How Soil Acidity and Related Factors Affect Turf

(Second of a Series on Chemisty of Acid Soils)

By O. J. NOER

Soil acidity has two principal effects on grasses and other plants. One is the direct influence upon growth. The other is indirect and related to the soil supply of calcium, and occasionally of magnesium.

Plants usually grow best in the range pH 6 to 8. Many can withstand a considerable variation and will grow in soil which is acid or alkaline. Others tolerate very small variations with the optimum at or near neutrality, some preferring slight alkalinity and others slight acidity. There are a few acid-loving plants requiring a soil more acid than pH 6.0.

The white potato is an example of a plant capable of growing under a wide range of pH. It thrives in soils which are acid or alkaline, but commercial growers prefer an acid soil of pH 5.2, or slightly lower to prevent scab. Control is obtained because the potato will grow in an acid range which the scab producing microorganism cannot tolerate.

Sweet clover and alfalfa are examples of plants requiring a neutral or alkaline reaction for maximum growth. Soy beans and some other legumes can withstand considerable acidity. White clover tolerates more acidity than is generally supposed, especially some of the native wild strains. This is the reason why clover is often troublesome on soils presumably too acid to prevent its growth. Plants requiring an acid medium are small in number. Blueberries, azaleas, gardenias, rhododendrons and camellias are the principal ones.

Kentucky blue grass thrives on the limestone soils of Kentucky, and is the classic example among grasses of a lime-loving plant. It will not tolerate marked acidity and grows best in soils which have a reaction of pH 6.0 or above. Canada blue grass withstands somewhat more acidity, and a lower level of fertility. The rye grasses, either domestic, Italian or perennial do best at or near neutrality. The fescues and the bent grasses grow over a wide range of reaction and will tolerate more acidity than the blue grasses or rye grasses.

Bermuda grass in the south can grow in an acid or alkaline medium, but responds markedly to the use of lime when the soil is moderate to strongly acid. Carpet grass is less tolerant of acidity and needs lime when grown in acid soil. Another southern grass called centipede is an example of a grass which requires an acid medium. When limed heavily, or grown on an alkaline soil, centipede turf has a yellow chlorotic color. Spraying with iron sulfate temporarily restores the normal green color. Apparently this grass cannot obtain an adequate amount of iron from the soil unless it is acid in reaction.

Bents O. K. on Alkaline Soil

The belief still persists that the bent grasses require an acid soil for best growth. Many greens in the midwest contain large amounts of free lime, due to limestone particles introduced with the sand used in the topdressing. The creeping bent turf on most of these greens is especially good despite an alkaline soil reaction of pH 7.5 or higher. It would be futile to lower the reaction to pH 6.5 or less, by the use of ammonium sulfate, aluminum sulfate or by applications of sulphur. The amounts needed would introduce more serious complications than the one of high pH. Slight acidity in the range of pH 6 to 6.5 is desirable to help curb clover and weeds. It is not the sole answer to their elimination.

Fescue persists on soil which is too acid to support Kentucky blue grass. Yet swards of pure fescue turf are rare and seldom encountered except in isolated instances in the northerly belt extending from New England across to Northern Michigan and Wisconsin. It is usually found on the lighter soils of moderate to low fertility. Elsewhere, there is the occasional golf course with more or less fescue in the roughs, otherwise it is scarce and is usually confined to dry shady spots. Making the soil acid is not the only answer to the secret of keeping fescue in pure stand. Fescue cannot withstand the competition of more aggressive grasses, notably Kentucky blue grass or the creeping bents unless conditions are made unfavorable for the aggressive ones, and yet remain satisfactory for fescue. A program of heavy liming along with the generous use of phosphate and moderate amounts of nitrogen will enable Kentucky blue grass to overcome fescue and take possession.

Until recent years it was common practice to use creeping red fescue on greens. The fescue was seeded alone or along with south german mixed bent grass. Mowing equipment and water systems were less efficient then than now. The fescue persisted because of higher cutting, the use of minimum quantities of water and possibly lower rates of nitrogen fertilization.

A few golfers still bemoan the loss of fescue greens and crave for their return. The desire is wishful thinking and probably unattainable without reverting to practices which most players would not tolerate. Modern putting green turf is better than the fescue of several generations ago, if golf scores are a true measure of turf conditions.

Bents Thrive In Fairways

The bent grasses resemble fescue in respect to their ability to withstand considerable acidity and to require less phosphorus than Kentucky blue grass, but the bent grasses use much more nitrogen than fescue and respond to water more than any other grass. Nobody has yet succeeded in retaining fescue on watered fairways, or of keeping a pure stand of Kentucky blue grass. The bent grasses eventually predominate on properly fertilized and generously watered fairways. Poa annua, clover and knotweed take possession on under-fertilized close cut, heavily watered courses.

Instances where the acidity is just beyond the range of plant tolerance is quite common in agriculture. The degree of acidity may vary in the same field. Then growth of the crop is spotty and very unequal, due to differences in acidity and its effect upon the other soil factors. This characteristic uneven effect on growth is a considerable help in diagnosing incipient acidity. No other factor causes such a patchy appearance in the field.

Occasionally fairways vary rather widely in reaction. There have been several notable examples in northern Ohio. The turf in the localized spots of stronger acidity was poorer and was the first to show the effects of drought. Liming improved the quality of turf and its ability to withstand dry weather.

Excess Acid Retards Roots

Excessive soil acidity produces poor root systems, but is not the only reason for shallow roots. Healthy plants have an extensive and well branched root system with many fine rootlets. The roots themselves are fibrous and white in color. But in soils which are too acid, the root system is shallow and restricted. Rootlets are scarce or absent and the roots are often brownish in color. An illustration in "Soil Conditions and Plant Growth" by Sir E. J. Russell, depicts the relation between soil reaction and root structure very graphically. A legume was grown in a soil of pH 6, with an intervening layer of very strongly acid soil having a reaction of pH3. There were no rootlets in the strongly acid zone; roots were few in number and brownish in color. Those above and below, growing at pH 6, were much branched, with numerous fine rootlets and were white in color.

The sward of turf on strongly acid soil is frequently heavily matted. There is an accumulation of undecomposed stems, leaves and roots at or near the surface, with a partially decayed peat-like layer underneath. These layers develop because of reduced earthworm activity and because the soil micro-organisms responsible for decay of organic matter do not function effectively in an acid soil. Matted turf rots during periods of excessive rains; it drys out badly during drought due to meager root systems because the roots stay near the surface to obtain essential oxygen from the air. After the turf dies, it is almost impossible to establish grass in the dead debris by seeding. The planted seed germinates but the young seedlings die almost immediately. The best method is to rake out the dead grass and level the surface with good soil before seeding.

Soil reaction has a direct effect upon the soil population of worms, fungi and bacteria. Earthworms are less in evidence and less troublesome in acid than in non-acid soil. Fungi develop over a wide range and are more numerous in acid soil. There have been instances where dollarspot and brownpatch have been aggravated by excessive soil acidity and have lessened by the judicious use of lime. Most soil bacteria prefer a reaction near the neutral point. This is especially true of the nitrifying organisms which convert ammonia into nitrates.

Marked acidity has an adverse effect upon the physical condition of loams and heavier soils. The pore space is less extensive and the soil is more impervious to the absorption and movement of water. The minute silt and clay particles have colloidal properties. When they are acid, or in the form of sodium salts, the mineral soil particles exist as separate individuals, but when combined with calcium, the clay and silt particles group themselves into granules and are held together by the soil humus. These compound granules retain the desirable colloidal properties of silt and clay, but act like sand particles in their effect upon the physical properties of the soil.

The availability of phosphoric acid is reduced by soil acidity. Truog puts the critical point at pH 6.2. When soil is more acid, the phosphoric acid becomes less mobile. Strongly acid soil contains very little calcium and magnesium in forms which can combine with the soluble phosphoric acid of applied phosphate fertilizers. Then the phosphoric acid is precipitated as relatively insoluble aluminum and iron phosphate rather than as the more available calcium and magnesium phosphates.

Strong acidity increases the solubility of the so-called basic elements such as manganese, copper, lead etc. Copper poisoning was prevalent during the acid era when bordeaux was tried for disease control due to the solvent action of the acids resulting from the excessive use of ammonium sulfate. Copper toxicity can be reduced by applying lime to precipitate the soluble copper as an insoluble compound.

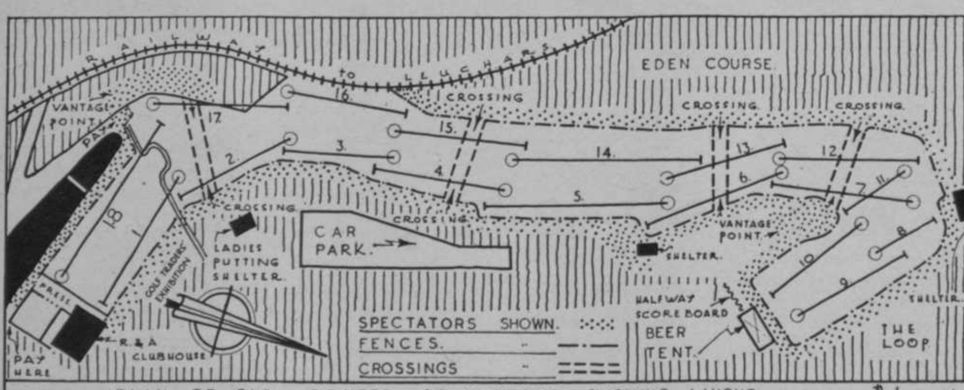
Results of Excess Lime

The excessive use of lime, particularly in the form of hydrate, occasionally depresses growth of grass and other plants. It is because the lime makes all the trace elements such as iron, manganese, copper etc. insoluble and hence unavailable. Even phosphoric acid is less mobile in the presence of excessive amounts of lime.

But the other extreme of excessive acidity may cause a lack of calcium, and sometimes of magnesium in amounts adequate for growth and is believed to be the reason for the failure of plants to behave normally in acid soil. To support this contention there are instances when plants tolerate more acidity provided there is sufficient calcium in the soil. But a condition is reached eventually when the acidity becomes too strong for the plant.

The fad for dosing turf with ammonium sulfate to produce an acid soil for the control of clover and weeds was short lived. It lasted less than a decade. Emphasis now is placed upon practices which produce and maintain a dense heavy turf. The value of lime, even for the acid tolerant bents is recognized and the necessity for using it is stressed not only because of the direct effect upon the plant, but because of other essential benefits upon the physical, chemical and biological properties of the soil.

The concluding article of this series will discuss the practical aspects of lime and its application to turf.



Spectators are to be kept on the "side lines" at the Spalding Tournament, 5th to 7th June and the Open Championship, 1st to 5th July.

The plan shows you where spectators can watch the play

Diagram from Golf Monthly, Edinburgh, shows how St. Andrews arranged to keep spectators on side lines during Spalding tournament in June and British Open in June. German PWs, working under Andrew Corstorphine, head gkpr., cut spectator path through whins which separate Old Course from the New. Pathways are laid out to provide maximum view of play, with hillocks forming natural grandstands. Spectators follow a one-way traffic system, kept off fairways by stake and rope fence. Marshals allow spectators to cross course behind players, at points shown on map. Admission fee for the British Open was approximately 96 cents.

Greens and tees were judiciously roped off at U. S. Open at Canterbury by Golf Supervisor Jack Way and Gkpr. Mal McLaren and marshaling was done probably better than at any other U. S. major championship. Nevertheless, crowd surging in too close to a drive caused Nelson's caddie to kick ball after elbowing through the pack and brought the penalty that beat Byron out of the title.

Bleachers at eighteenth and ninth greens have not provided satisfactory answer for spectator problem at U. S. tournaments. The St. Andrews idea may inspire further effective study of crowd control.