desired and sometimes demanded by the golfer. After Labor Day when the cool, moist days of fall arrive, blue grass looks good again. About one year in five we have what the course superintendent calls a blue grass year, yet we still have the ever present problem of crabgrass and clover infestation.

Our blue grass has failed to pass the test of a good fairway turf. We only need to drive a block and we can see that it has failed as a good lawn grass.

Although bent grass meets some of the requirements of a good fairway turf, its establishment and cost of maintenance make it prohibitive except for the very wealthy clubs and home owners.

Most of the same problems present themselves when we think of grass for our golf course tees. Zoyzia has done excellent on the tees at our club when cut at ½ inch and the clippings removed. The chief drawbacks to Zoyzia are:

1. difficulty in establishing
2. length of time needed to develop a turf
3. cost of establishing
4. winter color

Our plant breeders have done much to improve yields of corn, wheat, soybeans and other crops that are being produced in an over-abundance. We should ask them to use some of their time, effort and knowledge in producing a good turf grass. One that would be used on most every golf course, park or lawn in the blue grass belt.

Disease control on bent grass greens merits discussion. We have excellent control for major turf diseases with the exception of Helminthosporium. The ideal fungicide would be a systemic that would immunize the plant to all disease. We would be most happy with a satisfactory control for Helminthosporium.

Thatch is probably our greatest disease causative factor. It is my firm belief that the more we spray, the more we cause a thatch build up. I believe that our present fungicides not only control disease causing organisms but control our decay organisms that are needed to break down this undecomposed plant residue into useful organic matter. Studies on microbiological activity as related to fungicidial applications is needed.

Golf cart usage is a modern day headache. Research is needed to determine if excessive wear of turf is due to friction, compaction, or a combination of both. Tests comparing the damage caused by the conventional tire compared with the 'terra-tire' would be very useful. If reduction in damage occurs, the superintendent would have valid reason for requesting all carts be equipped with the improved tires.

The research that is accomplished each year on turf grass should be published. The information must be in the hands of the consumer-the grass grower, whether he be golf course, cemetery, or park superintendent or a home owner. We need an annual turf grass publication reporting the findings of the research on grass. Research is useless unless the findings are made available to the man in the field.

New herbicides, insecticides and fungicides are continually being placed on the market. We must know their capabilities and limitations.

Many problems have been omitted from this discussion. Much work is being done on crabgrass and poa annua control. Putting green soil mixtures are being studied and evaluated.

Our fledgling Illinois Turfgrass Foundation would be an immeasurable success if we could:

1. develop a satisfactory fairway-lawn turf grass,
2. find or develop a systemic fungicide for the control of all turf grass diseases or find adequate control measures for each disease and
3. provide an annual publication of turf grass research findings