Progress Report: Enhancing Herbicide Resistance Management with Growing Degree-Day Models

Patrick McCullough, University of Georgia

Background. Herbicide-resistance is a major problem in golf course turfgrass. We have identified biotypes of sedges, broadleaf, and grassy weeds with resistance to pre- and postemergence herbicides. Many herbicides that offer alternative modes of action for resistance management cause excessive turfgrass injury. Our current research efforts are focusing on the use of growing degree-day models for applying herbicides that offer alternative modes of action for controlling herbicide-resistant weeds.

Completed research. The GGEF grant provided partial support for field experiments recently completed at the UGA Griffin campus. The turf was a 'Tifway' bermudagrass fairway grown on a Cecil sandy loam with 6.0 pH and 2.5% organic matter. The field was irrigated as needed to reduce turf wilting. Treatments were the factorial combination of four herbicides applied at four growing degree-day (GDD) timings. Herbicides applied included Sureguard 51% (flumioxazin) at 12 oz/acre, Roundup Pro (glyphosate) at 16 oz/acre, Aatrex 4L (atrazine) at 1 qt/acre, and Ronstar Flo (oxadiazon) at 3 lb a.i./acre. These herbicides were applied at 50, 100, 200, and 300 GDD using a base model of 50° F on January 1st. Daily temperature data was used to calculated cumulative GDD with the following formula: $GDD = (T_{max} + T_{min})/2 - T_{base}$, where T_{max} is the daily high temperature, T_{min} is the daily low temperature, and T_{base} is the base temperature for the model (50° F). Visual ratings were made weekly on a percent scale including annual bluegrass cover and control and turf injury. The experimental design was a randomized complete block with

four replications of 3 x 10’ plots. Separate plots were used each year. Data were subjected to analysis of variance and means were separated with Fisher’s LSD test at $a = 0.05$.

Bermudagrass injury was acceptable (less than 20%) in all three years when herbicides were applied at 50 and 100 GDD. Sureguard, Roundup, and Ronstar applied at 200 and 300 GDD caused unacceptable injury in all three years. Injury persisted for several weeks from these treatments. Atrazine applied at 200 GDD caused acceptable injury to bermudagrass on all evaluations, but treatments at 300 GDD caused unacceptable injury in one of three years. Bermudagrass injury was expressed as stunted growth and discoloration relative to the nontreated.

Annual bluegrass control was only evaluated in two of three years. Acceptable control (≥70%) was achieved with Sureguard at 50 and 100 GDD at 50 GDD in one of two years, Roundup and atrazine at 50, 100, and 200 GDD in both years, Sureguard at 200 and 300 GDD in both years, and atrazine at 300 GDD in one year. Ronstar treatments caused suppression of annual bluegrass but generally gave about 50% control.

Overall, the best selectivity for bermudagrass safety and annual bluegrass control were with the following treatments: Roundup and Sureguard applied at 50 and 100 GDD and atrazine applied at 50, 100, or 200 GDD. Ronstar is not a postemergence herbicide for annual bluegrass control but turf managers may be able optimize the safety of sprayable formulations when treating bermudagrass no later than 100 GDD with our model. The use of GDD will enhance selectivity of herbicide application timing to help rotate modes of action in spray programs. Further research is needed to look at the interaction of photoperiod with GDD on turf tolerance and annual bluegrass control.

Current research. We have conducted multiple field experiments evaluating growing degree-day and heating degree-day accumulation for timing weed control strategies. In the fall, heating degree-day models are being used with a base model of 70 degrees (F) beginning on July 1st to time applications of Specticle, atrazine, Sureguard, and Barricade. We are evaluating the reductions in temperatures as benchmark indicators for beginning herbicide programs. In winter, we are using growing degree-day timings with a base model of 50 degrees (F) beginning on January 1st to evaluate the selectivity of Ronstar Flo, Finale, Sureguard, and Roundup on bermudagrass and zoysiagrass. This research was initiated in January 2018 and will continue as part of the GGEF grant in 2019.