

# Use Nature's Signals to Manage Landscape Pests



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Successful pest management in the landscape depends on using control tactics only when necessary and only when an insect pest, weed, or pathogen is most vulnerable. Depending on weather conditions, rates of insect and plant development at the same location may vary significantly from one year to the next. If calendar dates alone are used to time pesticide applications, you may be applying materials when the pest is not susceptible or not even present. This could waste both money and time and result in more pesticides being used than necessary. The best way to make an effective pesticide application is to observe pest development at the site through regular monitoring, but making these observations for each pest can be time consuming and difficult.

A more accurate system to predict pest activity has been developed by Donald A. Orton of the Illinois Department of Agriculture, and it is described in his book, *Coincide: The Orton System of Pest Management*. This system pairs *phenology*, a study of the effects of climatic conditions on the development of plants and animals, and *growing degree-days*, which are used to measure the amount of heat that has accumulated in a given season. It allows caretakers of ornamental plants to correlate easily observable events in landscapes with difficult-to-see stages of common pests.

## GROWING DEGREE-DAYS

Arthropods (insects and mites) are cold blooded, so they depend on heat in the environment to regulate their metabolism. They develop rapidly in warm temperatures, and slowly—or not at all—in cold temperatures. Researchers have observed that most insects require a certain, consistent amount of heat to accumulate to complete each stage of their development. Plants also need a certain amount of heat accumulation to bloom and leaf out.

Heat accumulation is measured in units called growing degree-days (GDD). A growing degree-day is the difference between the average daily temperature and a base threshold temperature below which development ceases. The simplest way to calculate growing degree-days is to use the formula listed below.

Since development of most insects and mites is limited below 50 degrees Fahrenheit, 50 is commonly used as a base temperature for growing degree-day calculations. Other base temperatures are occasionally used, so it is best to check when using GDD information from different sources.

Using the formula below and the information in Table 1, on March 1 you would add 40 and 60 and divide by 2 to obtain the average of 50. Then subtract 50 (the base temperature) to obtain zero GDD. If your calculation results in a negative number like the example on

### Growing degree-days formula:

Maximum + Minimum Temperature - Base Temperature = Growing Degree-Days

2

Table 1: Calculating growing degree-days using 50 degrees Fahrenheit as the base temperature.

Date	Min. °F.	Max. °F.	Average °F.	GDD	Total Accumulated GDD
March 1	40°	60°	50°	0	0
March 2	40°	65°	52.5°	2.5	2.5
March 3	50°	65°	57.5°	7.5	10
March 4	30°	40°	35°	0	10
March 5	40°	65°	52.5°	2.5	12.5

March 4, no GDDs are accumulated for that 24-hour period.

Since growing degree-days are cumulative, data collection must begin at the same time each season. March 1 is often used as a starting date for calculating GDD. In one growing season, thousands of GDDs can accumulate. The cumulative GDD value can vary greatly on the same calendar date from one year to the next, depending on the weather.

There are several ways to gather growing degree-day readings. You can use a minimum/maximum thermometer and calculate them by hand, use one of several electronic instruments that calculate the data automatically, or subscribe to the Southeast Pennsylvania IPM Research Group's scouting report, which includes weekly cumulative growing degree-day readings and key insect, mite, and plant development observations for many locations within that region. If you use GDD readings based on data gathered from a site other than your own, keep in mind that the GDD accumulation at your location will probably be slightly different due to effects of the immediate microclimate.

## PHENOLOGY

Phenology is the study of the synchronization of developmental stages of plants and animals with the weather. The timing of these events depends on factors like temperature, moisture, and day length. Easily observable plant phenological events, such as bud break or leafing out, can be correlated with growing degree-days. Less easily observed events like the hatching of insect eggs can be associated with the appearance of certain stages of plant development. These correlations can then be used to predict when an insect pest will appear in the landscape, and when it may be most susceptible to effective management tactics.

Plants that are used for phenological observations are called "indicator plants." Good indicator plants should be common to a wide geographical area, hardy, easy to recognize, and easy to grow. They should have short, well-defined bloom periods, with blooms and fruits that are recognizable from a distance.

## USING INDICATOR PLANTS AND GDD INFORMATION AS PEST MANAGEMENT GUIDES

Researchers have been determining GDD numbers associated with life stages of many species of pests and stages of development of various indicator plants. Informed landscape plant managers are using this information to make wise pest management decisions.

For example, years of careful observation have shown that the eastern tent caterpillar is a young larva and most vulnerable to control measures, between 100–200 GDD. This is also the GDD range when saucer magnolia, *Magnolia x soulangiana*, is in pink bud to early bloom. A landscape manager can observe the development of local saucer magnolias to pinpoint the best time to treat or remove the small eastern tent caterpillar nests.

Another example: Suppose pine needle scale has been a problem in past years and a grounds manager wants to prevent further outbreaks. By checking references such as *Coincide: The Orton System of Pest Management*, he or she learns that the eggs of pine needle scale hatch and first generation crawlers are most vulnerable between 200 to 350 GDD. This is also about the range that horsechestnut, *Aesculus hippocastanum*, blooms. When 150 GDD have accumulated, or when horsechestnut just begins to bloom, it is time to scout pines for newly hatched pine needle scale crawlers. Since the crawler stage is the most easily controlled life stage, when crawlers are observed, it is time to treat with a registered material.

Plant phenological indicators are only guidelines. Grounds managers still have to monitor pest life stages to pinpoint what is happening at each site. Likewise, specific events in insect development occur within GDD *ranges*, not by a specific number. Tracking GDD and phenological indicators gives a useful way of knowing when to look for a particular pest and to manage it in its most vulnerable stage. Following signals in nature helps arborists, nurserymen, and grounds managers make effective pest management decisions and minimizes the impact of their pest control applications on the environment.

## SELECTED REFERENCES

*Coincide: The Orton System of Pest Management*. 1989. Orton. Plantsmen's Publications, Flossmor, IL 60422.

"Growing Degree-Days Weekly Report," from the Southeast Pennsylvania IPM Research Group, Penn State Cooperative Extension, Montgomery County, 1015 Bridge Road, Suite H, Collegeville, PA 19426-1179. March 1 to early October.

## FOR MORE INFORMATION

Penn State Cooperative Extension, the University of Delaware, and the Southeast Pennsylvania IPM Research Group have been working together to provide information and educational materials on IPM and landscaping.

This fact sheet, "Use Nature's Signals to Manage Landscape Pests" is part of a series of educational fact sheets about using and understanding integrated pest management. Other topics in the series include:

- Creating Healthy Landscapes—Introduction
- Choose Plants Wisely
- Plant With Care
- Promote Plant Health
- Keep Plants Well Groomed
- Monitor Pests and Keep Records
- Pest Management Methods
- Recognize and Conserve Natural Enemies

Copies are available from your local extension office.

The Southeast Pennsylvania IPM Research Group is a collaboration of university and industry horticulture professionals who are inspecting landscapes across the region to monitor pest populations and share current IPM data. The group is partially supported by the Pennsylvania IPM Program (PAIPM). For more information about the research group, contact: Penn State Cooperative Extension, Montgomery County, 1015 Bridge Road, Suite H, Collegeville, PA 19426-1179; telephone: (610) 489-4315.

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