The Virtual Irrigation Audit: A Diagnostic Tool For Turfgrass Disease

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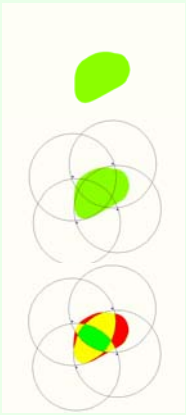
SUMMARY

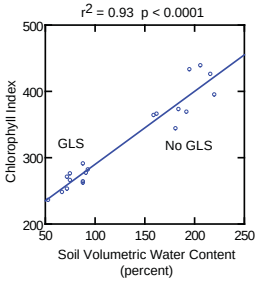
Recent research suggests that soil moisture impacts the severity of turf diseases such as anthracnose caused by *Colletotrichum cereale* (3) and Pythium root dysfunction caused by *Pythium volutum* (2), as well as by gray leaf spot (GLS) caused by *Magnaporthe grisea* and brown ring patch (BRP) caused by *Waitea circinata* var. *circinata* (see below). The virtual irrigation audit, a simple computer model that predicts the size and location of both wet and dry areas on golf course turf, was designed to provide diagnosticians and turf managers with a precision turfgrass management tool for disease and soil moisture management. In this study, the virtual audit was used to describe the occurrence of GLS and BRP on golf course turf.

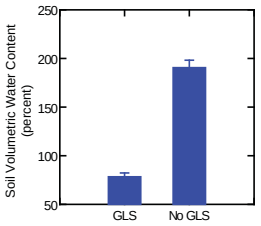
The virtual irrigation audit is as simple as 1, 2, 3

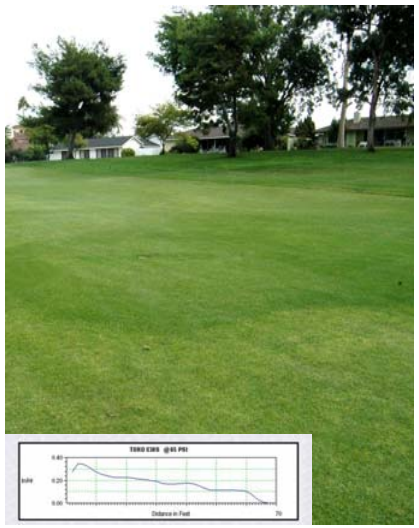


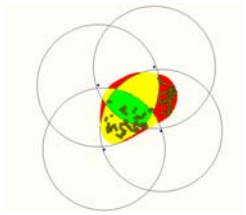
1. Map the perimeter of the area being studied using a sub meter accuracy Global Positioning Receiver as described in Materials and Methods.
2. Map the location of the irrigation heads and draw a circle centered on each head that represents the throw of that head as specified by the manufacturer.
3. Indicate the number of heads that impact each area. In the example to the left, red designates two heads, yellow three heads and green, four heads irrigating the indicated areas.

Gray leaf spot on kikuyugrass fairway. Note the lack of symptoms in the wetter area surrounding the irrigation head. There was a strong negative correlation between disease severity and soil volumetric water content. The manufacturer's specification indicates that precipitation rate is high within 3.7 m (12 feet: see inset) of the head. This corresponds to the area of low disease incidence.

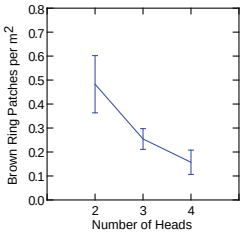








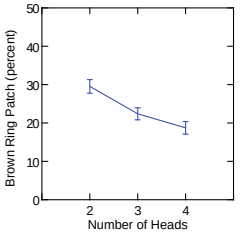
Example of a virtual irrigation audit with brown dots indicating georeferenced BRP locations.



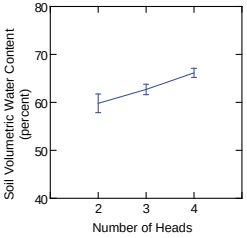
Brown ring patch incidence measured as patches/m^2 in areas receiving irrigation from 2, 3, and 4 irrigation heads. Results represent the average of 8 greens, with vertical bars illustrating the standard error of the mean.

Original photograph illustrating typical BRP symptoms.

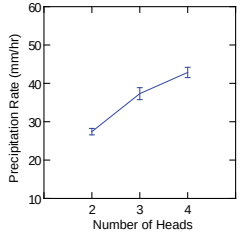
Image analysis for percent BRP based upon hue angle between 0 and 50 degrees with saturation between 0 and 100. In this plot, 16% of the area falls into the 0 – 50 degree hue angle range.



BRP severity evaluated using digital imaging and reported as the percent of area affected. Results represent the average of eighty-one 3.2 m^2 plots with vertical bars illustrating the standard error of the mean.



Soil volumetric water content as a function of the number of irrigation heads impacting the area. Areas sampled correspond to the same plot locations where % BRP was evaluated.



Precipitation rate as a function of the number of irrigation heads impacting the area. Areas sampled correspond to the same plot locations where percent BRP percentage was evaluated.

MATERIALS AND METHODS

Virtual irrigation audit mapping was conducted using a Trimble AgGPS 132 sub meter receiver set to beacon, and HGIS GIS software from Starpal running on a Tripod Data Systems Recon 400 hand-held computer.

Irrigation precipitation rate studies were conducted on green 4, Torrey Pines Golf Course North, San Diego, CA, Wayne Carpenter, superintendent. Plots measuring 1.8 by 1.8 meters were arranged in a grid pattern that covered the entire green. A plastic shoe box (30.2 cm x 17.2 cm) was placed in the center of each plot, and the irrigation system was run for 10 minutes. The volume of water collected in each box was measured, and the precipitation rate (mm/hr) calculated by multiplying cm^3 collected/10 minutes by 0.115.

Soil volumetric water content was measured prior to irrigation in the plots described above. A Spectrum TDR300 soil moisture meter equipped with 4.8 cm rods was used to probe each plot once. Readings were taken within 1 meter of the locations where irrigation catch cans had been placed for the precipitation rate study described above.

Gray leaf spot studies were conducted in September, 2006 at Mesa Verde Country Club, Costa Mesa, CA, Eric Lover, superintendent. Disease presence on kikuyugrass fairways was confirmed microscopically, and its severity evaluated using Spectrum Technologies' CM1000 chlorophyll meter. Volumetric water content was determined using the TDR300 soil moisture meter.

Brown ring patches per m^2: Studies were conducted in the Spring of 2008 on eight greens at Torrey Pines Golf Course, North. The areas of zones irrigated by two, three or four irrigation heads were determined using the equipment described above (see "Virtual irrigation audit mapping"). The number of disease patches in each irrigation zone was then manually counted. Disease incidence per m^2 was calculated by dividing the number of patches by the area (m^2) of the irrigation zone in which they occurred.

Percent brown ring patch: Digital image analysis (with a Nikon D70 digital camera [3008 x 2000 pixels, fine quality setting] with an 18-35 mm F1:3.5 to F4.5 ED lens mounted on a tripod 1.2 m from the ground) was used. Images were cropped to represent only the area within each plot. Sigma Scan and a macro developed by Karcher and Richardson (1) were used for image analysis. Hue angle was 0 – 50 degrees with saturation ranging from 0 – 100. Images were sized down to 800 by 800 pixels prior to analysis using a companion macro for Sigma Scan also written by Karcher and Richardson. The same areas used for the irrigation precipitation rate study were used for disease evaluation.

Statistical analysis was conducted using Systat version 10.2, Systat, San Jose, CA.

REFERENCES

1. Karcher D.E., and M.D. Richardson, 2005. Crop Sci. 45:1536-1539
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3. Roberts, J.A., J.C. Inguagitato, BB Clarke and JA Murphy, 2008. Proc. 17th Ann. Rutgers Turfgrass Symp, p. 54