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:

Arborvitae
Birch
Fir
Ginkgo
Hackberry
Hawthorn
Hickory
Honeylocust
Hophornbeam
Juniper
Larch
Mountainash
Oak - white and bur
Pine
Poplar
Serviceberry
Spruce
Willow

OFF THE TOP OF MY HEAD

GREG HUBBARD, CGCS
Editorial Chairman

DEVELOP AN IRRIGATION PHILOSOPHY - HOLD BACK THE WATER!

As last summer's drought taught us, water availability for golf course use has become a hot issue. As temperatures rose and grass plants withered, water resources suddenly dwindled and watering bans were mandated throughout the state. Where demand did not meet the need, bushes and trees, turfgrass, and mental outlooks suffered. Though many courses have now recovered from the short term drought effects, the long term problem of allocating water supplies fairly continues to grow. Suitable water supplies are becoming more scarce and competition for these limited supplies is growing. The lesson of 1988 is that the economics of water use, like that of the oil crisis in the 70's, will demand that we use this precious resource more sparingly and efficiently in the future. As demand outsrips supply, we will be forced to change our water use philosophy. No longer will water be in unlimited supply, readily available for our demands. As ground water reserves and surface water reservoirs become depleted through increased domestic and commercial use, and as pumping costs rise, more pressure will be put on golf courses to reduce their consumption. We will find ourselves at the end of the water main, last in line for this precious commodity. Now is the time to prepare for this eventuality. Now is the time to develop new water management strategies. HOLD BACK THE WATER!

The first step to developing new water management strategies begins with personal commitment, integrating old practices with new ideas. Rather than reacting to short term water supply problems through new wells and improved pumping systems, a long term comprehensive program on both a political and personal level is necessary. Politically, we should attempt to raise our category of water use prioritization to a higher level. Rather than being on the end of the water pipeline, we must actively influence legislative bodies, emphasizing our importance in the local economy over that of our country club image. We must stress our role in fulfilling recreational needs for our ever aging population and for those with more leisure time opportunities. We can also emphasize our importance in the environment, as wild life preserves, air conditioners, and water reservoirs. On a personal level, we must renew our devotion to the basics of turf management. Through the application of proper water conserva-

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!