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Determining Base Temperature for Warm- and Cool-Season Turfgrasses

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Growing degree days are used to describe the amount of heat energy received by a plant over a given time period. Growing degree days are used extensively in agriculture to predict plant growth stages, such as, time from emergence to flowering or emergence to maturity. Using a growing degree day model a turfgrass manager can better time pesticide and growth regulator applications compared to a calendar day approach.

Growing degree days are calculated by averaging the daily high and low air temperature and subtracting a base temperature. Base temperature is defined as the temperature at which a plant species becomes physiologically inactive causing shoot growth to cease. Calculating growing degree days with an inaccurate base temperature can equate to a difference of up to two or three calendar weeks. The objective of this research was to determine the base temperature of warm- and cool-season turfgrass species/cultivars.

A study was conducted using the Soil-Plant-Atmosphere-Research (SPAR) units at the R.R. Foil Plant Science Research Center at Mississippi State University to determine the base temperatures for five cool-season and five warm-season turfgrasses. The SPAR unit facility is comprised of ten naturally-lit chambers that have the ability to simulate and monitor several environmental aspects, such as temperature, humidity, UV-B light exposure, soil moisture, and CO_2 levels (Figure 1). The SPAR units are controlled by a dedicated computer system located inside the Environmental Plant Physiology Laboratory. Cool-season turfgrasses included ‘Penn A1/A4’ and ‘Penncross’ creeping bentgrass (*Agrostis stolonifera* L.), ‘Midnight’ Kentucky bluegrass (*Poa pratensis* L.), ‘Fiesta 4’ perennial ryegrass (*Lolium perenne* L.), and ‘Falcon V’ tall fescue (*Schedonorus arundinaceus* (Schreb.) Dumort.). Warm-season turfgrasses included ‘MSB-285’, ‘Latitude 36’, ‘TifEagle’, and ‘Tifway’ hybrid bermudagrasses (*Cynodon dactylon* (L.) Pers. X *C. transvaalensis* Burtt-Davy) and ‘Meyer’ zoysiagrass (*Zoysia japonica* Steud.). MSB-285 is an experimental cultivar from the Mississippi State University breeding program.

This cultivar was a top performer in the 2013 National Turfgrass Evaluation Program/USGA warm-season putting green test (www.ntep.org) and has unique alleles compared to other ultradwarf bermudagrass cultivars when amplified with the simple-sequence repeat marker ES295668 (Harris-Schultz, personal communication, 2013).

Day/night temperature regimes for the cool-season grasses were 18/10, 22/14, 26/18, 30/22, 34/26 °C. Day/night temperature regimes for the warm-season grasses were 20/12, 25/17, 30/22, 35/27, 40/32 °C. Each unit included six replications for each of the five turfgrasses used for a total of 30 randomized pots for each temperature regime. Turfgrasses were grown in a 3:1 sand to native top soil mix in lysimeters measuring 41 cm in depth and 10 cm in diameter. Nutrients and moisture were maintained at optimum conditions using drip irrigation containing half-strength Hoagland's nutrient solution three times per day. Clipping yield was collected every three days using scissors and a PVC guard cut to the desired height (Figure 2). Additional parameters measured included chlorophyll index, root dry weight, and tissue nutrient content. Clipping yield was subjected to quadratic regression analysis as a function of temperature in order to determine base temperature.

Base temperatures for Penn A1/A4, Penncross, Midnight, Fiesta 4, and Falcon V are –2.23, -0.44, 4.69, 3.81, and 4.25 °C, respectively. Base temperatures for Latitude 36, MSB-285, Tifway, and TifEagle are 13.21, 12.51, 12.67, and 12.58 °C, respectively. Base temperature for Meyer zoysiagrass was unable to be determined due to lack of performance during the trial. Using these base temperatures to calculate growing degree days can more accurately represent total accumulated growing degree days. Accurately calculating growing degree days can be the difference between a timely and mistimed application.

Summary Points

- Base temperature for the bermudagrasses cultivars ranged from 12.51 to 13.21°C
- Base temperature for the cool-season species ranged from -2.23 to 4.69 °C
- Using these base temperatures to calculate growing degree days can more accurately represent total accumulated growing degree days.
- Future research is needed to validate base temperatures in a field setting.

Figure 1: The Soil-Plant-Atmosphere-Research (SPAR) facility is located at Mississippi State University in Starkville, Mississippi. The facility is composed of ten naturally-lit chambers on a 20 × 30 m concrete pad. Each unit is composed of a Plexiglas chamber measuring 2.5 m high, a steel soil bin measuring 1.0 m deep × 2.0 m long × 0.5 m wide, and an air handling unit.

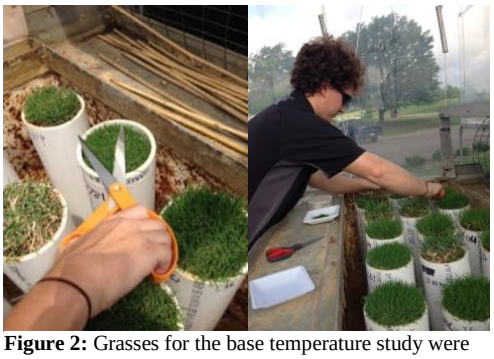

Figure 2: Grasses for the base temperature study were grown in lysimeters measuring 10 cm in diameter and 41 cm deep. Clippings were collected every 3 days using scissors and a PVC guard cut to desired mowing height. Clippings were oven dried for at least 48 hours and then weighed.