

Irrigation Scheduling—

(Continued from Page 10)

ECH2O Capacitance Sensor Performance

The ECH2O sensors showed a definite response to the irrigation treatments (Fig. 2). Soil moisture fluctuation decreased with increasing soil depth throughout the four experiments, with few exceptions (Fig. 3). Sensor response to irrigation input at the 5 cm depth was significant following each irrigation application in each treatment. Sensor response to irrigation input at the 10 and 15 cm depths varied slightly with treatment, and more importantly, with irrigation volume. In experiment 2, sensor data indicated a difference in wetting front and water storage between treatments over the 10-day period. The 100% lysimeter ET replacement treatment seemed to maintain positive water storage at the 5 and 10 cm depths, with a slightly negative trend at the 15 cm depth. The 80% FAO 56 ET treatment appeared to maintain soil moisture at the 5 cm depth, while losing soil moisture at the 10 and 15 cm depths (Fig. 4). In experiment 4, cool and cloudy conditions dramatically lowered ET and irrigation treat-

ment volumes, resulting in significant sensor response to irrigation input only at the 5 cm depth, regardless of treatment. Throughout the experiments, sensor response to irrigation input at the 20 and 25 cm depths was largely restricted to deviations from the normal daily irrigation pattern, regardless of treatment. Although the 80% FAO 56 ET deficit irrigation treatments showed a more muted response to irrigation inputs, volumetric water content changes throughout the entire root zone as indicated by the ECH2O sensors were not significantly different between treatments in any experiment.

Discussion

In addition to passive collection of soil moisture status in research and cropping systems, capacitance sensors such as the ECH2O probe show great promise in play-

ing an active role in irrigation management. Sensor-activated rain shut-off switches represent one simple use of incorporating soil moisture sensors into

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Table 4.

Experiment	Irrigation Replacement Treatment	Mean TDR Volumetric Water Content (0-11.7 cm) (%)	Mean ECH ₂ O Volumetric Water Content (0-10 cm) (%)	LSD
1	100% actual ET	16.5†	12.8‡	0.74§
	100% FAO 56 ET	15.7	13.6	0.46
	LSD	NS¶	0.16	
2	100% actual ET	17.7	13.7	1.05
	80% FAO 56 ET	14.3	12.7	1.04
	LSD	1.42	0.39	
3	100% actual ET	16.8	13.9	0.90
	100% FAO 56 ET	17.5	14.0	0.58
	LSD	NS	NS	
4	100% actual ET	16.5	13.8	1.06
	80% FAO 56 ET	16.5	13.7	1.22
	LSD	NS	NS	

† Data presented is the grand mean of daily mean treatment TDR volumetric water content.

‡ Data presented is the grand mean of daily mean treatment ECH₂O volumetric water content aggregating the 5 and 10 cm depth sensors.

§ Fisher's LSD values are reported where significant differences at the 0.05 level occur.

¶ NS, nonsignificant at the 0.05 level.

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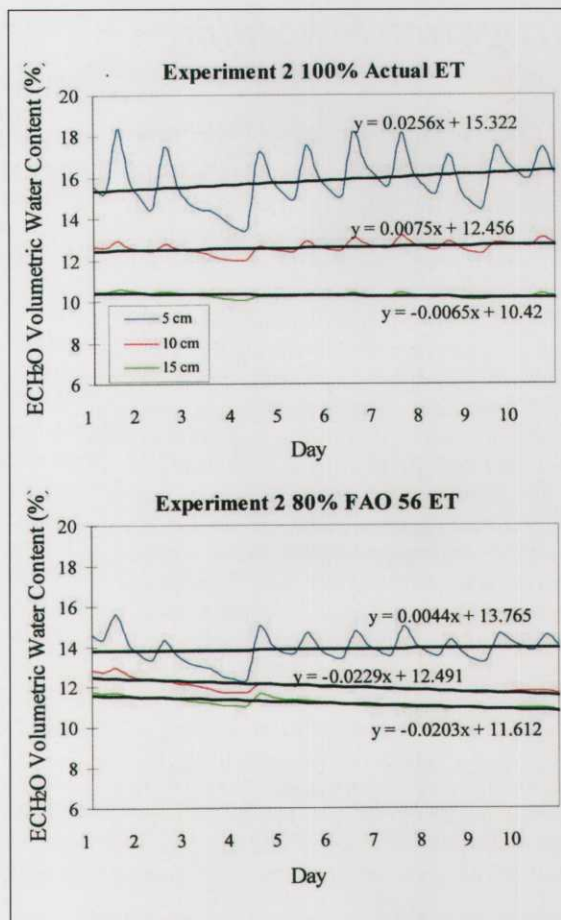
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conservation-based irrigation management. Fares and Alva (8) demonstrated that capacitance sensors could be used to schedule irrigation of citrus trees in Florida by establishing set points in the context of plant available soil water content using data collected by sensors.

Comparison of the lysimeter and ECH2O sensor indicated irrigation inputs suggests that over 70% of soil moisture fluctuation occurred in the top 4 cm of soil (Table 4). The depth of irrigation, rather than treatment, appeared to be most important in determining the depth of wetting. Project data suggests that the first 3 mm of irrigation applied daily was intercepted by the top 4 cm of soil. Young et al. (15) found a similar occurrence while investigating the use of TDR in large turf lysimeters in Arizona. In their work, TDR probes installed beneath the thatch layer consistently estimated lower water content than that measured by weight. In our research, the surface penetrating TDR probes measured higher soil water content than that measured by the 5 and 10 cm depth ECH2O probes (Table 3).

Results from our research indicate that daily irrigation which seeks to replace 80% of estimated ET is sufficient to maintain creeping bentgrass quality during the summer months under 10-day intervals. This agrees with the findings of DaCosta and Huang (7), who report that creeping bentgrass on a sandy loam soil maintained at 0.95 cm during the summer could be irrigated on a three times per week frequency with as little as 80% of actual ET and maintain acceptable turf quality. Deficit irrigation has great potential in conserving water resources in areas such as Minnesota where rainfall occurs at fairly regular 10- to 14-day intervals since low irrigation volumes could be used to simply maintain minimum soil moisture levels between periodic rain events. These rain events, rather than irrigation, would serve as the primary means to fully recharge the root zone.

(Continued on Page 13)



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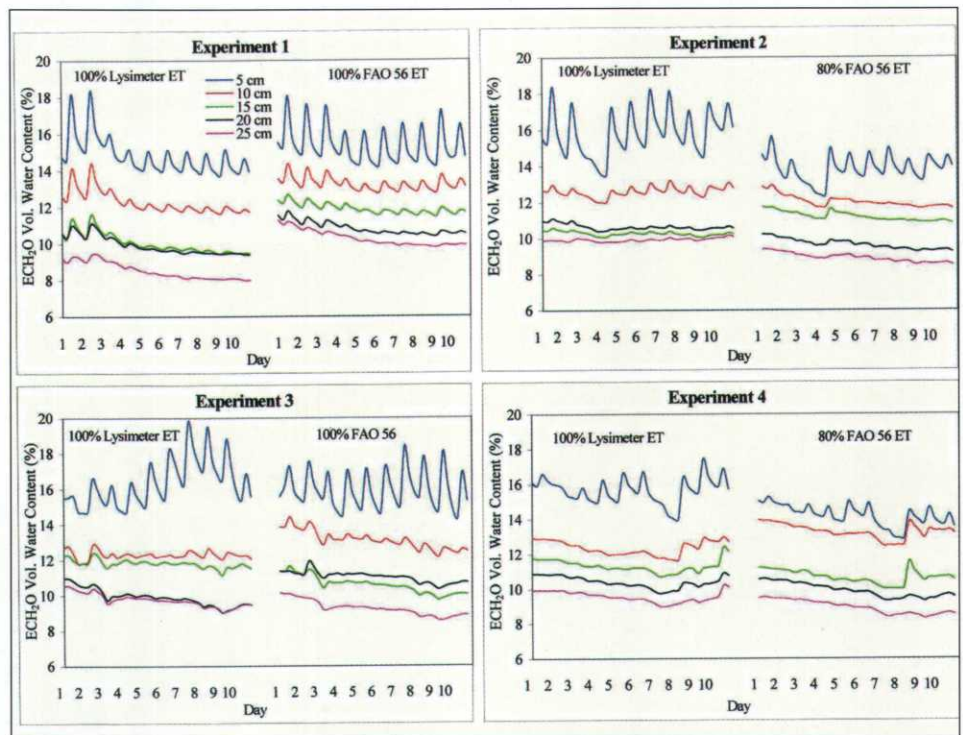
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Our data seems to validate the adage that watering daily with low irrigation volumes is less water efficient compared to deep and infrequent irrigation. Under daily shallow irrigation, a large proportion of the irrigation volume applied remains in the upper 5 cm of soil and is subject to high rates of evaporation. Because of this, a lower proportion of water delivered to the turf surface reaches the plant roots and is available for root uptake. Deep and infrequent irrigation should be more water efficient since the lower frequency interval reduces the impact of water entrapment and evaporative losses from the upper soil and thatch layer. However, Huang and Liu (11) found that during summer months, the majority of creeping bentgrass root biomass was situated in the upper 10 cm of soil. In this case, irrigating heavily enough to wet soil past the 10 cm root zone depth will result in water losses to deep infiltration (internal drainage). A highly water efficient irrigation scheduling program seeks to limit losses both to entrapment/evaporation at the soil surface as well as deep infiltration past the root zone.

Confusion over the origin and turf specific applicability of the many different equations has made many turf irrigators wary of ET estimation. FAO 56 represents an excellent opportunity to incorporate standardized and accurate ET estimation into turf irrigation scheduling by golf course superintendents. The American Society of Civil Engineers (A.S.C.E) has recently recommended adoption of an updated equation for ET estimation. Grass reference ET estimated by the A.S.C.E. standardization is identical to FAO 56 using the daily time step procedure (1). Slight differences between the two equations when using hourly time steps may require additional research to translate FAO 56 specific crop coefficients into suitable form for use with the new standardization.

Conclusion

Results from this project indicate that both FAO 56 ET estimation and ECH2O capacitance soil moisture sensors have the capability to serve as the foundation for turf irrigation scheduling which should result in the conservation of water resources while maintaining turf quality.



These technologies can be used either to schedule irrigation applications independent of human input or to augment the art of irrigation scheduling practiced by many turfgrass managers. Deficit irrigation also shows great promise in conserving water resources and should be incorporated into existing and future turf irrigation best management practices. More research is needed to realize the potential of these technologies in meeting water conservation goals in the management of turfgrass.

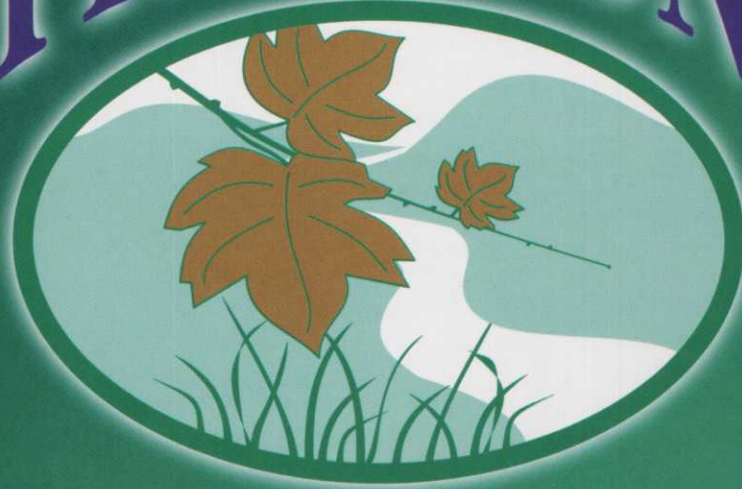
Acknowledgements

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Super Scholarship Scramble at Somerby

The Albany / Wapicada team once again proves to be the team to beat at MGCSA events. Tom Kasner and Mickey Saatzer from Albany Golf Club teamed with Mike Kasner and Scot Milstroh from Wapicada Golf Club to shoot 13-under-par 59 at the emaculate Somerby Golf Club in Byron to edge two teams at 60. Over the years these four have combined to win many MGCSA events.

Superintendent Casey Conlin and his staff had the Somerby course in excellent condition featuring L-93 bentgrass on fairways and tees which made for a very fast playing surface.

Special thanks to Tiziani Golf Car for again donating a vehicle for the University of Minnesota to use for the 2006 season and also to all other sponsors helping make this event possible.

Make plans to attend the Uof M TROE Center Field Day on July 27 and also the MGCSA Championship at Windsong Farm in Independence on August 7.

(Scramble Results on Page 18.)



Scholarship Scramble winners at Somerby Golf Club are, from the left, Scot Milstroh, Mickey Saatzer, Tom Kasner and Mike Kasner representing Albany Golf Club and Wapicada Golf Club. They teamed to shoot a 13-under-par 59.

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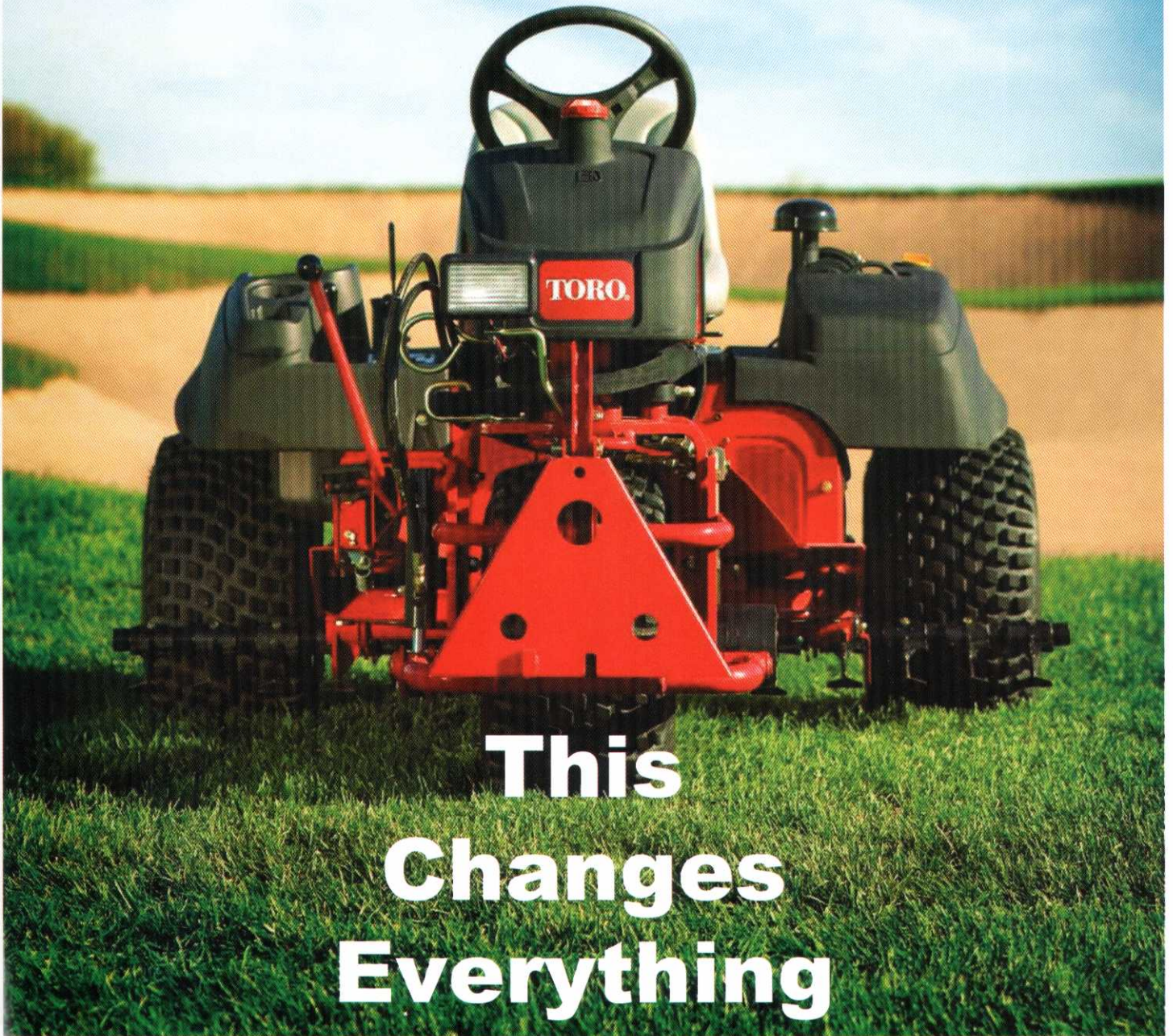
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Scholarship Scramble Results from Somerby Golf Club

Par 72

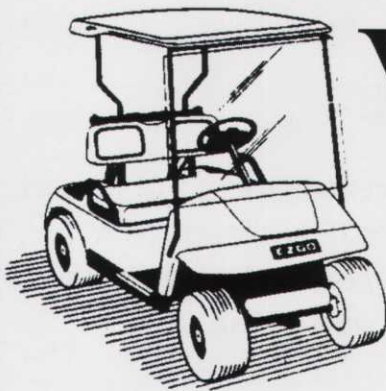
- 59 Tom Kasner, Mickey Saatzer, Mike Kasner Scot Milstroh
- 60 Greg Brodd, Scott Melling, Dan Brown, Mike Hilliard
- 60 West Stoneback, Tom Meier, Scott Thayer, Jeff Schmidt
- 63 Marlin Murphy, Justin Funk, Adam Larson, Todd Samarzia
- 63 Jason Ruhoff, Jeff Meyer, Tom Ramler, Tom Notch
- 63 Matt Rostal, Steve Makowske, Rick Carr, John Nylund
- 64 Shane Andrews, Cary Femrite, Leif Erickson, Mike Redmond
- 64 Paul Diegnau, CGCS, Brian Shaul, Brett Wenzel, Tony Belak
- 65 Kevin Norby, Kurt Knox, Joel Metz, Jeff Hartman
- 65 Ted Schirck, Tom Bjornberg, Todd Folie, Dave Newinsky
- 65 Donnacha O'Connor, Dennis Erickson, Tod Blankenship, Scott Turtinen
- 66 Marlow Hansen, Dan Trudeau, Tom Lundgren, Pete Grover
- 66 Michael Brower, Troy Lang, Brady Scott, Mike Devore
- 66 Dennis Salwei, Chad Belland, Chad Snuggerud, Kevin Belland
- 66 Jon Almquist, Bob Frank, Mike Brual, Scott Hines, CGCS
- 66 Mike Kelly, Brandon Schindele, Jeff Mold, Dave Samp
- 66 Walt Braunig, Luke Gordon, Paul Hanson, Greg Lentch
- 66 Mike Knodel, Andrew Schaufler, Dale Schwecke, Kyle Schaufler
- 67 Eric Counselman, Andy Olson, Kurt Krenke, Nathan Glaser
- 67 Dan O'Brien, Tim Goranson, Mark Christiansen, Joe Edberg
- 67 Jeff Johnson, Jake Schmitz, Rick Krause, Johnny Jarosz
- 67 Tom Proshek, Arik Hemquist, James Bade, James Gardner, CGCS
- 67 Joe Fischer, Randy Ryski, Jeremy Stafne, Craig Jerome
- 68 Aaron Johnsen, Eric Watkins, Eric Peters, Sean Kearney
- 68 Mark Boonstra, Derek Schroeder, Adam O'Reilly, Lance Crobe
- 68 Dave Kasmierczak, Brad Melsa, Jamie Bezanson, Dick Reig
- 68 Eric Peterson, Nate Uselding, Jeff Bohler, Ken Galloway
- 69 Jim Schmitz, Tim O'Driscoll, Scott Bearson, Ben Anderson
- 69 Larry Gorman, Dennis Hendrickson, Mark Simeon, Brian Birdwell
- 70 Joe Otto, Brad Smith, Jimmy Johnson, Pete Nolan
- 72 Tom Fuller, Mike Nelson, CGCS, John Meyer, David Oberle
- 72 Bill Gauwitz, Casey Conlin, Dale Parske, Keith Woodruff
- 73 Jason Swanson, Al Swanson, Brad Swanson, Donny Baldwin



Finishing Second in a scorecard playoff were, from the left, Mike Hilliard and Scott Melling, Par Aide Products Co.; Greg Brodd from Turfco Mfg., and Dan Brown, Par Aide Products Co.

Pictured at the left is Somerby Golf Club Superintendent Casey Conlin.

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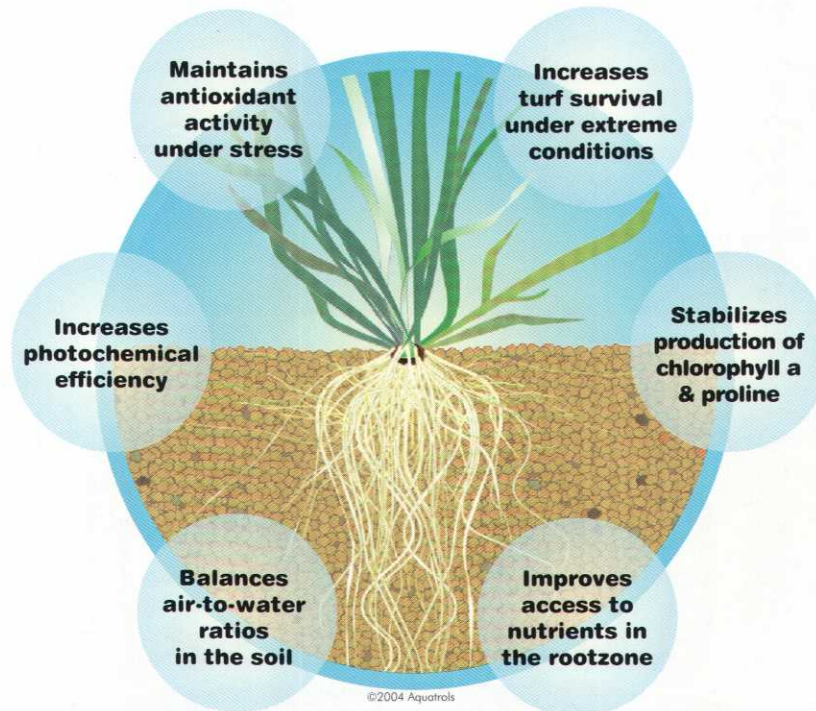
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BASF Sponsoring People vs. the Pros Regional Qualifier Tournament For Minnesota GCSA Superintendents at Albion Ridges on July 17

BASF Professional Turf & Ornamentals Sponsoring July 17 People vs. the Pros Regional Qualifier Tournament for Minnesota GCSA Superintendents at Albion Ridges

BASF Professional Turf & Ornamentals will sponsor an Official 2006 People vs. the Pros qualifying golf tournament for Minnesota GCSA superintendents at Albion Ridges in Annandale, Minn., on Monday, July 17.

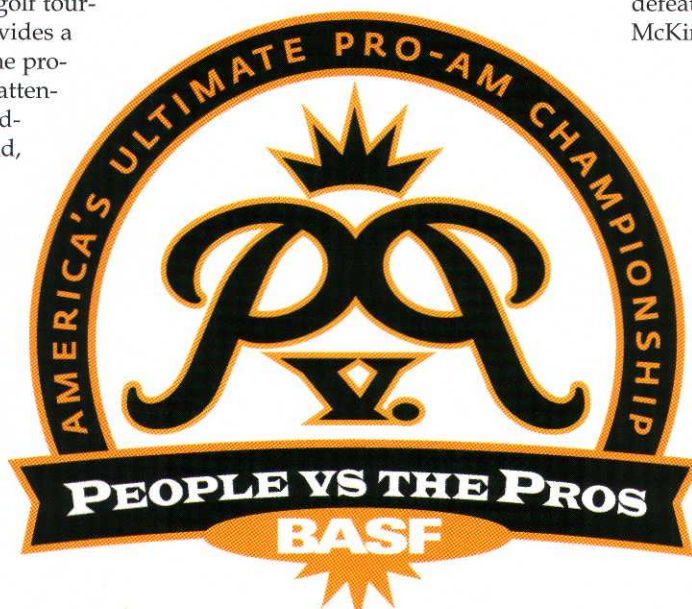
The 2006 People vs. the Pros golf tournament, presented by BASF, provides a national platform to recognize the professional dedication and crucial attention to detail that the superintendent brings to the game of golf and, in turn, helps elevate the status of the superintendent at all levels. The regional tournaments give busy superintendents time to enjoy the game as well as providing a venue to exchange professional knowledge with one another.

BASF will host the tournament champion on an all-expense paid trip to compete at the fourth annual People vs. the Pros championship tournament at Pinehurst on August 18 - 22, 2006. The July 17 winner will be one of up to 200 amateur golfers playing in the 54-hole national stroke play event utilizing handicaps for a chance to win \$50,000 for charity by defeating professionals Retief Goosen (49-and-under) or Gary McCord (50-and-over division) in front of a national television audience on ESPN2.

The Albion Ridges tournament is one of 20 regional qualifier tournaments that BASF is conducting specifically for superintendents across the country and the winner will join 24 other superintendents at the national finals. Over 1,000 superintendents will vie for a spot in the Pinehurst final through the regional BASF events. Additionally, at every regional tournament, BASF will donate \$2,000 to

the hosting GCSA chapter to help support their education fund.

Dr. Toni Bucci, business manager for BASF Professional Turf and Ornamentals said, "This is our third year sponsoring these regional events and the national tournament. It's an honor to help provide a national platform to highlight the professional dedication of golf course superintendents."



The 2006 People vs. the Pros Tournament at Pinehurst

The People vs. the Pros tournament allows two amateurs—one in a 50-and-over division and one in a 49-and-under division—to compete head-to-head against a PGA pro in an 18-hole stroke-play match. The winner in each division, be it pro or amateur, will win \$50,000 for the charity of his or her choice.

The 2006 championship event is scheduled for August 18 - 22 at Pinehurst Resort. The top amateurs with the lowest net scores from the three-day tournament will compete against either Retief Goosen

(49-and-under) or Gary McCord (50-and-over) on Pinehurst No. 8 for the top charity prize.

Last year, professional golfers Justin Leonard and Ben Crenshaw defeated their amateur challengers at Barton Creek Resort and Spa in Austin, Texas.

While Goosen is a first time participant, McCord will be making his second appearance at America's Ultimate Pro-Am Championship. In 2004, McCord was defeated by amateur Phil Johnson of McKinney, Texas, on Pinehurst No. 2.

BASF Superintendent's Cup

In addition to the two national finals matches, BASF Professional Turf and Ornamentals will host the third annual BASF Superintendents' Cup, where the top two golf course superintendents from the Pinehurst tournament (who do not qualify to play against a pro), will compete in head-to-head match play for a \$10,000 cash prize and \$10,000 worth of BASF products for their home course. The runner-up will receive a \$5,000 cash prize.

Rafael Martinez, superintendent at the Via Verde Country Club in San Dimas, Calif., defeated Greg Wiles of The Links at Echo Springs in Johnstown, Ohio, for the second annual Superintendents' Cup championship at Barton Creek's 2005 People vs. the Pros tournament.

(Editor's Note: For more information on the Carter Plantation event, please contact David Oberle at oberled@basf.com. If you plan to participate, you must present a verifiable USGA handicap at the tournament. For more information on People vs. the Pros, visit www.peoplevsthepros.com. For more information on BASF Professional Turf & Ornamentals, visit www.turfacts.com.)

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