"golf business" he must "can" all his prejudices and traditions of the ancient and horrible kind. Provided he is willing to do this, he will have a chance to supersede the tradesmen and shopkeepers, whose encroachment upon his original province is becoming more pronounced every day.

The latter-day professional will fall more readily into the line of reform than the old-timer, who has those same traditions more deeply cemented into his make-up, and who in many instances will rather chuck the job than give up his birthright. In short, if the young pro is willing to sink his championship ambitions—and he generally is after a few years of futile effort—and stick to business, financial prosperity should follow. But if he has altruistic leanings, is an ardent lover of the game itself and a devotee of the out-of-doors, and plans to spend a lifetime on the links, he will have to suffer the consequences. While gratifying his desires and having a picnic of a time, he will possibly remain poor in pocket. Even giving lessons, at which many pros persevere with some financial success, is in the long-run hard work for little pay. Golf business pays better.

How and Why of Fairway Fertilization

By O. J. NOER

WHEN thin turf is not tillering and developing a denser sod, either conditions are not favorable for growth or the supply of plant food is not sufficient to support additional turf plants. If the soil is well drained, in good physical condition, plentifully supplied with moisture and free from harmful agents such as grubs, lack of aggressive growth is almost certain to be due to a lack of sufficient available plant food.

The presence of moss is more frequently an indication of impoverishment than a sign of sour or poorly drained soil. Luxuriant clover may be due to insufficient nitrogen if the turf grasses are not growing actively. The bacteria in the nodules or sack on the roots gather nitrogen from the air so the clover is not dependent upon the soil for its nitrogen supply.

The fallacy of extensive reseeding without fertilization should be recognized. How can the new seedlings survive in competition with established plants if the latter are struggling simply to maintain themselves! In the future more fertilizer and less seed will be the order on established fairways.

When to Apply Fertilizer

When once obtained it is easier and cheaper to maintain good turf than to periodically renovate poor fairways. Troublesome weeds do not easily establish themselves when the turf is dense, but become a serious problem where the turf is sparse.

Fertilizers are best applied to fairways in the early spring, early fall or late in the season after active growth ceases, and should never be applied during the hot summer months when turf suffers for want of water. Many clubs prefer late fall applications to early spring. At this time the soil is firm and fairways are not cut up by the distributing machine; the arduous summer work is over and sufficient labor is available to complete the work with dispatch. When growth starts in the spring the turf obtains immediate benefits from the additional plant food.

Plant Food Elements Removed by Turf Grasses

Turf grasses in common with other cultivated crops require only one or more of the plant food elements, nitrogen, phosphoric acid or potash. All soils contain an abundance of the other essential elements.

Freshly cut clippings consist of about 65% water and 35% dry matter. A ton of dry clippings contains approximately 35 pounds nitrogen, 8 pounds phosphoric acid and 25 pounds potash. More than 3500 pounds of dry clippings per acre were obtained from some fertilized plots of blue grass last year. On this basis 60 pounds nitrogen, 12 pounds phosphoric acid and 35 pounds potash were removed from the soil during the year. Usually well fertilized turf contains larger amounts of

plant food than turf grown on impoverished soil, but the above figures probably represent the average amount of plant food removed during a season.

What Plant Food Elements to Apply

Based on composition a fertilizer high in nitrogen and potash seems best, but the plant food content of the soil, and the rate at which insoluble plant food becomes

The endgate type spreader, attached to rear of wagon box. Fertilizer is fed into the hopper by shovel or poured from bags, and spreads by the machine in a fifteen-foot strip.

available must be considered also. Sands are usually low in all three, while sandy loams, loams and heavier soils may be low in nitrogen and phosphoric acid, but are high in potash. Most of these soils, in fact, contain about 15 times more potash than nitrogen and additional potash is rarely needed.

In exhaustively cropped soils the plant food is frequently locked up in very insoluble compounds, and such soils respond markedly to fertilizer applications. A history of previous cropping and manurial treatment serve as a criterion of soil exhaustion. As a rule farmers in the vicinity of large cities anticipate real estate and golf development and have paid little attention to maintaining fertility. Black soils are not necessarily fertile and may even need nitrogen if they have been heavily cropped. The dark colored humus resists further decay and does not yield sufficient available nitrogen. In case of doubt, simple trials will quickly settle the question of fertilizer needs.

The growth of clover is greatly stimulated by the liberal use of phosphoric acid and potash, especially if the soil is not very acid. Hence they should be used with discretion.

A fertilizer relatively high in nitrogen, moderate to low in phosphoric acid and with little or no potash will ordinarily give best results.

Plant Food Losses from Soil

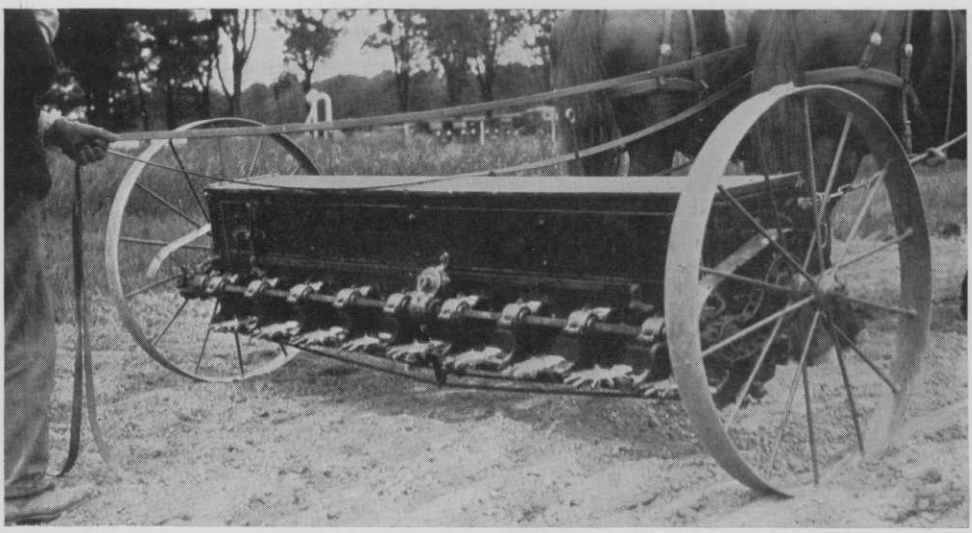
Plant food may be lost from the soil in two ways, either mechanically as a result of surface wash, or as a result of leaching.

Mechanical losses may occur when heavy rains follow immediately after fertilizers are applied, and may be severe on slopes and steep hillsides. The danger is always greatest after a period of dry weather. Moist soil always absorbs water more rapidly than dry soil. Surface run-off is usually greatest following the first rain after a period of drought. It is best to make applications after sufficient rain has fallen to moisten the soil thoroughly.

Losses from leaching occur when excess water passes down through the soil, and, of the three fertilizer elements, are confined to nitrogen. Phosphoric acid and potash are not lost because both are fixed and held by the soil. Sulphate of ammonia and ammo-phos, even the water soluble, are not subject to direct loss. When applied to the soil the ammonia is taken up and held temporarily by the finer soil particles. Most of the nitrogen in organic materials is not soluble in water and is not lost until converted into soluble forms. Only nitrogen in the form of nitrates is subject to loss, but since all other forms of nitrogen are converted to nitrates in the soil, as a result of bacterial activity, the danger of loss exists no matter what the original form of nitrogen applied. During the growing season losses are negligible unless larger amounts of nitrogen, than can be used by the growing turf, are applied. During cold weather when the turf is dormant, bacterial activity in the soil is at a standstill, so there is little danger of loss unless nitrogen in the form of nitrates was applied in the fall.

Sources of Plant Food

Manure has been widely used and greatly prized, but is now difficult to obtain. If of good quality, it contains about 8 pounds nitrogen, 5 pounds phosphoric acid and 10 pounds potash per ton. About one-half the nitrogen and three-quarters of the potash is water soluble. While the actual plant food content is low, the heavy



Thist type of distributor will spread a strip 8 to 10 feet wide at the rate of 400 to 5,000 pounds per acre. Two or more different materials can be mixed in the hopper, an advantage not possessed by the endgate type.

applications usually used supply considerable plant food. Unless thoroughly rotted there is danger of introducing weeds and clover. When heavy applications are made the large amounts of soluble potash may further stimulate clover. The benefits resulting from humus are over emphasized and confused with the extended action of the slowly available insoluble nitrogen. To be of real benefit the humus should be incorporated with the soil and this is only possible before seeding. Fall applications are the rule and in the spring considerable work is necessary to remove trash and other debris. Unless obtained at very low cost other materials can be substituted and, if inteligently used, equally good results obtained.

There are a large number of commercial materials to choose from, which may be divided into groups based on the predominant plant food element and the nature of the material.

Nitrogenous fertilizers are grouped into three classes, namely, organic, ammonia and nitrate, pending on the form of nitrogen.

Organic Materials

Organic fertilizers are waste animal or plant products. The nitrogen content varies considerable and is in organic forms, largely insoluble in water. Before the plant can utilize the nitrogen soil processes must convert it into soluble and available forms. This is a gradual process so nitrogen is released over long periods, and thus the turf is provided with a uniform and continuous supply. Since bacterial action in the soil is at a standstill during the cold winter months, these materials can be applied in the late fall without danger of loss from leaching.

Organic materials are least apt to burn or injure the turf. They differ in this respect, depending upon the rapidity with which they break down in the soil.

Ordinarily a long period elapses before results show because of the breaking down process necessary which takes place in the soil.

Bone meal has been widely used in the past, but is rapidly falling into disfavor. It contains only about 2.25% nitrogen, and is very high in phosphoric acid, usually 27%. The high cost per ton prohibits sufficiently large applications to provide adequate amounts of nitrogen. The large amount of phosphoric acid and the accompanying lime stimulates the growth of clover. Slowly available nitrogen can be supplied better from other materials.

Dried sheep manure is another material of rather low nitrogen content. It contains about 2% nitrogen, 1.25% phosphoric acid and 2% potash. It is an expensive material, if purchased solely as a source of plant food.

Among the higher nitrogen containing

materials are the following: cottonseed meal with 6% nitrogen, poultry manure with 5% and milorganite with 5½% nitrogen. These materials carry up to 2.5 to 3% of phosphoric acid and potash also.

Ammonia Containing Materials

The only two materials of commercial importance are sulphate of ammonia and ammo-phos. The former contains 20% nitrogen (25% ammonia) and the latter 16.4% (20% ammonia). Ammo-phos contains 20% phosphoric acid in addition. Both are water soluble, quick acting, and burn the turf when too heavy applications are made. Since the ammonia is taken up by the soil particles, the nitrogen is held temporarily at least in the shallow surface soil where root development takes place. Because of their quick action it is probably best to confine their use to the growing season, and to make several successive light applications to avoid too heavy initial growth. On fairways a slow continuous growth is preferable to a quick spurt.

Nitrate Containing Materials

The chief nitrate containing fertilizer is nitrate of soda, which contains 16% nitrogen. This is a soluble, quick acting fertilizer which is liable to burn the turf unless applied carefully. The use of nitrate of soda is being discouraged because experimental plots show that it encourages weeds and coarse grasses.

Phosphate Fertilizers

Acid phosphate is the main and cheapest source of phosphoric acid, and is produced by treating rock phosphate with sulphuric acid to convert the insoluble phosphoric acid into a readily available soluble phosphate. There are three grades on the market containing 16, 20 and 45% phosphoric acid. The fertilizer manufacturer uses acid phosphate as the main source of phosphoric acid in mixed fertilizers. When added to the soil the soluble phosphoric acid is precipitated as a finely divided insoluble phosphate, which readily passes into solution again when needed by the plant. Turf is not easily burned or injured even by relatively heavy applications.

The other two main sources of phosphoric acid have been mentioned. namely, bone meal and ammo-phos. Bone meal is a slowly available material and its use presents no advantages over acid phosphate. Ammo-phos is a high grade source of readily available phosphoric acid. Its selection and use must be based on a need for both nitrogen and phosphoric acid.

Potash Materials

The bulk of potash fertilizer comes from Germany and France. Muriate of potash, which is most widely used, contains 50% of potash. While it is water soluble and quick acting, the potash is held by the fine soil particles and is not lost by leaching. Due to its complete solubility there is danger of burning the turf.

Mixed Fertilizers

Manufacturers make up mixtures containing various amounts of plant food, whose value depend not on the price per ton, but on the relative proportion and total amounts of the different plant food elements present. In expressing the plant food content the first figure represents nitrogen, the second phosphoric acid, and the third potash. Thus a 9-7-3 contains 9% nitrogen, 7% phosphoric acid and 3% potash. For fairways, mixtures containing about twice as much nitrogen as phosphoric acid and low amounts of potash are probably best.

How Much Fertilizer to Apply

The amount of fertilizer to apply must depend upon the condition of the turf and soil, and the material used. If the turf is thin, usually the soil is poor also and more fertilizer should be used to encourage heavier growth. When a dense turf is obtained it is simply a case of maintenance and smaller amounts suffice. A 10-ton application of manure supplies about 80 pounds nitrogen, 50 pounds phosphoric acid, and 100 pounds potash. Many of the disappointments attending the use of other materials have been due to the small amounts of plant food, particularly nitrogen, which have been applied, and until reasonable applications are made, disappointments will continue.

A thousand pounds or more of the better organic materials is not unreasonable. As previously stated, sulphate of ammonia and ammo-phos should be applied in several small applications. Because of their higher nitrogen content and complete solubility, the total applications should be smaller.

How to Apply Fertilizers

Fertilizers do not move laterally in the soil, so uniform distribution is important. This is best obtained by the use of a good fertilizer distributer. There are two com-

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does seem like a poor return for the professionals' efforts in popularizing the patented tees. Clubs that make a proper point of the professionals' due of profit on golf accessories as the major part of his income, also are puzzled about the best way to handle the tee purchases.

However, this phase of the matter seems to be handling itself as a number of cases are reported where the clubs started by giving the tees away on too loose a basis and eventually adopted a policy of making the members pay for tees with the pro shop handling all sales. This switch of policy brought up no complaints. With this being the history it looks like the patented tee standardization will be accomplished by a clear saving in maintenance to the golf clubs and an increase in pro business, both being consummations devoutly to be wished.

The How and Why of Fairway Fertilization

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mon types on the market. The two-wheel lime and fertilizer distributer has a hopper which holds about 500 pounds of fertilizer, and spreads the fertilizer in a strip 8 to 10 feet wide. It can be adjusted to sow at rates of 400 to about 500 pounds per acre. The endgate type spreader must be attached to the end of a wagon box as the name implies. One or two revolving discs throw the fertilizer in a strip 15 to 17 feet wide. An extra man is required in the wagon to feed the fertilizer into the spreader.

Uneven distribution of fertilizer produces spotted turf which is evident throughout the entire season and should be carefully avoided.

Good fertilizers uniformly applied will effect marked improvement of poor turf, but a program extending over several years may be necessary to produce a heavy sod. When finally obtained, fertilizer applications every second year are ordinarily sufficient.

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