Soil Conditions Show Need For Aeration Program

Physical soil conditions affecting plant growth are being accorded recognition equal to that given to chemical factors. This is as it should be, for it is not possible to draw a sharp line between physical and chemical influences. Plant nutrition depends upon air as well as upon a proper balance of chemicals in the soil. Even soil fertility isn't just a chemical condition because the amount of available plant food depends upon the physical condition of the soil.

Desirable physical conditions include good drainage and porous soil structure. Good aeration results from proper drainage and loose soil, all of which sounds quite easy to achieve and maintain, but this is not so. It is not easy for the greenkeeping superintendent to maintain conditions of good aeration. For obvious reasons the problems in maintaining adequate aeration where soil is covered by sod are much greater than where less dense vegetation is grown. Last year's plant residues can't be plowed under, and undecomposed roots and creeping stems tend to form an airproof thatch at the surface of the ground. During some seasons excessive rainfall compacts the soil, causing poor circulation of air. On the golf course these conditions may be aggravated by heavy traffic and the necessary use of equipment while the soil is too wet.

Good Aeration Conditions

Excessive rainfall, the close growing habit of grass and heavy traffic are unpreventable factors which cause poor aeration. However, the greenkeeping superintendent can minimize this damage by providing conditions which contribute to good aeration. Construction that provides proper drainage, improvement of soil by the addition of coarse textured materials and mechanical loosening of the soil by forking, discing or aerifying, all help to provide desirable conditions. Good drainage improves aeration by carrying away excess water and letting the pores between soil particles become filled with air instead of water. Even so, the upper soil layer containing plant roots tends to become compacted by rainfall and traffic unless a program to combat the condition is followed.

It's a debatable question whether the physical effects of aeration are due to the presence of air or to the absence of water. Growth begins earlier in the spring in well-drained, well-aerated soils because air warms up more readily than water. Heaving is less severe in well-aerated soil than in water logged soil. When an excessive amount of water freezes in the soil, it lifts up the sod just as frozen milk lifts the cap off the bottle. Fungus growth is favored by dampness, so grass grown in well-aerated soil is less likely to be injured by disease. Because of these things, a soil aeration program carried out in the fall makes for a better golf course in the spring.

Root Growth Affected

Plants survive dry spells much better if soil is well-aerated. A deep layer of loose soil encourages the extensive root system that enables plants to live through periods of drought. Any available water readily penetrates down through the loose, porous structure of well-aerated soil and the grass greens up quickly after a rain.

The effects of aeration on root growth are striking. The increased root growth is partly due to mechanical loosening of the soil which also permits fertilizer to penetrate to the root zone. The presence of oxygen is also necessary for plant roots as has been demonstrated by water cultures. In this type of culture, plant foods are present in the solutions, and the vigorous growth which occurs in aerated solutions indicates the importance of an adequate supply of oxygen. Both plant foods and ample aeration are needed in order for plants to secure nourishment.

Perhaps the most important, and surely the least discussed, aspect of aeration is its effect upon the chemical and biological activities that take place in the soil. That is, the processes brought about by the soil microorganisms. Well-aerated soil is soil considered to be in a good, healthy condition. It's not so much that air tends to purify, but rather that air encourages the scavenger work of the microorganisms. Dead plant tissues serve as food for some of the organisms which live only in the presence of oxygen.

The presence of these invisible organisms in well aerated soil makes it possible to convert food chemicals into forms which can be readily absorbed by the roots of the grass and other small plants.

Well-aerated soil is productive soil, also due to the presence of microorganisms. They convert nutrient chemicals into forms available to higher plants.

Not all the soil microorganisms are bacteria, but a good number of them are. Bacteria are single cell plant organisms which contain no chlorophyll. When conditions are favorable they reproduce very rapidly by simply splitting into two parts, each of which grows into a complete organism.

Effect of Decaying Matter

The decay of organic matter, the conversion of its nitrogen into simple ammonia compounds, and the further transformation of these compounds into nitrites and nitrates is probably one of the best examples of the known work of the soil microorganisms. The names of the microorganisms, which after all were merely pinned on them by man, are unimportant. It is the processes by which they maintain soil sanitation and fertility essential to the higher forms of plant life that are of interest to us.

It is not to be inferred that all microbial activity in the soil is of a beneficial nature. Although soil microorganisms cause decay and nitrification, soil microorganisms also cause putrefaction and denitrification. Both beneficial and detrimental organisms require warm temperatures and derive food from organic matter or simple inorganic compounds. The rate of aeration is the chief factor determining whether desirable or undesirable microorganisms will function in the soil.

Importance of Air

To understand why air is so important it is necessary to consider the nature of the chemical activities which take place. Decay is the chemical process called oxidation (which simply means combining elements or compounds with oxygen). Simple ammonia compounds are transformed into nitrites by oxidation. And it is the oxidation of nitrites that yields nitrates. Oxygen from air is essential for these oxidation processes brought about by soil microorganisms. Clay and even loam soils tend to become too compact for nitrification to take place as rapidly as is desirable, unless the soil is mechanically loosened from time to time. Nitrification is especially slow in soil covered by sod.

In the absence of adequate aeration, putrefaction, or decomposition of organic matter takes place. In this process decomposition is incomplete and certain offensive smelling compounds which are resistant to further decomposition are formed. None of these compounds can be utilized by higher plants, and many are actually poisonous.

A limited supply of oxygen encourages denitrification. When oxygen is deficient, anaerobic microorganisms compete with the higher plants for available nitrates. These microorganisms reduce nitrates to nitrites, and then to ammonia and gaseous nitrogen, which is lost into the air. Poor aeration can cause the denitrification of fertilizer.

The oxidation of simple sulfur compounds into sulfates which are available to higher plants is brought about by soil microorganisms. The process is similar to the nitrification cycle.

The assimilation of nitrogen from the atmosphere is usually associated with the bacteria that attach themselves to the roots of legumes. However, there are unattached nitrogen fixers at work in the soil. Attached and unattached nitrogen fixers are aerobic and are found in soil and sewage.

Soil microorganisms also produce organic acids and carbon dioxide which have a solvent action on soil minerals. Some organisms increase the solubility of phosphates. Others make minute quantities of certain nutrient elements available for higher plants. The fact that applied chemicals don't tend to be retained or accumulate to an extent where they might be poisonous to plants is believed partly due to the activities of microorganisms.

Excessive acidity or a low content of organic matter, as well as poor aeration, will reduce the number and activity of soil organisms. However, even under unfavorable conditions, microorganisms don't disappear from the soil altogether; they just go on a sit-down strike. They are in the soil and ready to resume work as soon as good working conditions are provided, therefore the need to be ever alert to the requirements of the soil and cognizant of the benefits that can be derived from proper aeration.

Greenkeepers Annual Tourney; Medinah, Chicago, Oct. 4-5

National Greenkeeping Supts.' Assn. will hold their annual golf tournament at Medinah (Ill.) CC, Oct. 4 and 5. The greenkeepers expect a large field for their annual championship and the numerous sub-championship flights. They'll play the Medinah course on which the 1949 National Open will be played for the first time the top event of golf has been in the Chicago district since 1933 when Johnny Goodman nosed out Ralph Guldahl at North Shore CC.

Ray Gerber, 865 Hillside ave., Glen Ellyn, Ill., is chmn., championship committee. Entry blanks may be secured from him.