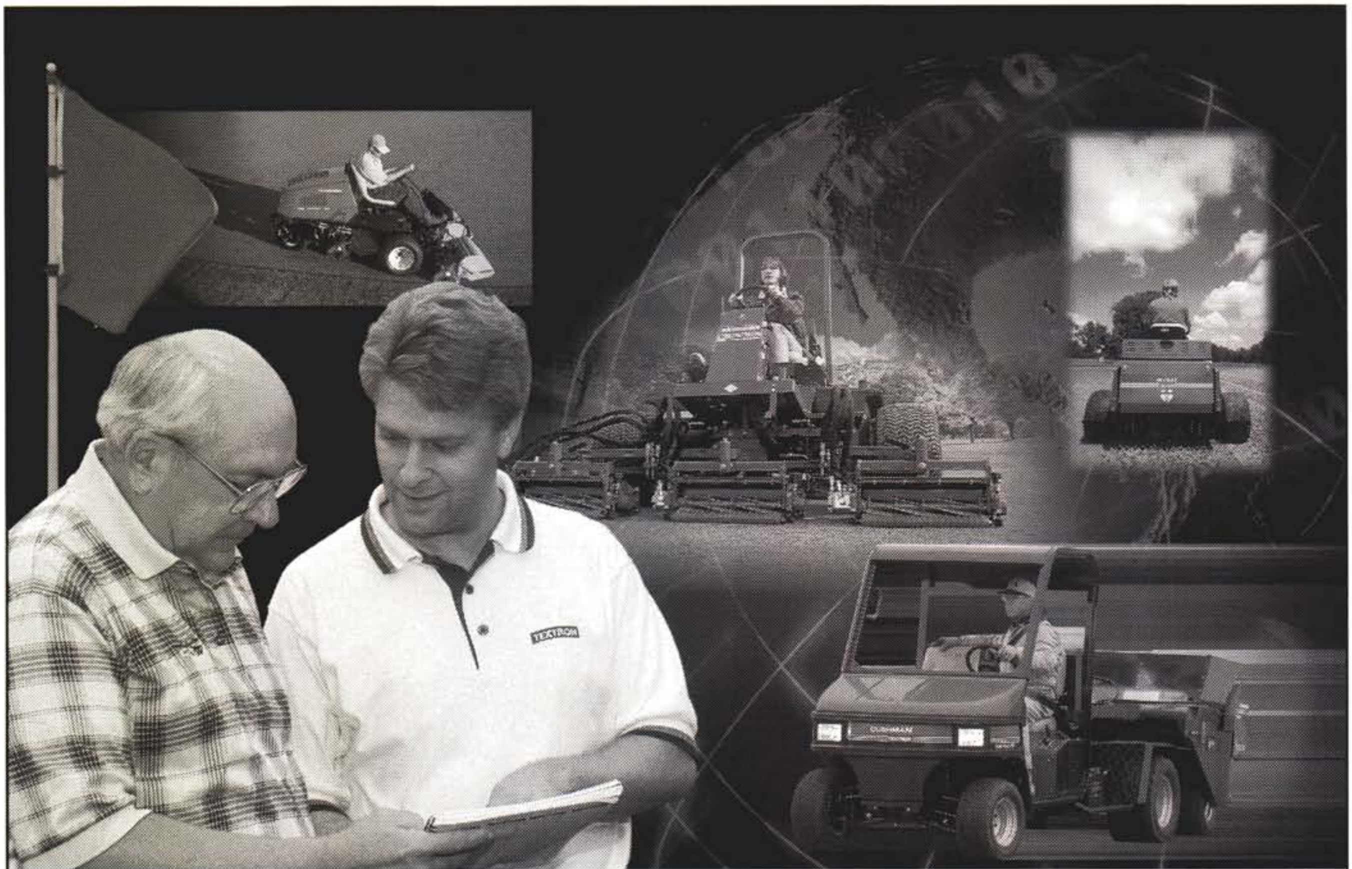
ther enhanced with a 'Site Pro' central controller that was donated by Toro Irrigation and supported by Reinders Irrigation. Actually I had no complaints with the old 'Network 8000' central controller except that our computer was making lots of noises like it was on its last legs. Adam Mock and Craig Reinders assured me that if I liked the 'Network 8000', I'll love 'Site Pro'.

The new land that we anticipate acquiring in 2000 or 2001 is not a 100% sure thing yet, but I'd be willing to bet Pat Norton's sense-of-humor that it will happen. I briefly spoke to one of the head people that will be organizing the transfer of this land who told me that it's just short of a done-deal. He will be working on the land transfer after the first of the year. The land will first transfer from the University of Wisconsin Foundation to the Athletic Department before it can get transferred to Agricultural Research Stations. The person that I'm communicating with is an Athletic Department administrator who happens to be a little preoccupied with a certain football game in Pasadena before he starts working on any land transfers. We are anticipating that it will happen though. Dr. Gary Bubenzer, from the University's Biological Systems Engineering department, had his class survey the new land this fall. That information will help us know the amount of land that has to be shaped to preserve as much research space as possible.

The O.J. Noer Facility is poised to do great things with turfgrass research in 2000. We couldn't do it without the support from the turf industry. Almost every major turf industry supplier in Wisconsin has helped us with donations of equipment, fertilizer, seed, chemicals, consulting and other supplies to lend a hand in supporting the facility which helps produce exceptional turf research. We are so thankful for this support that we hope will continue for many years. With this backing complemented by the new irrigation and land additions, and the many dedicated researchers and staff that are now in place, the Noer Facility will serve the turf industry well into the next century.



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It's A Watery World

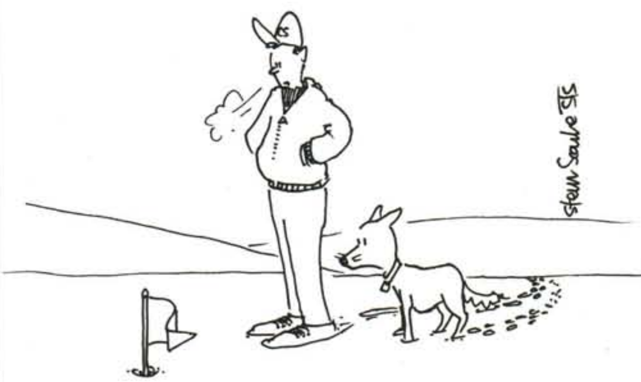
By Dr. Frank S. Rossi, Department of Ornamental Horticulture, Cornell University

Editor's Note: The northeast part of the U.S. experienced dry weather in 1999, suffering through a season that was drier than ours was. Former University of Wisconsin - Madison faculty member Frank Rossi used that event to discuss plant and water relationships in the Volume 10, Number 2 issue of Cornell University Turfgrass Times. *It appears here with permission of the author and the editor (one and the same!).*

In the education profession, we are always in search of a "teachable moment." A teachable moment occurs when the audience you intend to address is experiencing exceptionally good times or really bad times. It is at these times when we have their attention and they are likely to hear your message. This has happened several times in the last decade, especially around environmental issues such as pesticide use. Remember the bird kills associated with insecticide applications in the 1980s? More recently, the industry has become deeply concerned with the gray leaf spot disease that is devastating ryegrasses on golf courses. Gray leaf spot is capable of destroying scores of acres of rough and fairways in a matter of hours! Turf managers can't seem to get enough information about the disease, how it infects and how to control it. From an educator's perspective it is a perfect time to educate people on the basic tenets of pest ecology and plant pathology.

It follows then that the dry weather over the last few seasons that has culminated in the drought of 1999 in the northeast creates an opportunity for an important dialogue concerning a vital natural resource: water. How much do plants need? How best to apply? How to prepare and recover from drought? What if we could not use water any longer for turf management? We have a unique opportunity to discuss weather patterns, hydrology, soil physics and plant physiology. I for one am not going to miss it!

While we in the humid Northeast are discussing water use efficiency and drought stress management, in the arid Southwest, water use efficiency is a way of life. For example, many areas of the Northeast receive 30 to 40 inches of precipitation annually, while regions in the Southwest average between 2 and 12 inches of precipitation. When the most important resource becomes restricted for climatic or regulatory reasons, the turf industry in the Northeast feels the pinch quickly and then focuses on improved efficiency. Again out west, water use is closely monitored and irrigation management is a precisely managed practice with application limits set to keep the plants alive, but not assist with other challenges such as salt accumulation. Therefore, the question remains, what can turf managers do to maximize water use efficiency in a "watery world"? The first step is to understand some basic principles of water in the plant and soil.



"BOY, PUTTER. THAT WAS QUITE A SNOWSTORM WE GOT LAST NIGHT."

A Liquid World

The majority of the earth's surface is covered by water, yet only about 1% is available for human consumption, recreation activities, agricultural production and industrial use combined. Additionally, water is the basis of all things biological. In fact most forms of terrestrial life (life out of the water) survive as a result of complex chemical reactions that function in water.

The water molecule possesses some unique properties that are worth being aware of so that water use efficiency can be maximized. Although water is an electrically neutral molecule (non-ionic), the way the two hydrogen and one oxygen (H2O) elements are organized creates polarity, similar to a magnet where one end is more attractive to metal than the other. Polarity is vital to water movement through the plant-soil continuum. Specifically water polarity allows for association with other molecules (cohesion) or with a solid surface (adhesion) and ultimately determines how much water will penetrate the soil and subsequently be available to the plant. Therefore, under drought conditions, as soils dry, the forces holding the water can be greater than the plant's ability to take it up.

Interestingly, water movement through the plant-soil continuum is driven by simple forces that allow movement from a high concentration to a low concentration. For example on a warm dry day when the relative humidity (a measure of the moisture stored in the air) is low, water is literally pulled from the moist soil, through the plant and into the atmosphere. In fact it is this same pressure that then draws the water in the soil upwards and to the root surface. Comparatively, on warm humid days when the air is filled with water, the movement of water through the plant is limited because the concentration in the air is likely greater than that of the soil or plant. This has important physiological implications that will be discussed further.

Soil Water

The soil has chemical and physical properties that are intimately linked and influence water and nutrient movement and availability. The ability of the soil to aggregate from smaller particles and larger particles "bridging" together creates pores where water (or air) can be stored. Soils with a high clay content and a collection of smaller particles, create very fine pores that hold water very tightly. This is why many fine textured soils do not drain well and the water within the pores allows for the soils to compact more easily. In comparison, sandy soils with a high proportion of particle sizes greater than 0.5 mm (medium to coarse sand) have a greater amount of large pores that drain more easily and are less prone to compaction. What often confuses many turf managers is when they utilize sand as a growing medium or a topdressing on fields and the sand is very fine. Many fine sands, especially when improperly amended with organic sources such as peat or compost can compact to an equal degree as a clay.

Porosity that results from the structure of the soil allows for air, water and nutrient dynamics. Each of these components fluctuate regularly throughout the soil profile. When soils dry the pores have literally exchanged the water with air. When smaller pores fill with air they can also be difficult to re-wet. This also happens on many sand-based greens that are regularly allowed to dry out for tournaments. Localized Dry Spots (LDS) occur when the sand grains become coated with organic acids that are thought to be a by-product of organic matter decomposition. LDS creates a hydrophobic situation where the adhesive force, between the water and the soil particles, is less than the cohesive force between the water molecules. As a result the water is repelled. In droughty years the LDS condition can worsen as a result of the regular reliance on irrigation systems that may not have uniform coverage. Ironically, even when the water is eventually applied, it is repelled by the air filled pores in fine textured soils or the hydrophobic surfaces of sand particles.

Plant Water

As mentioned previously, water is the substrate for many biological reactions. It follows then that green plants, such as turfgrasses, require water for chemical reactions. However, water also serves an important cooling function as it passes through the plant from soil on its way to the atmosphere in a process known as transpiration. This cooling is essential for the plant to maintain internal function. If the turfgrass canopy temperature rises and the transpiration is slowed, as it is on warm humid days when the air is filled with water, the plants experience heat stress.

Water loss from a turfgrass community is characterized as evapotranspiration (ET). ET is the total amount of water lost from evaporation from the soil surface and transpirational water from the plant surface. In most turfgrass situation, ET is almost entirely from transpiration as most of the soil surface is covered by vegetation. In fact, the measure of ET is where the recommendation to apply 1 inch of water per week is derived. On average, throughout the season in many parts of the country approximately 1 inch of water is lost via ET.

What seems as a simple "flow through" process with water passing from the soil through the plant into the atmosphere, is actually highly regulated within the plant. On a simple level, the pores in the leaf surface, known as stomates, are created by cells that are regulated by molecules that cause swelling and shrinking. The swelling and shrinking of these cells causes the pores to open and close, thereby regulating water loss. Additionally, a more complex process occurs under dry conditions. For example, as the soil dries, roots send chemical signals upwards to the region where growth occurs. These chemical signals are hormones, specifically abscisic acid (ABA). ABA triggers a reduction in leaf growth so that the plant can conserve water. ABA is a critical survival element for many environmental stresses such as drought and cold.

Specific Differences

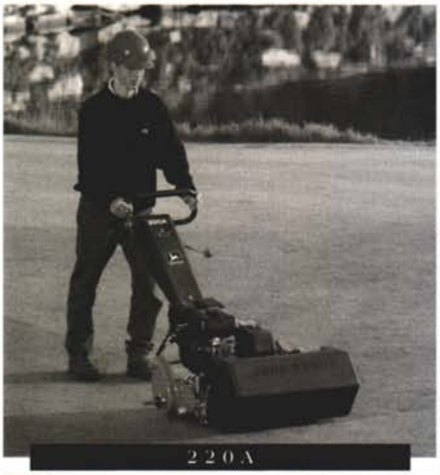
Turfgrass species and cultivars vary widely in their water use and ability to tolerate drought conditions. Studies have indicated that cool season grasses use about three times the amount of water than warm season grasses to produce a gram of dry matter. Interestingly, cool season grasses experienced a 29% increase in water use when grown in a dry climate as compared to humid conditions. Warm season grasses experienced a slightly larger 35% increase in water use when dry and humid conditions are compared. Therefore, it is not only "who" you are in the turfgrass world, but more importantly it is "where" you are. Obviously, this has important implications as we strive to use turfgrasses outside of their normal climatic adaptation.

Essentially when it comes to discussing the turfgrasses aspects of water management it comes down to two major issues: ability to produce deep rooting and consumptive water. use. As breeders strive to develop more drought tolerant varieties, there are many traits that influence stress tolerance and to be sure it is under strict genetic control. Yet, ultimately a plant that can produce a deep root system and can down-regulate water use will be a significant improvement.

Currently, when selecting a turfgrass variety, knowledge of climatic conditions is essential. Recent research has indicated that Kentucky bluegrass varieties demonstrate different water use requirements depending on the humidity level, just as much as the species differential discussed previously. For example, under humid conditions one bluegrass variety has a very conservative water use rate, yet under dry conditions, the same conservative variety has a much higher consumptive water use rate as compared to other varieties.

The Biological End

The turfgrass manager who does not have at least a modest understanding of simple biological principles is likely to become frustrated with the current drought conditions. However, by understanding some simple concepts, one realizes how very little control we currently have over the turf's ability to survive when conditions become harsh. The process of improving the "biological end" of water issues is complex and only recently understood at the level that we might influence with genetic engineering. There are still important management implications from the "delivery end" where management (mowing and fertility) as well as water quality and application uniformity significantly influence performance.



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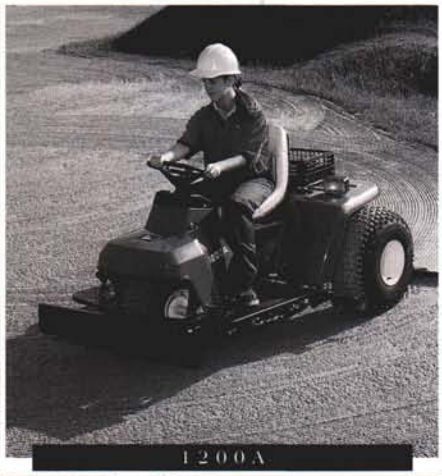

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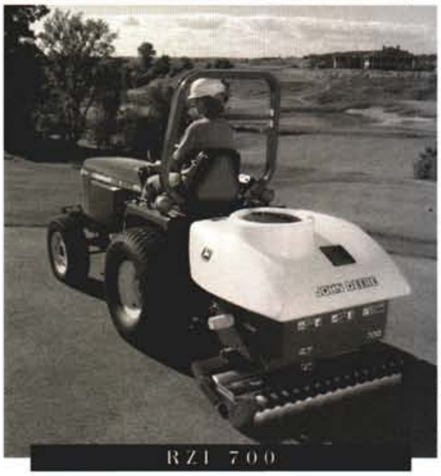

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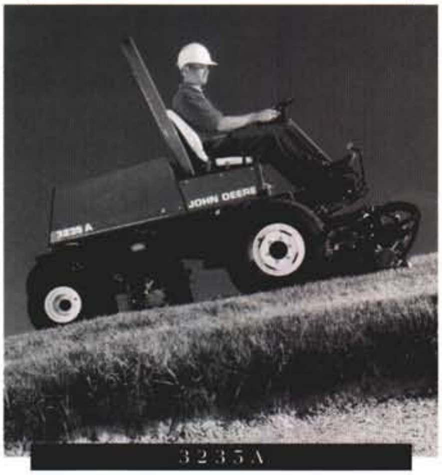

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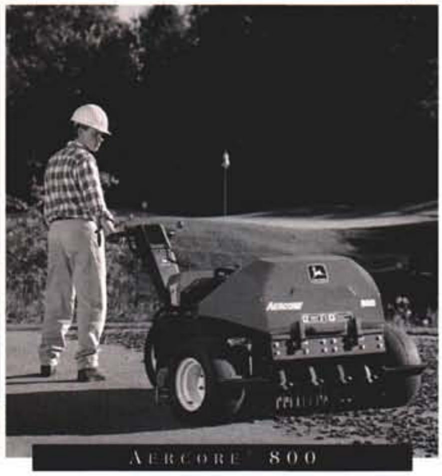

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Tracking Down Deere

By Monroe S. Miller, *Golf Course Superintendent, Blackhawk Country Club*

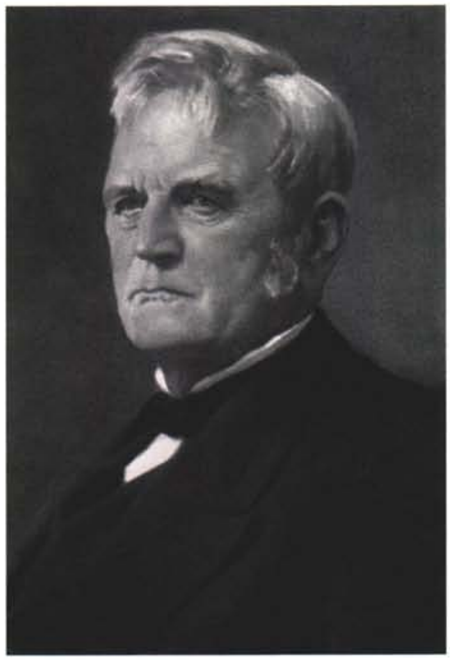
The story of John Deere, founder of the company that is now one of the major manufacturers of grass machinery in the world, is a story that took place in the midwest. It is an interesting story and one that is easy to touch and investigate from Wisconsin; we are close enough to immerse ourselves in and really enjoy it. Let me tell you a little about his life.

A few years ago Cheryl and I were touring the beautiful Middlebury, Vermont area in the autumn. Middlebury is located in west central Vermont, between the southern tip of Lake Champlain and the Green Mountain National Park. It is home to an excellent private college - Middlebury College - and it was also where John Deere learned the blacksmith trade and served a four-year apprenticeship.

John Deere was the son of William and Sarah Deere. William R. Deere was an immigrant to America from Wales; Sarah, it is believed, was born in Connecticut. They were married in the 1790s and settled in Rutland, Vermont. John Deere was born in Rutland on February 7, 1804. He had two older brothers (William, Jr. and Francis) and two older sisters (Jane and Elizabeth) and a younger brother, George. William Deere was a tailor in Rutland. Middlebury was a thriving community of almost 1,500 people at John's birth. His father's business in Rutland was prosperous.

In 1808 William returned to England to settle an inheritance with family there. He arrived safely in England, but apparently perished in a sinking on the return trip to Boston. His widow assumed his tailoring business, eking out a meager living for her young family.

John Deere's education was minimal. Sometime during his early teenage years he worked for a tanner. But his mother must have recognized some special skill in her son and helped him acquire an apprenticeship with a well-known blacksmith, Benjamin Lawrence. John was 17 years old at the time and the year



Portrait of John Deere.

Welcome sign at the John Deere historic site in Grand Detour, Illinois.

This building is an exact replica of John Deere's first blacksmith shop in Grand Detour.

was 1821. An apprenticeship provided housing, some clothes, training and a small wage. It is possible he also received some instruction in arithmetic, writing and reading.

During his years as an apprentice blacksmith in the Lawrence shop on the river that runs through Middlebury, he learned well the trade that would carry him to great success in later years. The site of that blacksmith shop was an archaeological excavation and is noted today with a historical marker - a bronze tablet on a boulder. It is right in the middle of the bustling and busy town. It is inspiring to imagine, nearly 200 years ago, that a man named John Deere learned the trade that would lead to one of the world's major corporations.

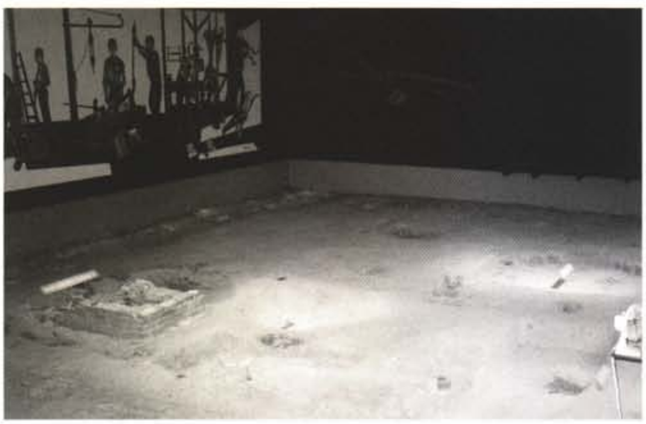
Deere was at the Lawrence shop for three years. While there he met and dated Demarius Lamb from Hancock, Vermont. Hancock is about 20 miles southeast of Middlebury. She attended school in Middlebury. After his apprenticeship ended in 1825, he became a journeyman blacksmith, a job he held for two years. In 1827 he married Demarius Lamb and was hired to do all the ironwork for a sawmill and a linseed oil mill. That contract launched him into business for himself.

Over the next nine years, Deere was involved in numerous business relationships. He had a partner in Salisbury, Vermont for a couple of years. From there he and another partner built a blacksmith shop in Leicester Four Corners, Vermont.

Primitive by today's standards, John Deere built the best equipment of his time.

This view of the back of Deere's home shows the well beneath the porch roof that he dug himself.

This shows the lawn and the back of the house that serves as the visitor center.



The actual site discovered during an archeological dig, is now under roof and part of the site tour.

A bronze sculpture of John Deere at work on an anvil.