FERTILIZERS

Something About Their CHARACTER and USE

By O. J. NOER

THE intelligent use of fertilizers promotes the growth of good turf on greens and fairways. Successful turf culture also depends upon an ample supply of water and light, favorable soil conditions, selection of varieties of grasses adapted to local climatic conditions, and protection of the turf from injury. When these are favorable plant feeding becomes the prime factor in turf culture.

Ten different chemical elements are required by plants to make complete growth, and when any one or more is lacking, or deficient, normal growth is not attained. Turf culture is concerned with only three of the ten elements, namely nitrogen, phosphorus and potassium. These are often referred to as ammonia, phosphoric acid and potash. The other seven elements are generally sufficiently abundant to supply plant needs.

The solid substance of the soil is made up of minerals derived from the disintegration of rocks, and organic matter or humus, resulting from the decay of plant and animal residues. Most of the soil nitrogen is stored in the dark colored humus, hence dark colored soils usually contain more nitrogen than light colored soils. Humus also contains some phosphoric acid and potash but the main supply of these elements is derived from the mineral constituents of the soil. Phosphoric acid and potash are most abundant in the small soil particles, silt and clay.

In general, peat and muck soils are high in nitrogen but often low in phosphoric acid and particularly potash. Sands are often low in all three elements, especially nitrogen. Heavy soils, while they usually contain abundant supplies of potash, may be low in phosphoric acid and are usually deficient in nitrogen, especially when turf grasses are grown continuously.

Nitrogen is the most essential element in turf culture, due to its effect upon vegetative growth. Within certain limits the amount of growth is proportional to the amount of nitrogen available. The dark green color associated with rapidly growing foliage is largely the result of an abundance of nitrogen. Hence the need for nitrogen can be judged by the rate of growth and depth of color of foliage.

Phosphoric acid affects seed formation, which is of little interest in turf culture, but it also encourages root formation and development. The young grass seedling must get its food from the soil very early, because the young seed contains very little stored food, hence the presence of ample phosphoric acid is of primary importance in promoting establishment of young grass.

Potash aids in the formation of a class of substances called carbohydrates (sugar, starch, and cellulose). The first two are sources of energy, while cellulose is the substance which makes up the structural portion of the plant.

The growth of clover is stimulated by phosphoric acid and potash, so their use beyond the absolute requirements of the turf grasses is generally discouraged.

Nitrogen Occurrence

Nitrogen occurs in different forms which may be classified into the three following groups:

1. Organic nitrogen is derived from animal and plant residues. The principal sources are, manure, cottonseed meal, dried blood, animal tankage, fish scrap and milorganite. Most organic nitrogen is insoluble in water, and is not available to the plant until broken down into other forms.

2. Ammonia nitrogen is the form of nitrogen in ammonium sulphate and ammonium phosphate. Both are water soluble, and while many plants cannot assimilate ammonia as such, nitrogen in tnis form is readily available.

3. Nitrate nitrogen is the form of nitrogen in nitrate of soda. All nitrates are

water soluble, and nitrogen in this form in preferred by most plants.

While plants prefer nitrate nitrogen, other forms of nitrogen are converted to nitrates by the bacteria of the soil. During decay, organic nitrogen is first converted to ammonia, and the ammonia is then changed to nitrate nitrogen. Soil bacteria can and do convert the ammonia nitrogen of ammonium sulphate and phosphate into nitrate nitrogen. Since decay is necessary, organic nitrogen is usually more slowly available than either ammonia or nitrate nitrogen.

Soluble nitrogen is easily lost from the soil by leaching, and on greens the loss may be serious, due to frequent watering. Organic nitrogen is not so easily lost because the nitrogen must be converted into soluble forms, by soil bacteria, before leaching can take place. By making frequent light applications of soluble nitrogen fertilizers the danger of loss is reduced. A longer feeding of turf can be obtained by using a small amount of ammonium sulphate or phosphate together with an organic material. The immediate needs of the turf are satisfied by the ammonium sulphate or phosphate, and the later needs by a gradual conversion of the organic nitrogen into available form as needed by the plant.

Phosphoric Acid Sources

Bone meal, ammonium phosphate and acid phosphate are the principal sources of phosphoric acid, and of these, bone meal contains the least readily available phosphoric acid. The water soluble phosphoric acid of ammonium phosphate and acid phosphate is not lost from the soil by leaching, because insoluble compounds are formed in the soil.

In non-acid soils lime phosphate is formed but in acid soils iron phosphate is produced, because acid soils are deficient in lime. Iron phosphate is less readily available than lime phosphate, so acid soils often require applications of phosphoric acid. Greens, fertilized continuously with acid producing nitrogenous fertilizers, may eventually require limited applications of phosphoric acid.

Potash Sources

There are two sources of potash, muriate and sulphate of potash, each containing about 50 per cent potash. Both are water soluble and hence readily available for plant use. Potash does not leach from the soil, because any soluble potash applied in fertilizers is absorbed and retained by the finer constituents of the soil.

An understanding of the mechanism whereby plants obtain phosphoric acid and potash is important in the intelligent use of these materials. The insoluble phosphate and potash compounds formed when these materials are applied to the soil in fertilizers are not directly available to the plant. Plant roots can only absorb materials dissolved in the soil water. But there is always a little phosphoric acid and potash dissolved in the soil water, and as the turf removes these materials the supply is replenished by solution of some of the insoluble phosphate or potash. When the turf makes heavy demands, solution must take place rapidly, or the plant suffers. Thus the rate of solution determines whether the turf can satisfy its requirements.

Soluble phosphoric acid and potash, when applied to the soil are fixed in a condition which permits rapid solution whenever the plant makes heavy demands.

Since phosphate and potash fertilizers are quickly fixed in the soil, best results are usually obtained when they are worked down into the region of the soil where maximum root development occurs. Uniform distribution is also important because very little lateral movement of soil water takes place. Soils are so often low in phosphoric acid, that it is well to apply phosphates to new fairways prior to seeding. At this time the phosphate can be worked down into the soil by discing, and since there is no danger of loss by leaching, the added phosphoric acid provides for plant requirements over an extended period.

Soil Reaction

In addition to supplying plant food, fertilizers affect the soil reaction, and may tend to make the soil either more or less acid. Since an acid reaction discourages the growth of clover and weeds, fertilizers which promote acidity are preferred. Nitrogenous fertilizers affect the soil differently, nitrate of soda decreases soil acidity, ammonium sulphate and ammonium phosphate increase acidity, while dried blood and activated sludge have but little effect on the reaction.

When nitrate of soda is applied to the soil, the nitrogen is used by the plant and the soda is left in a form capable of neutralizing any acid already existing in the soil.

While the plant also uses the nitrogen of ammonium sulphate and phosphate the residue left in the soil is acid in character. Bone meal tends to decrease acidity because of the lime contained in the mineral portion. Acid phosphate also decreases the acidity of acid soils. In the formation of iron phosphate, previously referred to, the small amount of lime contained in the acid phosphate is released in a form capable of neutralizing the acid in the soil. Acid phosphate has less effect on soil reaction than bone meal, because it contains less lime. Potassium fertilizers increase soluble soil acidity. This is because the residue left, after potassium is taken up by the clay, has acid properties.

Acid producing fertilizers are now generally used on greens, but some factors connected with their use are often overlooked. Heavy soils in particular, possess a remarkable power of resistance to change of reaction and as a consequence repeated applications are necessary to produce the desired results. Sandy soils are more easily changed. The soil or sand used in top-dressing mixtures often contains sufficient lime carbonate to easily overcome the acid producing power of any fertilizer used. Manure contains considerable lime, and when used in large quantities in top-dressing mixtures, tends to decrease soil acidity.

Making Cotton Seed Hull Greens at Parris Island

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CINDERS make the best foundation for cotton seed hull greens. They grip the cotton seed hulls and prevent the green from wrinkling when rolled. Greens can be contoured or stepped at a steeper angle than grass greens. Our greens are all elevated at least a foot in the rear to help hold a pitch; some are made with two steps, some with one and some plain. Those that have two steps are elevated eighteen inches. Where drainage is very good, the front of the green may merge into the fairway. Where the drainage is not good, it is better to make a four inch step so that all the green will be elevated. After a heavy rain our greens are ready for play within twenty-four hours. They are at their very best after a light rain or sprinkling. Greens may be made fast by constant rolling, or slowed by light sprinkling. Greens are usually made sixty feet in diameter, the front half consisting of a rectangle sixty feet wide and thirty feet deep, the rear half is a half-circle, thirty foot radius.

All cinders are screened through a quarter-inch screen. The cinders that will not pass the screen are used for the bottom layer. This foundation is laid true to the final shape of the green, then rolled with a two hundred pound roller, scattered and re-rolled. It must be packed hard. Next, place two by four inch lumber to make forms fifteen feet wide and two lengths of the green, in the same manner as forms would be laid for a four inch concrete floor. These forms are then filled with the fine cinders, raked and screened with a straight edge across the top of the forms. We leave about a two foot section between the forms and fill and level after the forms are removed. Steps are shaped by hand. This layer is then rolled with a fifty pound roller until footprints will hardly show. This rolling and packing of the cinder foundation is one of the secrets of a good finished green. The green is now ready for the cotton seed hulls.

Forms are again laid, using the two by fours flat. Hulls are distributed and raked and screened so as to make an even layer two inches thick. Forms are removed and the green rolled with a fifty pound roller. Small sections are rolled at a time, care being taken not to step on the unrolled hulls. Men should wear shoes without heels. The green is then sprinkled and re-rolled. This process is repeated again and again. We usually roll a green for three hours the first day, then for two hours a day for a week. Keep the green moist all the time, but not wet enough to pick up the hulls on the roller. The green can be played on after the first week, but needs about a month to reach its best condition. After the first week, use a roller weighing one hundred and fifty pounds until the green reaches good putting condition, then use the fifty pound roller for maintenance.

Greens made as above will hold a pitch shot as well as a good grass green. A pitch shot will take a divot from the green, but this can easily be replaced and firmed with the foot.