Fairway Fertilization

By O. J. NOER

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GOLF clubs cannot afford to neglect fairway turf. Players demand good lies and will not support clubs which permit turf deterioration. It is also vastly more expensive to rejuvenate thin, weed infested turf than to maintain good fairways. In the interest of economy feeding should not be abandoned. To meet reduced income, programs should be designed to produce desired results at reasonable cost.

O. J. NOER
who is acknowledged generally as the best informed turf expert in America.

The argument favoring universal use of complete fertilizers is open to grave question. Admittedly this is the easier method, but it is more satisfying and certainly more economical to correct soil deficiencies whatever they may be.

Fairways are never cropped because clippings are constantly returned. In this respect they differ from greens and all farm practices. Upon decay, all the phosphoric acid and potash are released in forms which can be re-utilized by the grass. Furthermore these elements are not subject to loss by leaching. Growth-producing nitrogen is the elusive element. It may be leached away as nitrates in the drainage waters, or escape as elemental gaseous nitrogen resulting from so-called denitrification processes carried on by soil organisms.

NITROGEN IS DOMINANT ELEMENT

NITROGEN is conceded to be the dominant element for turf growth on established fairways. Not only is it responsible for deep green color and active vegetative growth, but it supplies the urge to induce grass to spread laterally; the first essential to production of satisfactory dense sod. Contrary to general belief nitrogen is not the sole cause of shallow root systems. As a matter of fact roots also require nitrogen and only when their requirements are fully satisfied is a dense root system possible. Too close cutting, superficial watering and exceedingly compact soil tend to restrict root systems.

The most effective way to control clover in fairways is to feed nitrogen. Grasses, unlike clover, depend upon the soil for needed nitrogen. If the soil supply is low, clovers flourish at the expense of the turf grasses. Nitrogen feeding encourages the grasses and clover thereby becomes less noticeable. The truth of this statement is demonstrated on many test plots.

Chemical methods fail to throw much light upon need for nitrogen. Yet there are unfailing signs which can be used to determine whether its use is necessary. The soil supply of nitrogen exists in the dark-colored humus and organic matter of the soil. Hence light-colored heavy soils and sands are low in this vital element. Even on dark-colored soils turf may show marked response to additions of nitrogen because the humus materials resist further break down and its nitrogen is not converted into forms which the roots can take up.

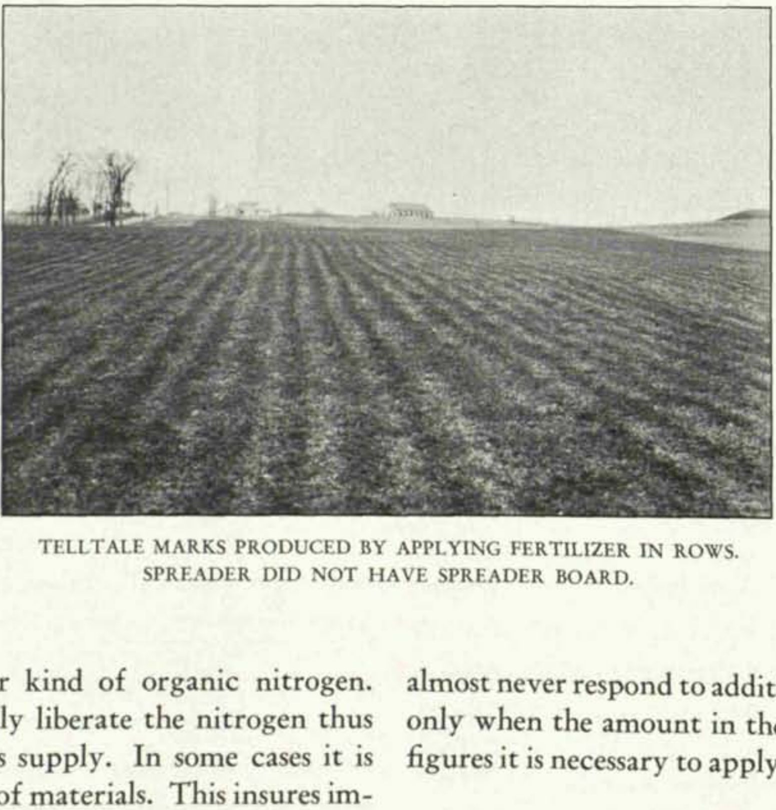
The turf itself plainly shows any need for nitrogen. Lack of color, failure to spread and grow vigorously, when moisture is plentiful and air temperatures favorable, are sure signs of nitrogen deficiency. Prevalence of moss and clover are further indications of need for nitrogen.

CHOICE OF NITROGEN MATERIAL IS IMPORTANT

THE choice of nitrogen material is important. Broadly, there are two distinct groups of materials depending upon the form in which nitrogen occurs. These are classed as organic or inorganic materials. The true organics are of vegetable or animal origin including such materials as manures, cotton seed meal, activated sludge, bone meal, etc. Typical examples of inorganic materials are sulphate of ammonia, ammo phos, nitrate of soda, etc.

The inorganic materials are water soluble, consequently apt to burn the turf. They produce rapid growth immediately following their application but effects soon disappear. The more lasting effects of organics is due to the water insoluble nitrogen. This becomes available gradually as a result of the activity of soil organisms. Any water soluble nitrogen in the organics is similar in its action and effects to the soluble inorganic materials.

From the standpoint of fairways a slow but continuously growing turf is the ideal. This necessitates less frequent mowing. Since amount and rapidity of growth are roughly proportional to amount of available nitrogen the ideal condition would be to have a continuous and uniform supply of nitrogen at all times during the growing season. This can be accomplished by periodic applications of soluble nitrogen materials using moderate rates, or by single applications of the proper kind of organic nitrogen. Soil processes gradually liberate the nitrogen thus insuring a continuous supply. In some cases it is best to use both types of materials. This insures immediate effects from the water soluble nitrogen and as these wear off additional nitrogen, becomes available from the organics.



TELLTALE MARKS PRODUCED BY APPLYING FERTILIZER IN ROWS. SPREADER DID NOT HAVE SPREADER BOARD.

If the soil is impoverished and turf thin, more generous nitrogen feeding is necessary to urge dense turf formation than where feeding is simply a matter of maintaining good fairway turf.

PHOSPHORIC ACID AND WHAT IT DOES

PHOSPHORIC acid, although the dominant element on new seedings, plays a less important role on established fairways. During a growing season constantly clipped grass requires only one-fourth to one-third as much phosphoric acid as nitrogen. There is some reason to suspect that fescue, Bermuda and bent either require less phosphoric acid or have a greater feeding power for this element than Kentucky blue grass.

When soluble phosphates are applied any phosphoric acid not taken up immediately by the grass roots is precipitated in the soil and does not leach away. Solution gradually takes place as required by the grass. On most soils requiring phosphate a reasonable application should last for several years. Leaching losses are negligible and the soil supply is constantly augmented by the decay of clippings.

Fortunately fairly simple methods have been devised for rapidly measuring the amount of available phosphoric acid in the soil. They deserve more general use. Heavy soils containing 75 pounds or more, and sandy soils containing 50 pounds or more of available phosphorus per acre as measured by the Truog method almost never respond to additions of phosphate, and only when the amount in the soil falls below these figures it is necessary to apply phosphate fertilizers.

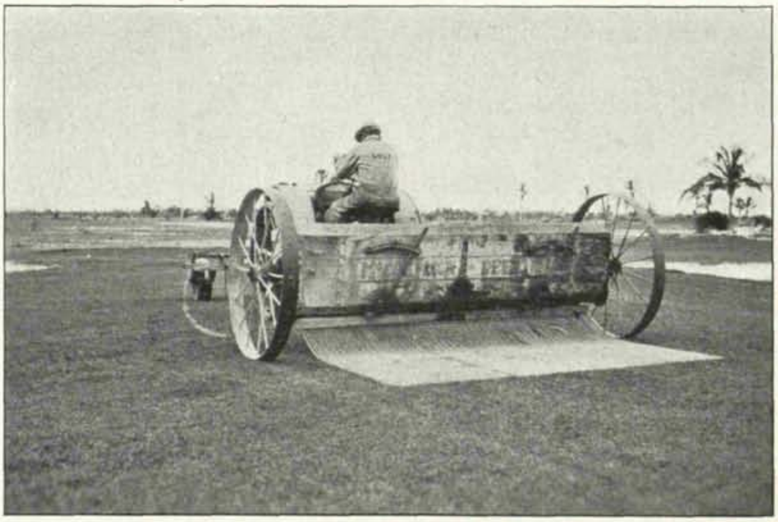
POTASH IS RARELY NEEDED

POTASH, although almost as plentiful in clippings as nitrogen, is rarely needed on fairways. Excepting sands, peats and mucks, the surface soil contains from 20,000 to 40,000 pounds of potash per acre, or from 10 to 20 times the amount of nitrogen.

Unlike nitrogen, this element does not leach from the soil, so the large initial supply constantly augmented by that released during decay of the clippings satisfies turf requirements. As yet there are no trustworthy chemical methods for determining need for potash. The only sure method is actual trial on limited areas. Ordinarily this is only worthwhile on sands, peats and mucks. Even some of these soils do not respond to additions of potash.

The first logical step preceding inauguration of a fertilizer program is to determine soil reaction and available phosphorus. Samples for these determinations should be representative of the major types of soil occurring on the grounds.

If the soils are very acid the use of some ground limestone is justified, particularly if Kentucky blue grass is the dominant grass. There is reason to believe that both fescue and bent will thrive and withstand more acidity than blue grass. If soils are very acid, applied phosphates are sometimes precipitated in forms which do not go back into solution with sufficient rapidity to satisfy turf requirements. Consequently applications of lime should precede the use of phosphates to reduce the possibility of its fixation in unavailable forms. Applications of 1 to 2 tons of ground limestone should suffice for several years. Overliming should be avoided because of its tendency to encourage clover.



UNIQUE ARRANGEMENT USED BY O. E. BAKER AT BOCA RATON

The mat insures uniform distribution and prevents burn of soluble fertilizers by knocking particles off blades of grass.

Where the available phosphorus is below the limits mentioned above, an application of phosphate may prove beneficial. From 20 to 500 pounds per acre of high-grade super phosphate will suffice for several years. Use the heavier rate when the available phosphorus is negligible, and the light rate when the soil supply approximates the limits mentioned. Where some immediately available nitrogen is desired one of the ammonium phosphates can be substituted for the super. If bone meal is preferred it may be wise to use 500 pounds or more per acre because of its lower availability.

The phosphate can be applied separately or mixed with the nitrogen fertilizer. If an organic is used, preliminary mixing is not necessary, for they can be mixed right in the hopper of the distributor.

CHOOSING THE SOURCE OF NITROGEN

THE choice of source of nitrogen depends upon several factors. If soil is poor and turf thin, generous use of nitrogen is warranted. It is seldom advisable to apply soluble materials at rates of more than 300 pounds per acre due to the danger of scorching the grass. When larger quantities are needed it is safer to divide the applications and apply at intervals of 4 to 6 weeks. Such materials should not be applied while there is dew on the grass, or during hot weather, because of the danger of burning.

Organics can be used more liberally without danger. Rates of 1000 to 1500 pounds per acre are justified where turf is poor. Some prefer to use a combination consisting of 700 to 1000 pounds organic and 100 to 200 pounds per acre of sulphate of ammonia or ammo phos. They can be mixed right in the hopper. Such combinations are ideal, for immediate results are obtained from the water soluble nitrogen, and growth is continued by the organic nitrogen as it gradually becomes available.

Opinions differ somewhat as to when fairways should be fertilized, but there is general agreement that spring and fall are the logical seasons. It is during these periods that turf makes its most active growth. When turf is poor more rapid improvement results from feeding in spring and again in the fall. This is also good practice on sandy soils to reduce leaching losses.

Organics are certainly the ideal materials to use for fall feeding. They will not burn the turf, and temperatures are such that nitrogen is released in amounts sufficient to promote fall growth. The remaining nitrogen does not leach away during the winter because soil organisms are not active due to low temperatures. Beneficial effects extend into the following season.

UNIFORM DISTRIBUTION IS IMPORTANT

FERTILIZERS do not move laterally in the soil, so uniform distribution is exceedingly important. Best results are obtained by using the two-wheel hopper type lime and fertilizer spreader. The better machines cover a strip 8 to 10 feet wide, and have a hopper capacity of at least 500 pounds. On most machines a slanting spreader board is attached directly below the outlet spouts to facilitate uniform distribution.

If the outlet spouts are spaced four inches or more apart even with the spreader board, the fertilizer is apt to be applied in rows. This can be overcome by attaching grain seeder chains to the outside top edge of the spreader board and directly under each outlet spout. These chains can be obtained from any implement dealer.

Another effective method is to remove the spreader board, and replace it with a steel mat which is the exact width of the hopper and 5 or 6 feet long so it drags along the ground behind the spreader. Besides insuring uniform distribution, the chains, or mat, reduce the danger of turf scorching by preventing soluble material from adhering to the grass blades.

The factory calibration of fertilizer distributors is only approximately correct. Further, there is a wide difference in the flowing qualities of different fertilizers. Hence rates of application should be carefully checked.

CAREFUL APPLICATION OF FERTILIZER IS NECESSARY

CARELESSNESS leaves telltale marks. Failure to overlap leaves disappointing turf in the unfertilized strips or skipped areas. It is best to fill the hopper in the rough to avoid burns resulting from spilled fertilizer.

Whenever it becomes necessary to stop the machine on fairways the outlet spouts should be closed, for unless the flow of fertilizer is stopped burned strips may result. This usually necessitates placing a man on the spreader to perform this operation. These details may seem trivial yet it is folly to invest funds in fertilizer only to obtain disappointing results because of carelessness in its application.

On hillsides where turf is thin, it is often well to spike or disc fairways before fertilizers are applied. This reduces the danger of mechanical loss during heavy rains. Following prolonged summer drought it is unwise to fertilize until after the first good rain. Dry soil sheds water and surface runoff is usually greatest with the first rain. After the soil becomes moist, water is more effectively absorbed.

Fertility and Fertilizers

By H. B. SIEMS, Ph. D.

Talk Given Before the Mid-West Greenkeepers' Association

LESS than ten years ago, many authorities recommended nitrogen in the form of sulphate of ammonia as the only fertilizer for use on golf courses. There have been many changes since that time in fertilizer recommendations by experts on turf culture.

In general agriculture, it has been recognized for years that many soils require other elements in addition to nitrogen to produce normal plant growth. Today we see no real reason why not so long ago it was assumed by some people that in some way grasses on golf courses had nutritional requirements different from other cultivated plants.

Why was sulphate of ammonia recommended to the exclusion of all other plant foods? The history of this movement, or may we say fad, is rather peculiar.

In 1917, the Rhode Island Agricultural Experiment station published in Bulletin 170, the results of a series of fertility experiments with several different varieties of grasses. Different fertilizer mixtures were used on plot tests which had been running for several years. Thus, it was found that a fertilizer mixture which tended to change the soil reaction to an alkaline condition increased both grass and weed growth.

A fertilizer which tends to change the soil reaction from an acid to an alkaline condition during the course of the growing season, is known to be "physiologically alkaline." In this particular case, the physiologically alkaline portion of the fertilizer consisted of nitrate of soda and basic slag. A potash salt was the third constituent of the mixture. The grass used in these tests made the best growth, but lime-loving weeds also grew well.

Another mixture used was composed of sulphate of ammonia, superphosphate, and muriate of potash. This fertilizer increased soil acidity and was "physiologically acid." In this particular case, grass made good growth, however, weeds did not grow as luxuriantly as was the case with the physiologically alkaline fertilizer.

In the experiments cited on plots receiving the nitrogen, phosphorus, potash, and calcium salts, the bulletin brought out the fact that with "complete" plant foods, physiologically acid reacting fertilizer was superior to physiologically alkaline fertilizer, only in regard to decrease in weed growth. From the standpoint of grass growth, however, the alkaline reacting fertilizer was best.

Unfortunately, the bulletin caused some people to draw wrong conclusions. On the basis of the experiments reported, sulphate of ammonia was recommended by a number of the authorities as the only element of plant food necessary to be applied to the soil. Somehow the importance of phosphorus and potash in plant nutrition was disregarded, perhaps unintentionally.

"Sulphate of Ammonia for Weedless Putting Greens, Fairways, and Lawns," became the slogan of interests selling this product. Writers and speakers used it as a subject for articles and talks. Although nitrogen in the form of sulphate of ammonia is a good source of this element as a plant food, it obviously cannot be used indefinitely to the exclusion of all other essential elements without disastrous results.

SOIL ACIDITY SOMETIMES LIMITS PLANT GROWTH

SULPHATE of ammonia became popular because it made the soil acid. We know today that there is a certain range of soil acidity at which various grasses make optimum growth. Thus, Kentucky blue grass thrives at the neutral point and slightly on the acid side of this point, whereas, the bents and fescues do well at slightly higher soil acidity. Increase in soil acidity beyond certain limits, however, will have a decided detrimental effect on grass growth.

Where sulphate of ammonia alone has been applied for a number of years, a deficiency of potash and phosphorus limits grass growth, but the acidity produced in many cases may be the limiting factor.

If medium soil acidity is desirable, it does not follow that very strong acidity is better. Acidity must be controlled within reasonable limits otherwise increased acidity is not only detrimental to certain weeds, but to the grasses as well. As a matter of fact, beyond certain limits, increase in soil acidity will make conditions favorable for growth of certain acid tolerant weeds because the grasses have given up the struggle.

Let us consider briefly some experiments that are classical in the history of agriculture. At the outset I will admit that the experiments to be cited were made under conditions which in many cases are not identical with those prevailing on the average golf course, nevertheless, the sum total of the effects fertilizers had on the soil and plant growth may be expected to be reproduced on many of our soils.

CLASSICAL GRASS PLOT TESTS OF THE ROTHAMSTED EXPERIMENT STATION, ENGLAND[1]

In 1856, Sir John Lawes, a wealthy landowner, in conjunction with a young chemist, afterwards known as Sir Henry Gilbert, started some very important tests which are being continued today. A well established turf was subdivided into a number of plots. Each plot has received practically the same kind and amount of fertilizer ever since 1856. These grass plots today tell an interesting story as to what may be expected from various single and mixed fertilizer materials. The conclusions that may be drawn are useful information for greenkeepers, although the conditions of these experiments are not exactly those prevailing on golf courses.

Where sulphate of ammonia alone has been used, grasses have completely disappeared and only weeds are left. The surface of the soil has become extremely acid, and there is actually peat formation, three or four inches in thickness, on the surface. Very light annual applications of sulphate of ammonia have also caused very marked decrease in grass production. Weeds have crowded out desirable grasses.

Straight nitrate of soda applied year after year has gradually but definitely reduced the amount of grass cut annually. Weeds have crowded out most of the desirable grasses.

It seems needless to point out that the check plots which received no fertilizer of any kind are doing poorly. Plots receiving straight superphosphate at the rate of 350 pounds per acre are, after all these years, badly run down; however, they are much better than the check plots as should be expected.

[1]Book of Rothamsted Experiments by A. D. Hall, Published John Murray, Albemarle Street, W., London. 150-189.
Guide to the Experimental Fields, Rothamsted Experimental Station, 7 and 10, 1929.

A combination of 350 pounds of straight superphosphate plus 412 pounds of sulphate of ammonia per acre first gave increased yields. Gradually but very definitely, the yields decreased to such an extent that today the combination of two elements of plant food only gives no better results than straight sulphate of ammonia alone.

When, however, potash is mixed with the superphosphate and sulphate of ammonia, exceptionally high yields have been maintained until to date.

LIME AND SULPHATE WORK WELL TOGETHER

The whole series of tests as outlined has been duplicated with the exception that in this series, lime has been supplied as an additional constituent. It is significant that where complete plant foods were used and sulphate of ammonia was the source of nitrogen, the addition of lime gave the highest results. This is very interesting, and yet, in the light of present-day knowledge, it is exactly what we should expect.

In conjunction with these tests, it should be mentioned that when fourteen tons of well-rotted manure per acre were applied, alternating with 600 pounds of fish meal, the results of these large applications of organic materials were by no means as good as those obtained with the purely inorganic forms of plant food. Here we have tests that have run sixty-six years. The time interval is long enough for anyone to draw some conclusions. A summary of these classical tests is as follows:

In order to obtain best results, a suitable combination of nitrogen, phosphorus, and potash must be present in adequate amounts. Each element is important. Not one of these three can be omitted without limiting grass growth.

Large quantities of sulphate of ammonia alone used over a number of years also makes the soil so acid that normal grass growth is no longer possible. The neutralizing action of lime on plots receiving sulphate of ammonia only does not make up for the lack of phosphorus and potash.

Complete inorganic plant foods have definitely proven superior to organic forms. Relatively high percentages of phosphorus and potash in complete fertilizer mixtures have encouraged clover and certain other broad-leafed plants, whereas, a relatively high nitrogen content in complete fertilizers favor the grasses principally.

In modern fertilizer mixtures, the substance responsible for noticeable changes in soil reaction are the nitrogen compounds. The phosphorus and potash compounds have little or no effect on changing soil acidity. Dr. W. H. Pierre of West Virginia Experiment Station recently published some interesting work in regard to the effect of nitrogenous fertilizers on soil acidity[2]. The author shows by actual experiments the effect of a group of nitrogenous fertilizers on soil acidity. He has demonstrated that the acidity produced for each 1% nitrogen per ton of fertilizer from several sources requires the following amounts of lime for neutralization:

1% N (97 pounds) from Sulphate of Ammonia —120 Carbonate of Lime.

1% N (200 pounds) from Ammonium Phosphate, Ammo-phos, etc.—104 Carbonate of Lime.

1% N (77 pounds) from Leuna Salpeter—92 Carbonate of Lime.

1% N (43 pounds) from Urea—60 Carbonate of Lime.

1% N (57 pounds) from Ammonium Nitrate —58 Carbonate of Lime.

Another group of nitrogenous fertilizer materials produced an alkaline reaction in the soil. Nitrate of soda, calcium nitrate, and cyanamid made a neutral soil alkaline when these substances were applied.

One application of the acid or alkaline reacting materials mentioned may not have any significant influence on grass growth. The same materials supplied over a number of years, however, may cause injury to plant growth.

HOW NITROGENOUS FERTILIZERS AFFECT SOIL ACIDITY

THE ease with which nitrogenous fertilizers may effect changes in soil acidity will also depend upon:

1. The degree of acidity or alkalinity of the soil in question. Thus, if we have two soils of the same soil type, one is slightly acid and the other one alkaline, it is obvious that the addition of equal quantities of acid-reacting fertilizers will change the slightly acid soil to a strongly acid condition more readily than the alkaline-reacting soil.

2. Soil types differ in their ability to resist change in acidity. Thus, W. H. Pierre found for example, that a Ruston sandy loam could be changed from a reaction which we may

[2]Industrial and Engineering Chemistry 23, 1440, (1931).

consider favorable to creeping bent and fescues to the degree of acidity very unfavorable by addition of only 340 pounds of sulphate of ammonia per acre. The other extreme, a Cecil clay loam required as much as 4,290 pounds of sulphate of ammonia before the same degree of acidity was produced.

Generally speaking, the light sandy soils undergo significant changes in acidity due to relatively small amounts of acid-reacting substances. On the other hand, the heavy soil types require much larger applications before noticeable changes in acidity take place. The fact remains, irrespective of whether light or heavy soils are used, acid-reacting fertilizers if applied continuously without the addition of a neutralizing agent, will eventually make the soils too acid for good grass growth.

CHICAGO SOILS RESIST INCREASE IN ACIDITY

Most of the soils in this locality and most of the top dressing materials and water used on greens will resist for years rapid increases in acidity due to acid-reacting fertilizers. Eventually, however, a condition will arise where good grass growth cannot be expected unless lime or some other neutralizing agent is added to the soil.

At the Pennsylvania Experiment Station[3] where experiments have been in progress for fifty years, an application of 144 pounds of sulphate of ammonia per acre began to show reduced crop yields after eight years. For the past forty-two years, the yields have been going down annually and today the yield is less than 30% of the original.

As far as change in soil acidity is concerned, it makes little difference whether sulphate of ammonia is applied singly or in conjunction with phosphate and potash. Instead of attempting to modify acidity of soils to such an extent that weeds cannot grow, the aim of a greenkeeper should be to make conditions as favorable for grasses as is possible.

Recent experiments conducted in a number of countries have demonstrated that the best fertilizer combination favoring grasses, growing in competition with other plants, is one which contains a high percentage of nitrogen in a complete fertilizer.

FERTILITY TESTS OF THE U. S. G. A. GREEN SECTION

Here we have a number of fertility tests which have been duplicated at fourteen demonstration gardens during the past three years. As should be expected, the two complete commercial fertilizers made the best showing for putting green grasses. In all the tests listed, the amount of fertilizer applied is based on equivalent amounts of nitrogen from each fertilizer material; thus, for each pound of 12-6-4 applied per 1000 square feet, twice as much, or two pounds of 6-12-4 was necessary. This is due to the fact that the 6-12-4 contains only one-half as much nitrogen in this formula as the 12-6-4.

The rate of application of other fertilizer materials is on the same basis; namely, an application of equivalent amounts of nitrogen. The results indicate clearly that complete fertilizers after only three years of experimentation, made by far, the best showing.

We do not have to be prophets to make a number of predictions in regard to what results may be expected as the years roll on. For instance, we can predict about the nitrate of soda plots that gradually but definitely yields will decrease, the turf will

[3]Noll, C. F., Gardner, F. D., and Irvin, C. J., Pennsylvania Agr. Expt. Sta., Bull. 264 (1931).

get poorer, and weeds will come in—just what we should expect. The soil will become depleted in phosphorus and potash and finally normal grass growth will be absolutely impossible.

The same may be said about straight sulphate of ammonia, except that in this particular case, the soil will become more and more acid until finally high soil acidity, in addition to phosphorus and potash deficiency, will become the limiting factor to plant growth. This applies to Urea which supplies nitrogen only.

Ammonium phosphate will probably hang on a little longer since it supplies nitrogen and phosphorus, two elements of plant food instead of only one; however, in due course of time, potash deficiency will become very noticeable and the ammonium phosphate will show poorer and poorer results.

Activated sludge, tankage, and other nitrogenous materials will probably run parallel to ammonium phosphate as far as results are concerned. In May and June, due to the slow decomposition and nitrification, we find that the complete inorganic plant foods are awarded a much higher rating than the organic forms.

WORMS LIKE ORGANIC FERTILIZERS

WE WILL also find, as time goes on, that the plots receiving large quantities of organic substances will become heavily infested with worms. Beetles and other insects, whose larva will feed on the root system, will give preference to soils rich in organic matter, particularly, if this matter gives off a distinct odor.

Many of the soils on which fertility tests are now conducted are acid in reaction. Generally speaking, most of the soils east of the Mississippi react acid; therefore, the two complete plant foods used, 6-12-4 and 12-6-4, would gradually but definitely increase soil acidity because in these particular mixtures, sulphate of ammonia is the only source of nitrogen.

Let me state, in conclusion, that physiologically neutral fertilizers can be manufactured that will not cause a change in soil acidity. If, therefore, the composition of the two complete fertilizers used in the tests is not modified, there will come a time when an application of lime on the experimental plots receiving the complete plant foods will be highly desirable. From the standpoint of results the complete plant food will, in the long run, probably be the most satisfactory.

GREENKEEPERS AT THE UNIVERSITY OF WISCONSIN, MADISON

Canadian News

By J. H. EVANS, *Golf Editor*
Toronto Globe

PROF. A. H. TOMLINSON
Ontario Agricultural College

RESULTS of the experiments conducted on the Cutten's Fields Golf course, Guelph, Ont., to eradicate chickweed from the putting surfaces were presented to members of the Ontario Greenkeepers' association when the association held its monthly meeting at the Ontario Agricultural College and later visited the course.

The course and the attractive club house is the gift to the people from Arthur Cutten, internationally-known Chicago millionaire who was born in the city. The course was constructed three years ago and has been afflicted with chickweed.

Dr. G. I. Christie, president of the college, Professors Henry G. Bell, J. E. Howitt, A. H. Tomlinson and Mr. W. E. Gammon joined the party of greenkeepers and course superintendents. Professor Christie brieflly addressed the association, expressing his appreciation of the work it had voluntarily undertaken and explained to its members the result of some experiments on pasture land which might be applied to fairways. The field which had been used for pasture land for a great many years, was of a poor type but had improved materially with the use of fertilizers.

CHICKWEED AT CUTTEN'S FIELDS

WHILE the experiments with the pasture land and the results were of interest to the members of the association, the effort to rid the greens of the Cutten's Fields course from chickweed were of still greater interest. The experiments on the golf course were presented in detail and in a manner that the greenkeeper could understand what to apply and when to apply it and what he should not do.

Chickweed is a problem of considerable magnitude because turf is not uniformly good over the entire layout. The putting greens were seeded with mixtures and with bent stolens of the Clarkson strain.

Results secured from the application of ammonium sulphate, iron sulphate and sharp sand were considered to be highly satisfactory, providing a rapid and efficient kill. Greenkeepers were advised that it was well worthwhile testing. The mixture is three parts ammonium sulphate, one part of iron sulphate and twenty parts of sand. The ammonium sulphate should be in a fine granular form, while the mixture should be applied on a clear warm day, each plant of chickweed being covered with the material.

Should the chickweed be thick, an average green will require from 300 pounds to 400 pounds and under normal conditions the material should be thoroughly washed in two days after the treatment. The treatments can be applied with the most satisfactory results in the early spring or the late fall.

HOW THE GREENS WERE TREATED

ON MAY 12 a section of one green received an application of the mixture. A second section of the same green received an application of ammonium sulphate at the rate of five pounds per 1000 square feet with three pounds of sand being mixed with each pound of ammonium sulphate. Ten days later the second section received an application of ammonium sulphate and a third section also treated in a similar fashion.

Eight days later the first section received another treatment of the ammonium sulphate and iron sulphate and the other two sections of the green the ammonium sulphate treatment. Ten days later, the section which had been treated with ammonium sulphate and iron sulphate received an ammonium sulphate treatment and the second section which had been treated with ammonium sulphate received the ammonium sulphate and iron sulphate treatment. The third section received ammonium sulphate again.

The weather was cool after the first application of ammonium sulphate and iron sulphate on the first section and it became necessary to apply it again to eradicate the chickweed. The grass and chickweed turned black shortly after the material was applied. The grass soon became a dark green while the chickweed blackened and died.

The ammonium sulphate made the grass grow much more rapidly, members of the association were informed. On a second green, grass was worn down to the soil in spots. It received three applications of ammonium sulphate and as a consequence the grass grew much thicker and much faster.

CALCIUM CYANAMID APPLIED WITH SAND

ANOTHER green received an application of calcium cyanamid which was mixed with three parts of sand. A section of the same green was treated with ammonium sulphate without sand and a third section received the ammonium-iron sulphate mixture. The results of this experiment showed that calcium cyanamid and ammonium sulphate should not be used and the reason given was that the materials, while they might be satisfactory, the rate of applications had not yet been determined.

James Foster, secretary manager of the Cutten's Fields course took the party over the entire property and