Validation of a logistic regression model for prediction of dollar spot of amenity turfgrasses

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Objectives:

To validate new dollar spot prediction models for accuracy in predicting dollar spot epidemics so that preventative fungicide applications can be precisely applied in diverse locations of the United States.

Dollar spot (caused by Sclerotinia homoeocarpa) is the most economically important turfgrass disease in North America. This research focused on validating new dollar spot prediction models for fungicide application recommendations in 2011 and 2012. Models used in the validation were previously constructed using logistic regression. All validation was conducted on creeping bentgrass (Agrostis stolonifera) putting greens with four treatments and a minimum of four replications. In 2011, treatments included a non–fungicide treated control, fungicide applied using a standard calendar–based application where the spray interval was 14 to 28 days (depending on location), fungicide applied using the newly developed air temperature and relative humidity (AT+RH) model, and fungicide applied based on a relative humidity (RH) only model. In 2012, an additional model using minimum air temperature and relative humidity (MNT+RH) was incorporated. ZedX, Inc. supplied weather data (interpolated weather), which served as inputs for the models. Each location was provided a unique subscription (based on GPS coordinates), where cooperators received from ZedX, Inc., weather information along with spraying recommendations based on the models each morning via email. Sprays were applied for the model treatments only if fungicide protection had lapsed (e.g. fungicide was applied more than 14 – 28 days ago) using established probability thresholds for each model. If fungicide protection had not lapsed then no action was required by the user. In 2011 thresholds were initially set at 10% and later adjusted to 20% for each of the two models examined. In 2012 at locations with adequate research space, additional thresholds (10%, 20%, and 30%) were added for all three models used. If a location did not have space, then single thresholds for each of the three models was chosen for that location. The number of dollar spot foci were recorded for each plot on a regular schedule throughout the growing seasons. Data were analyzed using standard analysis of variance, disease progress curves were developed for each treatment at each location, standardized area under the disease progress curves (standardized disease intensities) were determined, and separation of means were calculated using Fisher´s test of protected least significant difference ($P<0.05$).

Dollar spot intensity was highly variable from one location to the next and across each season (see figure). In 2011 significant differences among treatments were observed at all locations. In 2012, no significant differences among treatments were observed at the Tennessee or Wisconsin site. In Tennessee dollar spot was limited due drought conditions. In Wisconsin, initial dollar spot was low due to the dry conditions, and then rapidly increased as weather conditions improved for dollar spot development, which overwhelmed the fungicide formulations used at that location. For all locations, fungicide applications based on the models generally provided a reduction in dollar spot over not treating. Depending on the location, models differed in their accuracy to predict dollar

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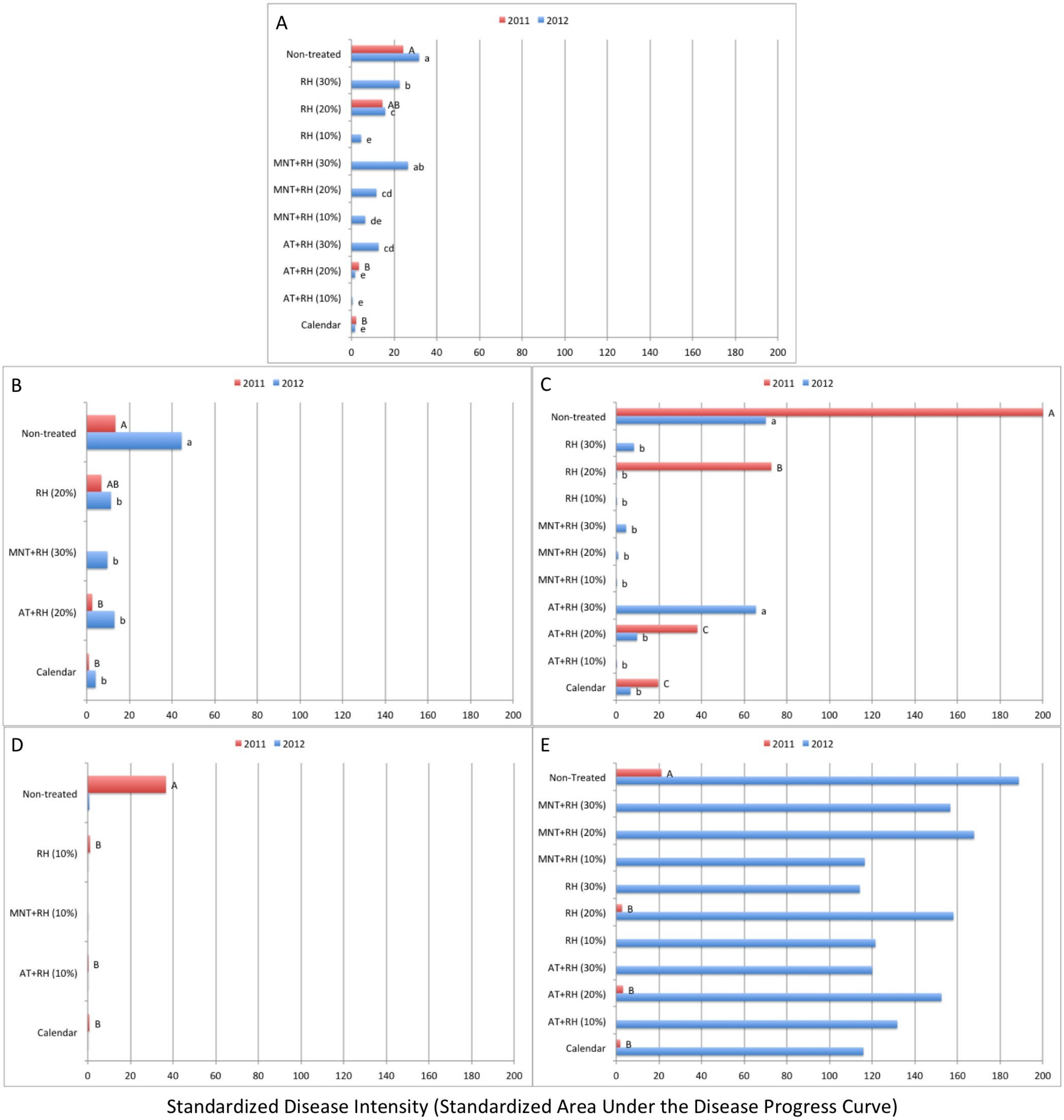
Figure 1. Standardized disease intensity for the 2011 and 2012 seasons for: A. Oklahoma; B. Mississippi; C. Pennsylvania; D. Tennessee; E. Wisconsin. Standardized disease intensity was calculated by dividing the area under the disease progress curve by the number of days for each epidemic, in each year, for each location. Red bars with the same upper–case letters indicate that disease intensity was not significantly different among treatments at each location in 2011, according to Fisher´s test of least significant difference (P<0.05). Blue bars with the same lower–case letters indicate that disease intensity was not significantly different among treatments at each location in 2012, according to Fisher´s test of least significant difference (P<0.05).



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spot. In the "deep south" and "transition zone" states (Figs. A, B, and D) the AT+RH (20%) offered good control of dollar spot over the two–year study. In Pennsylvania the MNT+RH model (all thresholds) offered the best control in 2012. However, the best model over the two–year study was the AT+RH (20%), while still providing a spray savings over the calendar program (Fig. C). In Wisconsin in 2011, the AT+RH model (20%) provided control of dollar spot comparable to the calendar treatment. Across all locations in both years, a one–spray savings was achieved using the AT+RH model (10 or 20%). In 2011, initially the AT+RH model was implemented using a 10% spray threshold, which resulted in over–spraying twice at the Oklahoma location and once at the Mississippi location. The threshold was adjusted to 20% late in the season and tested again in 2012. No over–sprays were documented in 2012 when using the AT+RH model (20%).

Summary Points

- The AT + RH model provided control of dollar spot, which was comparable to the calendar–based treatments while providing an average reduction of one fungicide application in both years.
- The AT + RH model tended to over–predict fungicide applications in 2011 by an average of one spray; this was corrected to reduce false positives in 2012 by adjusting the spray threshold to 20%.
- Tailoring models (model inputs and thresholds) to certain locations can provide a very accurate model dollar spot prediction model, however, the AT+RH model (20% threshold) performed consistently across all locations and is a viable solution to predict dollar spot epidemics for fungicide spray recommendation on creeping bentgrass across diverse environments.

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