

as a result of water replacing the soil atmosphere and leaving the roots poorly aerated. When transpiration occurs at a rapid rate in bright sunlight, the combined effect of accelerated water loss with retarded water absorption results in the development of a water deficit in the plant.

There are several reasons why poor aeration and drainage retard water absorption. They slow down the metabolic rate and, conversely, the uptake of nutrients and moisture. Secondly, the poor exchange of gases in the soil could result in an accumulation of CO<sub>2</sub> which appears to increase the viscosity of protoplasm and reduces permeability. This in turn retards water absorption.

Pathogenic turf fungi are promoted under conditions of poor drainage where liberal quantities of moisture are available. Saturated soils and high localized humidity create ideal conditions for their rapid development. Under conditions of prolonged excess moisture, you get a development of soft growth, a low pH, and a state of reduced vigor which facilitates invasion by pathogens.

### **Solving the Existing Problems**

In many cases the only remedy for poor drainage on established greens and tees is reconstruction. Generally, reconstruction is the answer where existing soil has poor texture and structure, or the area lacks surface drainage.

Minor depressions or low areas that hold surface water can be eliminated by stripping off the sod, filling and grading the area and replacing the sod. In northern regions where water collects in depressions when the soil is frozen, tile drains are of no value. Surface drainage is the only answer!

Sandy areas and steep banks around greens and tees tend to dry excessively and require frequent supplemental moisture to maintain satisfactory growth. Aeration and soil conditioners have been effective in reducing runoff and conserving moisture in these areas.

Tile or slit trenches can be used to correct poor drainage caused by impervious subsoils. Drains function on the principle that they can conduct water faster than the surrounding soil. Where a fairway has been constructed on heavy soil that requires uniform drainage over the entire area, a simple gridiron or herringbone pattern of drains will usually remedy the situation. Where tile or slit trenches will not function properly because of high groundwater levels, open ditches or grass waterways would be more suitable. In extensively low and wet areas, relief wells or reservoirs equipped with relief pumps may be the only means of lowering the water table.

Drainage encourages healthy, vigorous growth and reduces management problems. Drainage also keeps the player's feet dry, provides him with firm footing and smooth resilient surfaces for putting. Drainage promotes better overall conditions for both golf and turf.

## *Alexander Joins Green Section*

**D**r. Paul Alexander, recently of Clemson University, Clemson, S. C., has joined the USGA Green Section Staff effective July 1. He will be based in the mid-continent regional office in Chicago with F. Lee Record.

Dr. Alexander received his Bachelor of Science degree from California State Polytechnic College. He later earned a Masters degree and Ph.D. from Ohio State University. Most recently Dr. Alexander served in the Department of Horticulture at Clemson University.

He was actively involved in producing the USGA Green Section movie, "The ABC's of Putting Green Construction," which was filmed at Clemson. He has a smooth golf swing as well as an excellent background in turfgrass management.

