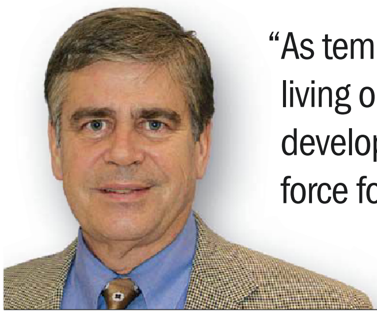

"As temperatures increase, plants and living organisms begin to grow and develop. Temperature is the driving force for all biological activity."

KARL DANNEBERGER, PH.D., *Science Editor*

Spring triggers growing degree-days

With the arrival of spring, the warmth of the sun is most evident. As temperatures increase, plants and living organisms begin to grow and develop. Temperature is the driving force for all biological activity. One method of using temperature to describe and predict the development of living organisms is accumulative growing degree days. In a previous column I described how growing degree days are calculated and used to predict annual bluegrass seedhead emergence (*Golfdom,* March 2010). In this column, I look more in-depth at ways to calculate growing degree days.

There are three ways to calculate growing degree days (GDD). The most common is the Average Method where the daily minimum temperature is added to the maximum temperature for that day and then divided by two. The base temperature, which can vary depending on the plant model, is subtracted from the average. If the calculated growing degree day is greater than zero, it is added to the cumulative total that has occurred since the start date. If the GDD is less than zero, it is set to zero. The base temperature can vary widely depending on the GDD model ranging from 32 to 55 degrees F with some models. The most common base temperature used is 50 degrees F (10 degrees C).

The second method is the Modified Average Method, which calculates GDD the same way as the Average Method except if the minimum temperature is below the base temperature; the base temperature is used as the minimum temperature in the calculation. This calculation has an advantage over the Average Method when temperatures fluctuate above and below the base temperature that occurs often in the early spring. When fluctuation occurs above and below the base temperature, the Average Method underestimates the number of GDDs. From an application perspective, timing a mefluidide (growth regulator) application for *Poa annua* seedhead control would be best based on the Modified Average Method of calculating GDD.

The Modified Sine Curve Method is the third and most accurate means of calculating GDD. It is based on the assumption that the daily diurnal temperature pattern is similar to a sine curve. The GDD calculated is the area under the curve. The Modified Sine Curve calculation is considerably more complex than the previous two methods and often requires a computer program.

The Modified Sine Curve Method also accounts for a high temperature threshold. In other words an upper temperature limit can be set where GDD are calculated to the threshold and not above. The upper threshold concept can be used to calculate Stress Degree Days that may help define and predict the summer stress period.

Lastly, there is the start date. With all GDD models, a set start date is given, which is sometimes referred to as biofix. The common start date is January 1st, but this can vary depending on the model. Early GDD models that predicted annual bluegrass or Kentucky bluegrass seedhead emergence had a start date of April 1 and March 1, respectively.

Recently, applications of the growth regulator trinexapac-ethyl are being recommended based on the work of Kreuser and Soldat (2011) at the University of Wisconsin. Based on GDD, they have proposed applications being timed around 200 GDD (base temperature zero degrees C). Repeated applications can be made on 200 GDD increment, or the GDD is reset to zero and accumulation starts again.

When creating or using a GDD model, be aware of the method used to calculate GDD, the temperature units used (Fahrenheit or Celsius), the base temperature and the start date used.

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