is soil-borne and enters the plant through wounds in the roots. A natural consequence of having a fungus clogging up the water-conducting system is wilting followed by yellowing and dieback. Trees and shrubs showing partial wilt during the growing season may wilt further and die the following year. Others may recover and not wilt in succeeding years. The pattern depends on the extent of root infection and the severity of other stresses. When most of the roots are infected, the tree may wilt and die before the end of the first summer.

Trees showing general and severe wilt cannot be saved and should be replaced with a nonsusceptible species. Trees with some symptoms may be saved or their life prolonged for some time if they are watered, fertilized with nitrogen, and pruned of dead and wilting branches. Pruning does not eliminate the fungus from the tree, but removes weakened limbs which may be infected by other fungi.

**Trees and shrubs susceptible to Verticillium wilt**

- Ash - black, blue, European, green, and white
- Azalea
- Barberry - Japanese
- Boxwood - Korean
- Catalpa
- Cherry
- Coffeetree - Kentucky
- Dogwood
- Elm - American, Chinese, and slippery
- Linden - American and littleleaf
- Locust - black
- Maple - Amur, Norway and varieties, red, silver and sugar
- Oak - pin and red
- Pagoda tree
- Plum
- Rose
- Russian Olive
- Smoke tree
- Sumac - fragrant, smooth, and staghorn
- Viburnum species

The following list of trees and shrubs might serve well as replacements for any trees the fungus kills:

<table>
<thead>
<tr>
<th>Arbovitaes</th>
<th>Juniper</th>
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</thead>
<tbody>
<tr>
<td>Birch</td>
<td>Larch</td>
</tr>
<tr>
<td>Fir</td>
<td>Mountainash</td>
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<tr>
<td>Ginkgo</td>
<td>Oak - white and bur</td>
</tr>
<tr>
<td>Hackberry</td>
<td>Pine</td>
</tr>
<tr>
<td>Hawthorn</td>
<td>Poplar</td>
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<tr>
<td>Hickory</td>
<td>Serviceberry</td>
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<tr>
<td>Honeylocust</td>
<td>Spruce</td>
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<tr>
<td>Hophornbeam</td>
<td>Willow</td>
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</table>
tion principles and cultural practices, we can help assure our proper place at the watering trough. Of greatest importance, however, is a personal commitment from you, the golf course superintendent, to conserve water and use it wisely.

Water conservation principles are simple, don’t take a large investment of time or money to implement, and provide the greatest return on investment. A quick review of your irrigation practices with these principles in mind can provide the greatest savings. Irrigation should be scheduled on need, as indicated by the turfplants, rather than one of common practice. Water supply should match the percolation rate of the soil, meeting the needs of the plant while avoiding excessive runoff. Irrigation should be done at night, deeply and infrequently, as target areas are more easily covered, drift is minimized, and evaporation rates are lower. When was the last time you checked your irrigation system’s operation at night? Can you reduce your irrigation times without any adverse affects? Have you prioritized your irrigation needs? Do you know how much water you use on the course? Apply these basic conservation principles to your course and watch the rewards. This is the second step in developing a new water management philosophy. You must commit yourself to saving water, not abuse the privilege of using it.

Once a commitment to water conservation is established, specific conservation strategies can be put in place. Consider the following practices.

1. Improve your water conservation through education.
2. Change traffic patterns where needed. Reroute golf carts, pedestrian traffic, and equipment traffic patterns.
3. Use mulches around plantings.
4. Erect tree barriers across open areas of land to avoid drying winds.
5. Expand your use of wetting agents and antitranspirants.
6. Investigate soil moisture measuring devices either soil-based (tensiometers, soil resistance blocks), plant-based (canopy temperature devices), or atmosphere-based (ET pans, ET formulas, or weather stations) to aid your water use decisions.
7. Increase the use of drought tolerant grasses where possible.
8. Improve your irrigation system.

IMPROVING YOUR IRRIGATION SYSTEM

Water conservation can be easily accomplished through fine tuning your irrigation system, again at very little cost. The most comprehensive approach would be to install computerized central controllers. These devices can more accurately measure and control the amount of water delivered on site, assuring efficient use of water. Integration of weather satellites, moisture sensors, or evapotranspiration predictors with computerized central controllers can help determine the complete needs of the turfgrass plant. Though the initial expense is high, the cost should be returned through increased water savings, lowered power costs, and better turf.

Other approaches are less expensive, requiring just a few hours of your time. The easiest quick fix is to inspect your irrigation system to make sure it is operating properly. Check and adjust water supply valves to assure proper delivery pressure. Repair leaky pipe, faulty irrigation heads, and mistimed field controller mechanisms. Zone areas with similar soil and contour conditions together. Prioritize your irrigation areas and water accordingly. Try doing with just a little less water on all your irrigated areas. All these can be done at very little expense and at least assure that you are delivering your water efficiently and where you want it. Once the water is where you want it, be sure to add a flow meter to your delivery system so you can measure your conservation efforts and alert yourself to problems. In other words, get the most from your existing system and then try to meet a goal of lowered water consumption.

Another method of conserving water is to develop other supply sources for irrigation purposes. Use of effluent water has become a regular practice in Florida and the Southwestern United States. Secondary or tertiary treated water has no appreciable danger as far as human life and health is concerned. Use of these water sources, however, is limited by supply, location, soil structure, and turfgrass variety. Containment of golf course surface run-off through additional ponding areas or improving the holding capabilities of your irrigation supply pond are also good alternatives to your present source and offer protection in case of system failure.

CULTURAL APPROACHES

The third step to water conservation is through the application of proper cultural practices. Various cultural approaches can be implemented to reduce the amount of water required by your turf plants. The main goal is to improve the general health of the grass plant through enhanced root growth by correcting soil, chemical, or biological properties. The following are some suggested cultural practices which can reduce water needs.

1. Hand syringe rather than program syringe problem areas. Apply a short syringe prior to your main irrigation program to break up hydrophobic soil conditions and aid soil infiltration.
2. Avoid applications of fertilizer and pesticides during stress periods. Practice a fall fertilization program to avoid lush growth during high temperature periods.
3. Increase potassium applications to encourage thicker cell walls and deeper rooting.
4. Use growth regulators wherever possible.
5. Consider applying turf colorants to dormant turf.
6. Increase soil cultivation programs.
7. Try some different mechanical approaches. Reduce the mowing frequency. Raise your height of cut. Remove grooved rollers. Avoid topdressing and vertical mowing. Keep your mowers sharp and well adjusted. In short, reduce the abuse from mechanical equipment and help keep your grassplants healthy.

Western states have been forced to conserve water for years. Water conservation policies are at our doorstep. The wise superintendent will prepare for this eventuality and act. He will correct his deficiencies and develop a new water management philosophy. HOLD BACK THE WATER!