

Growing Degree Days

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Growing degree days (GDD) are a measure of accumulated heat units. For a physiological change to occur, such as insect molting or plant flowering, an organism must accumulate enough growing degree days. The number of growing degree days needed for these changes to occur in some insect pests and flowering plants is known and should be utilized in integrated pest management programs (IPM). Using GDD can improve efficiency of plant health care applications. However, limitations exist for its use and landscape managers should be aware of these to make informed decisions.

What are growing degree days?

Insect emergence and plant developments are associated, yet do not occur on the same day from year to year. Temperature, not a calendar date, determines animal and plant growth events. GDD measures how many heat units contribute to development over a 24-hour period. When some organisms accumulate enough heat units, a physiological event occurs. Predicting these events based on GDD contributes to IPM strategies.

How are growing degree days calculated?

The GDD model takes into account the maximum and minimum temperatures within a 24-hour day and a fixed base temperature:

$$\frac{\text{Maximum temp} + \text{Minimum temp}}{2} - 50^{\circ}\text{F} = \text{GDD}$$

The base temperature is the assumed threshold at which animal and plant development start and stop. Most GDD models use a base temperature of 50°F. Greater GDD accumulation occurs in the warmest summer months.

How can I use growing degree days?

Knowing the GDD for a given pest's emergence enables preparation for effective treatments and practices, such as releasing biological control agents or improving cultural conditions, ahead of the event. Associated plant developments, which are easier to observe, provide an early indication of the approaching pest transition. A range of GDD corresponding to the pest's vulnerable state is typically used in IPM. For example, silver maples will be in full bloom at 42 GDD, providing an early marker. Next, border forsythia will start to bloom at 86 GDD followed shortly by the eastern tent caterpillar larvae emergence from 90-190 GDD (Figure 1).

Figure 1: Flowering of silver maples indicate eastern tent caterpillars will emerge soon



Daily GDD accumulation differs by latitude, elevation, and environments. Check online resources and local university extension services to obtain the GDD for your area.

What are the limitations for using growing degree days?

While a helpful predictive tool, GDD has limitations. For example, GDD may be different on the north side versus the south side of a house, or even on the same tree (Figure 2). These local differences are caused by microclimates. Additionally, GDD is not known for every pest or plant in the landscape. With these limitations in mind, GDD provides a general guide for pest management, but are not a substitute for on-site monitoring (Figure 3).

Figure 2: The left side of this pear is not yet flowering while the right side is in full bloom



Figure 3: A Bartlett Plant Health Care Specialist monitors for pests



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