Fertilizers and Fungicides

The Function of Soluble Fertilizers and Fungicide Chemicals in the Maintenance of Putting Greens

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CHEMICALS such as the soluble fertilizers urea, ammonium sulphate and ammonium phosphate, and the fungicides such as Semesan, are indispensable in the maintenance of a perfect putting turf.

Too often the use of chemical fertilizers has been attended by indifferent or poor results and here and there we find a discouraged greenkeeper reverting to the sole use of composted horse manure. Other greenkeepers have no especial difficulty in securing quick response and beneficial effects with the soluble chemical fertilizers, and the question naturally arises as to how they do it.

It is the purpose of this article to explain how it can be done and the underlying principles governing the utilization of the chemicals by the grass plant.

How Grass Derives Its Food

Plants derive potash, phosphoric acid, iron, magnesia, lime and other chemicals through the root system and plants other than legumes also obtain their nitrogen requirements in the same way. Grass, therefore, obtains all of its food through the root system with the exception of carbon dioxide most of which is acquired from the air through the leaves. I dare say that the greenkeepers who read this article have read such a statement many times and it is only incorporated here to make the writer's points in logical sequence.

All of us know in a general way how human beings and animals eat food, digest it in a stomach, how it makes blood, fat, and bone, but how many know how a plant derives its food and what form it should be in to keep the plant healthy and make it thrive?

Grass plants derive their food from the soil through a physical chemical process called osmosis. This process depends on the fact that a weak or dilute solution of a chemical separated from a stronger solution of chemicals by a thin skin or membrane, will penetrate the membrane in the direction of the stronger or more concentrated solution in order to weaken it. The pressure exerted during the operation is called osmotic pressure and for a solution which chemists call "normal," amounts to 330 pounds per square inch.

The root system of a grass plant is made up of not only the main roots which can be easily seen but of thousands of tiny hair roots which can only be seen by close observation and which provide relatively great absorption surfaces. The surface of these roots is a skin or membrane called the epidermis through which the osmotic process takes place, and within this cellular membrane is a solution of certain sap substances. The sap solution is concentrated enough to cause very dilute solutions of soluble fertilizers to penetrate the root membranes.

The soil salts such as calcium phosphate, potassium chloride and the nitrates, can only be absorbed by the plant when in true solution. They do not necessarily enter the roots at the same rate as water. Every soluble fertilizer chemical moves into the plant quite independent of every other soluble fertilizer chemical and water. Whether or not it will be sucked in depends on the necessity for it in the cell sap, for a plant will not take up through its roots fertilizing constituents for which it has no immediate use.

When the sap soluton is weakened slightly by the fertilizer solution it in turn by means of the osmotic process circulates upward through one set of the sap tubes or cells which scientists call fibrovascular bundles, and the fertilizer materials are withdrawn by certain of the plant cells and utilized for making tissue of various kinds needed for the growth of the plant. Relieved of its burden of soil chemicals, the sap again returns to the roots through another set of tubes bearing carbohydrates manufactured in the leaves for the use of the stem and roots and seeking more tissue building chemicals from the soil solution. Note how closely the circulation system of the plant corresponds to the circulation system of man and the sap to blood. A learned savant from

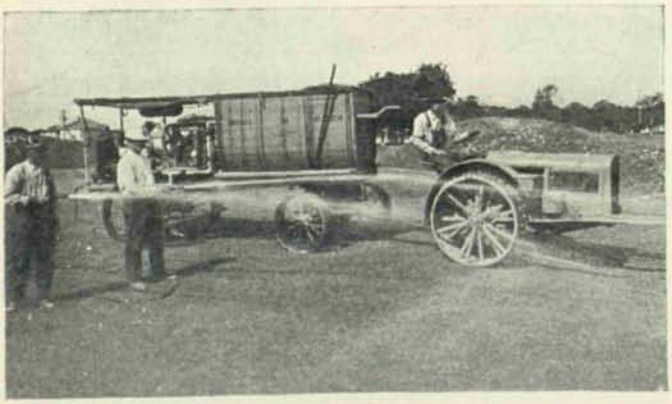
Using Boyce spray guns from giant pump in applying fungicide and ammonium sulphate mixture

India demonstrated last year in London that a plant on being injured acts as if it were enduring pain.

Grass Injury by Improper Application of Chemicals

Now let us consider the effect of feeding a grass plant with a strong solution of a chemical fertilizer. When this is done instead of the sap solution being able to acquire the fertilizer through the root membrane the contrary is true and the water of the sap solution flows out through the root membranes into the fertilzer solution and the grass having been deprived of the water which holds the solid constituents of the sap in solution and its normal circulatory system upset, wilts, dries up and dies. This is the condition which scientists call plasmolyses. In most cases the soil fertilizer solution is not strong enough to cause withdrawal of much water, but the effect is such as to stop the growth of the grass for several days or a week until the plant regains its normal balance. Someone may reason that a grass plant loses considerable amounts of sap through the continual cutting of its leaves. Mechanical wounds made by the cutters soon heal and do little damage, but it is worthy of note that grass survives the playing season with a reduced leaf area and it is through the leaves that it acquires carbon dioxide. During trying weather periods, raising the knives and giving the grass plants a little more leaf area has a tendency to strengthen them.

Here in a nutshell is the reason why some greenkeepers get poor results from soluble fertilizers. It has been common practice to spread ammonium sulphate over a green mixed in the top-dressing. Amounts from twenty-five to forty pounds of ammonium sulphate are applied to a six or eight thousand foot green. Most all directions say to "water well" when they should advise that when water is applied it should be applied rapidly on a limited area and large quantities used. Speed here is essential and if your green outlet pipe flows less than twenty gallons a minute you are liable to have trouble unless you concentrate the water on a limited area—practically puddling it. Never play a hose over a green or use a single sprinkler when you are wetting down top-dressing containing ammonium sulphate, ammonium phosphate, or urea. Wet thoroughly a small area and move from this space and take another of the same size and get around the green in this way.



Samuel H. Purvis, superintendent at Seaview Country Club, Absecon, N. J., directing the application of fungicide with a Royal Leader giant pump. Mr. Purvis is second from left of picture

In playing a hose or sprinkler over say one-quarter of a green on which has been spread a liberal quantity of the soluble fertilizers, you first make a concentrated solution of the fertilizers which cause the injury noted above. Later when the fertilizer solution has become dilute no further damage occurs.

This brings up the point as to whether the use of ammonium sulphate in top-dressing is a proper method of applying it to greens, and it is the writer's opinion that the use of the top of the green as a dissolving tub is not justified by the results obtained. Such practice has been recommended to greenkeepers in the past because it was the easiest way and required no apparatus.

Furthermore, the writer is convinced that the grass cannot utilize four to six pounds of ammonium sulphate per thousand feet before at least one-half of the fertilizer is washed below the grass roots and into the sub-soil by successive sprinklings. Such applications are a gross wastage of fertilizer.

Proper Method of Applying Fertilizers

It, therefore, follows that the ideal way to apply soluble fertilizers is in the form of a solution of definite strength, and that the solution should be made up before application and not on the surface of the green. Furthermore, that weekly applications of small amounts are preferable to a large dosage once a month. In utilizing the fertilizer in this way the grass plants are fed just what they will consume with a little to spare and are kept continuously vigorous instead of "greening them up" once a month for a week or ten day period.

No one to the writer's knowledge has conducted research to determine the maximum strength of solution in chemicals that can be applied without injury to the grass and the proper strength to achieve best results and it was necessary to search the literature concerning other plants than grass to get an idea of the permissible soluble salt concentration of soil solutions which would not cause injury. In greenhouse practice it is apparently well known that the soil can contain soluble chemicals of the solution concentration of .5 per cent without causing injury to most flowers and vegetables and above that concentration injury commences. It is to be noted that injury is based on concentration of solution of soluble chemicals and has nothing to do with percentage of nitrogen.

The writer arbitrarily adopted a concentration of .25 per cent, i.e. one pound of chemical in fifty gallons of water to be applied to 1000 square feet weekly since this formula would give in ammonium sulphate an amount of approximately one pound of ammonia per thousand feet per month; in urea 2.2 pounds of am-

monia per thousand feet per month, and in ammonium phosphate .8 pound of ammonia and .8 pound of phosphoric acid. Even if half the water of such a solution is soon evaporated, taking into consideration the natural soil moisture and the frequent waterings given a green, it is not likely the soil solution will become concentrated above .5 per cent.

Samuel H. Purvis Pioneers With the Giant Spray Pump

Obviously it would be an expensive job to apply three to four hundred gallons of solution to each green weekly with a spray barrel and Samuel H. Purvis, superintendent of the Seaview Golf Club of Absecon, New Jersey, demonstrated to the writer how it could be done economically. Credit is due him for adopting the first giant size spray rig and applying ammonium sulphate and Semesan in solution by means of it. His machine is a Royal Leader made by the Field Force Pump Company of Elmira, N. Y. and it has given him splendid service. He can get around his course easily in two days and his greens are always in splendid condition. This is remarkable when one considers that the Seaview Club entertains over seven thousand visiting golfers per year and the course is given hard wear. Mr. Purvis never permits his greens to become undernourished and Brown Patch never damages his grass because he always sprays ahead of it.

Special Bean Sprayer of Wilmington Country Club

For the Wilmington Country Club was purchased a Bean Super-Giant Outfit No. 737 (Bean Spray Pump Company, Lansing, Mich.), converted to conform to the writer's specifications. The 400 gallon tank is divided into two tanks of 200 gallons each by means of a partition. Both tanks are agitated with a propeller stirring device. Each tank has a gauge glass mounted on the rear in a small closet and protected from breakage when not in use by a door. The gauge glasses are calibrated to ten gallons. Each tank can be cut off from the pump by means of a valve and the overflow when the pump is running idle is returned to the tank from which the pump is sucking by means of a quickly adjustable piece of hose. A box on top of the rig carries the chemicals which are weighed out on rainy days into cotton bags containing just four pounds each.

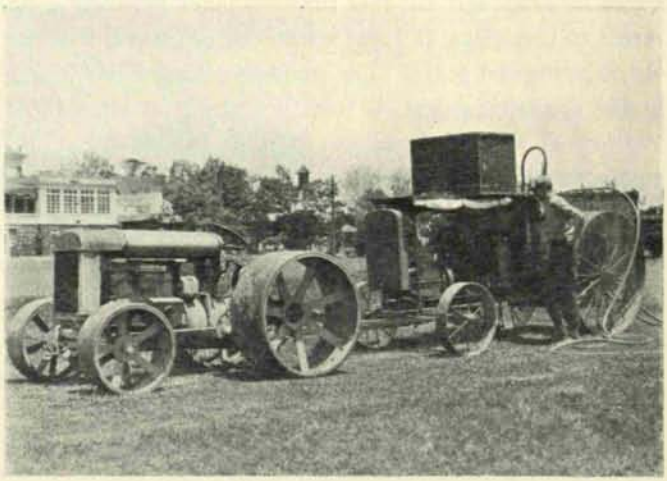
Special broad tired wheels were provided with the machine. The back wheels have ten inch tires and the front wheels six inch tires.

The pump will throw twenty gallons per minute at 300 pounds per square inch pressure on the Boyce spray guns. Two hose lines and two Boyce double bitted guns comprise the spraying equipment.

Spraying Procedure

The machine with one tank filled with solution is moved up to the water outlet near a green and a hose attached to this outlet is inserted through a hole in the top of the empty tank and the water turned on. Three men operate the outfit, a tractor man who looks after the machinery, reads the solution gauges and directs the gunners, and two Boyce gunners. The gunners assisted by the tractor man run out their hose lines and the tractor man turns the valves that allow the pump to throw the solution through the guns. The guns are throttled down until they throw a fine mist. The engine has been running idle for about five minutes. The tractor man now empties a bag of chemical in the tank being filled from the green outlet. The chemical is constantly stirred and dissolves within a minute. The gunners have now sprayed one tank but the other is full. Valves and the overflow line are reversed and the hose stream from the ground outlet turned into the recently emptied tank.

While watching his tank gauge the tractor man moves his gunners over the green and secures remarkably uniform distribution of the solution. The mist from the guns is so fine that they may be turned toward the turf without scoring it in the least and the wetting resembles that of dew.



Fordson tractor and Bean spray pump in use at Wilmington

The greens have been measured and a chart showing the number of gallons for each green hangs on the back of the rig. When the required volume of solution has been sprayed on a green the tractor man shuts off his spray rig engine, starts the tractor engine and off they go for the next green.

They accomplish the spraying of nine greens a day and occasionally give tees and tennis courts a dose.

Urea

At the Wilmington Country Club urea is mainly used with an occasional application of ammo-Phos. Urea has been selected because it is over twice as strong in ammonia as ammonium sulfate and by its use the soluble salt content of the turf may be kept at a minimum. It

gives a response in twenty-four hours after application unless the green is already in the prime of condition. While it is twice as costly per unit of ammonia as ammonium sulfate, nevertheless it is worth the difference. Last year when only top-dressings of a mushroom soil containing ammonium sulfate and top soil were applied to our greens they were in a miserable condition. This year even the "cranks" are congratulating the greenkeeper and the committee on the fine appearance and true playing surface of the greens. There is no room for doubt as to the improvement. The method is a splendid success. No burning is experienced unless a great quantity of solution is applied to one small spot. On hot days the rig is out only in the early morning and evening hours.

Brown-Patch

Brown-Patch is caused by a fungous plant, Rhizoctonia, and this plant is of just as definite a character as the grass itself only of a lower order. No amount of water or sand will kill this fungous plant and one must resort to chemicals of great selectivity to control it without injuring the grass. The greatest selectivity is found in the organic mercurial, Semesan, used by Dr. M. B. Waite and Mr. E. A. Siegler of the United States Department of Agriculture, in controlling Crown Gall which is sometimes called plant cancer. While speaking in glowing terms of Semesan they refer to the inorganic mercury compounds as follows:

> "Mercury compounds are among the most powerful of germicides; but the inorganic compounds, such as corrosive sublimate, are often very injurious to plant life, even in extremely dilute solutions."

Semesan is a necessity on the golf course and it can be most economically applied by means of the power spray rig. It can be used in the same solution with urea if desired.

Because the high pressure spray wets quickly and seeks out every exposed portion of the grass plant, frequently as little as twenty-five gallons of the standard solution (one pound in fifty gallons of water) will be sufficient for each 1,000 square feet of green. This is an additional reason why every golf course should be equipped with a large size power spray outfit.

Top Dressing

Only one top-dressing has been used so far this year on the course of the Wilmington Country Club. It was composed of equal parts Hyper-Humus and good top soil. Mushroom manure has been discarded entirely for greens since it has been found that most of it contains undestroyed weed seeds notably chickweed. It may interest some of the Pennsylvania and New York members to know of the changed composition of mushroom soil produced at Kennett Square, Pa., the largest center of the mushroom industry.

Prior to 1917, twelve parts of good horse manure were mixed with two parts by weight of top soil for composting. Composting was carried out in the boxes inside the mushroom house and the temperature of the fermentation was so high that practically all of the weed seeds were destroyed. After 1917, because it became known that mushroom growing was very profitable, many people hastened to erect houses and get into the business. Manure leaped in price and it became necessary to conserve it. Less and less manure was used in the compost until in 1924 it became standard practice to mix only seven parts of horse manure with two parts of earth in making the compost. Also good top soil became scarce and the growers substituted the clay soil from the farms adjacent to the mushroom houses. Therefore, at the present time only in the top boxes in the mushroom houses is the temperature of the fermentation of the compost sufficiently high to kill the germs of the weed seeds. Mushroom soil cannot be regarded as a fertilizing medium of any great value, only as a humus, since its present analysis is as follows:

Nitrogen as ammonia	.78%
Available Phosphoric Acid (P_2O_5)	.24%
Potash (K_2O)	.51%
Total	1.53%

The Future

The art of maintaining turf progresses due to the free exchange of ideas between those who are engaged in a professional way in keeping our golf courses and the writer heartily welcomes the advent of THE NATIONAL GREENKEEPER. Since Samuel H. Purvis purchased the first large size spraying machine, there have been six or eight such machines sold in the Philadelphia Golf District and it seems probable that the solution method of applying soluble fertilizers will become standard practice in the course of the next few years.

Some top-dressing will always be needed especially on the creeping bent grass types, but it will be used for the purpose of adding humus and to cover roots rather than for fertilization. It must be realized that every chemical which is absorbed by the roots of the grass must first be in a soluble condition and this applies equally to all fertilizers whether they be of organic nature such as cottonseed meal, soy bean meal and poultry manure or salts such as ammonium sulfate and ammonium phosphate.