Why Aerifying Has Become Standard Practice

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(Paper at Pennsylvania Academy of Science)

When we speak of aerification of soils we refer specifically to the cultivation of soil under permanent sod. The term has come into use rather recently because it is only recently that tools have been designed for the specialized work of cultivating soil under sod.

Aerification or cultivation of soil where row crops are grown has long been practiced. Even primitive farming methods include the use of the crude plow pulled by oxen. Men of the soil have long recognized the need for mechanical loosening of the soil. Early farmers did not know why plowing produced beneficial effects. No studies had been made, no theories advanced, but practical usage demonstrated its importance.

Rational-minded people demand reasons for their activities. Why do we plow soil for row crops? What effects does it produce? We know that rainfall and traffic make a crust on top of the soil and compact the soil beneath the surface. Cultivation breaks up the soil, restores the physical condition. The compact mass of soil is broken into particles. The soil is made open and porous. The porous structure allows water to percolate through the soil; it permits plant foods to move down to plant roots; it provides pore space for the free movement of air through the soil.

Soil Compaction Increases

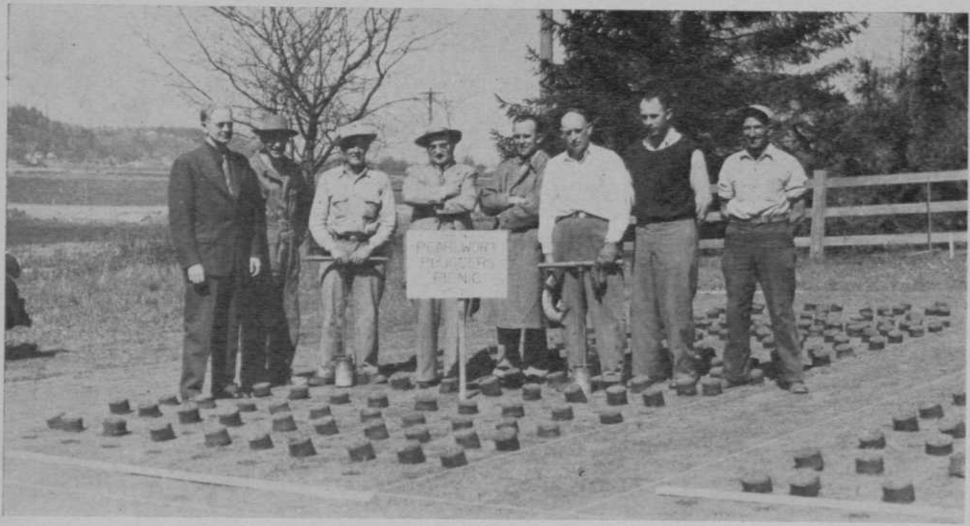
Just as these soil conditions are essential for the growth of row crops, so are they necessary where grass is grown. Lawns, permanent pastures, special purpose turf areas show plainly the increasingly poor quality of the grass as the soil deteriorates. Compaction of soil under turf is a greater problem today than it was in the past. Our modern mechanized equipment is much heavier than the tools used in the past. Efficient irrigation systems allow us to water turf areas so easily that watering often is done to excess. And overwatering is a big factor in causing soil compaction.

The job of loosening soil without destroying the grass cover presents a problem. It is interesting to look back at the evolution of the tools to loosen soil under sod. E. R. Steiniger, Superintendent at Pine Valley GC, has a very complete collection of these tools, collected through the years. The simplest was just nails driven through a board. A similar tool employed sword-like spikes. The hollow-tine fork, imported from England around 1926, came a little closer to the present day concept of aerating tools. Needless to say, all these early tools were slow to use. So spikes were mounted on discs or drums to cover more ground. These were pushed or pulled by one or two men and were mighty strenuous to use. The hollow tined principle also was enlarged upon. Hollow tines were mounted on a hollow drum. The idea was that the hollow tines would remove cores of soil and drop them into the drum, which could be emptied out after use. This did not work out because the hollow tines became clogged with soil.

The next step was toward mechanized tools. One of these was a piston-type machine, with hollow-tines that punched out soil cores as the machine moved forward under its own power. Another method was a drilling machine. These machines required less strenuous labor than the old implements, but they still operated so slowly as to be practical only on limited areas.

The Aerifier was developed to meet the need for a rapid, effective tool to cultivate soil under sod. It was first marketed in 1946. It cultivates by means of curved, open "spoons". The concave spoons remove soil as the full-round hollow tine does, but the open spoons have the advantage that they can't block up with soil. Spoons are curved to minimize tearing as they enter and leave the turf. The spoons are mounted on discs. Larger models are pulled by a tractor; a self-powered model moves forward at comfortable walking speed. Speed is obtained with this type of apparatus. The pasture model Aerifier is equipped with 1½" diameter spoons which cultivate to a maximum depth of 6 inches. Smaller models may be equipped with ½", ¾" or 1" diameter spoons which cultivate to a maximum depth of four inches.

Not only greater speed, but also greater effectiveness is obtained with the new principle. Tools with solid spikes make holes by displacing soil around the spikes. Soil around the holes is compacted even more than before it was spiked. Hollow tines are an improvement in that they make holes by removing cores of soil. However, the straight in and out punching of the holes glazes the walls of the openings. Hollow



"PEARLWORT PLUGGERS' PICNIC"

Members of Northwest Golf Course Supts'. Assn. brought 1120 plugs of pearlwort to experimental station at Puyallup, Wash., and plugged into a station plot the weedy infestation everybody would like to eliminate. The experiment was launched by the group shown above. (L to R) Ivan W. Lee of Ivan W. Lee Equipment Co., Seattle, and pres., Northwest Turf Assn.; Dr. Maynard Grunder, agronomist of Western Washington Experimental station at Puyallup; Louis Smith, asst. supt., Tacoma (Wash.) C&GC; Charles G. Wilson, USGA Green Section; Henry Land, supt., Tacoma (Wash.) C&GC; Glen Proctor, supt., Rainier G&CC, Seattle, Wash., and pres., Northwestern Golf Course Supts. Assn.; and Joe Greco, supt., Brookdale GC, Tacoma, Wash. While Charley Wilson was in the area the Northwest Turf Assn. and the Northwest GCSA held a joint meeting at the Seattle G&CC. The Northwest GCSA now has 35 members and having a busy year with two USGA championships

tines make openings from the surface downward, but the slicked, impervious walls prevent horizontal movement of air and water. The Aerifier spoons are moved forward at the same time they go down into the soil. This provides a "cultivating action" beneath the surface. The open spoons scoop out the soil cores, leaving loose-walled, easily-penetrated openings.

The difference in these types of treatment was shown with wax casts. Openings into soil were made with (1) a drill, (2) a hollow tube and (3) an Aerifier spoon. Melted wax was poured into the openings. Wax in the drilled and punched openings was confined within the slick walls of the cavities. Wax spread out into the loosened soil surrounding the Aerifier cavity.

The practical significance of this is demonstrated by the difference in root growth. One such demonstration was conducted on a putting green at a golf course. Half the green was cultivated by hollow tining. The other half was aerified with the Aerifier. Root growth on the hollow tined side was limited to a slender column of roots confined within the walls of the openings. Extensive roots grew in the Aerifier holes and spread out fanwise in the surrounding soil.

Aerification isn't a cure-all. Naturally, there are many causes of poor turf. Unadapted grasses, low fertility, too much water, disease and insects, poor air drainage — any of these may cause poor turf. But often poor turf is the result of poor physical soil conditions. These are the conditions that can be corrected through aerification.

Samples of the soil profile will reveal whether aerification is the answer. If the soil profile sample reveals heavy soil, compacted at the surface with root growth confined to the surface layer, aerification is needed. A blue color in the soil beneath the surface is caused by poor aeration. In the presence of adequate oxygen, iron in the soil is in the ferric state and gives a red color to the soil. In the absence of adequate oxygen, iron is in the ferrous state, which gives the characteristic blue color to the soil. Again, aerification will make openings to allow oxygen to move into the soil beneath the surface.

A soil profile sample will show if improper mixing of soil is a factor in causing poor turf. In the past, topdressing of plain sand or humus often was used on golf courses and athletic fields. These materials, applied without being worked into the soil, form a layer. Sometimes the layer is near the surface; sometimes subsequent topdressings have buried the layers more deeply. In either case the layer of different textured material causes trouble in the maintenance. Layers interfere with normal capillary movement of water. Roots seldom grow through the layer, so the root system is limited to a small amount of the surface soil. Aerification breaks through the layer so roots can penetrate and, in time, aerifying will mix the layered material into the other soil.

Thatch is another condition that interferes with growth. Stems, roots and clippings sometimes accumulate at the surface of the soil. They form an impermeable roof over the soil, which interferes with penetration of water, plant foods and air. Thatch is an unhealthy condition, too, in that it harbors disease organisms. Aerifying breaks through the thatch allowing fertilizer, water and air to reach the soil. In time, the mixing of soil with the thatched material will cause decomposition of the thatch into soil humus.

Soil samples taken after aerifying show clearly the penetration of water. Moisture spreads rapidly through the loosened soil surrounding the cavity. Increased water absorption is of considerable importance from a practical standpoint. Studies at Penn State indicate that as much as 80% of the applied water may run off sod on compacted soil. What does this mean in dollars and cents? In the 1951 Annual Report of the Detroit District Golf Assn., costs for watering fairways were reported as ranging from $1,000 to $2,000 per season. Golf courses report that water requirements are reduced 20% to 50% by aerification.

After lime or fertilizer has been applied, these chemicals can be found down in the Aerifier holes. In tests with phosphorus, a 56.9% increase in phosphorus in the 2 to 6 inch layer of the soil was found in the aerified plots. Undoubtedly the deeper placement of fertilizer is an important factor affecting the increased root growth noted after aerification.

Does air itself show any effects? A putting green in the Chicago area was aerified one time over and the holes left open. No topdressing or fertilizer was added. When growth began in the spring each spot where the Aerifier had opened the soil was visibly greener than the surrounding grass.

The movement of air into the soil depends primarily upon the amount of large pore spaces. Factors such as temperature, barometric pressure, wind and rainfall play only a minor part in the soil aeration — they account for about 9½% of the total soil aeration. The greatest part of the air moves into the soil by way of diffusion. There is evidence that the natural cracks in soil do not provide adequate ventilation. Man-made openings facilitate the exchange of gases between the soil and the atmosphere.

A further application of aerification is the preparation of a seedbed in existing turf. The surface can be broken up so seed can come in contact with soil, while the existing cover is left intact to prevent erosion and washing. Uniformly good results have been obtained using the Aerifier to prepare a seedbed in existing vegetation.

Although extensive aerification of soil under sod is a recent addition to maintenance procedures, in practical usage its value has been demonstrated. Reduction of water runoff, more efficient use of fertilizer, more extensive root growth, correction of compacted, layered and thatched conditions, preparation of a seedbed are visible effects produced by aerification. Aerification is routine procedure on many special purpose turf areas. There is every reason to believe that equally satisfactory results will be obtained on other grassland areas.

— Mascaro photo

They were at Tifton — the biggest group yet to attend the Georgia turf conference. Behind the group is the partially completed greenhouse for turf research, being constructed with funds supplied by the Georgia State Highway Dept. Glenn Burton spearheads the research work at Tifton.