Growing Degree Days: Using Heat to Defeat Pests

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What are growing degree days (GDD)?

The name is a bit misleading. They are not really days at all. They are units of heat. Both insects and plant develop and grow in response to an accumulation of heat. During the growing season, as temperatures warm, we can measure the accumulation of heat through the GDD. As the heat accumulates, so do the GDDs. Certain insects emerge and certain plants come into flower during a particular range of GDD.

We calculate GDD each day and add them up over the course of the season. They accumulate each day and never decrease. When we accumulate 100 GDD, we know that certain insects will start to emerge and certain plants will come into flower. Others won't emerge/flower until the total GDD is 200, 500, 700, etc.

There are different base numbers used to calculate GDD. Base 50 is commonly used with ornamental plants and the insects that attack them. This is because 50 degrees F is the level at which many plants and insects begin to grow. Other base numbers (32, 40, 45) may be used with some agricultural crops and insects that develop at cooler temperatures.

How do we calculate growing degree days?

There are a variety of methods by which to do this, but this simple calculation works well. On any given day, we add the maximum temperature of that day to the minimum temperature of the day and then divide it by two. This gives us the average temperature of that day. From that average, we subtract the base number. That gives us the number of GDD (units of heat) that accumulated on that calendar day.

$$\frac{\text{Temp (max)} + \text{temp (min)}}{2} - \text{base \#} = \text{GDD for that day}$$

What does the accumulation of growing degree days do for us?

It helps us know when insect pests will begin to emerge. GDD can be more specific than calendar dates. This is important because weather fluctuates so much from one year to another. An insect that we normally expect to begin emerging in mid-May, might emerge in mid-April in an unusually warm year. Knowing when the insect is really likely to be our, prompts us to look for it and defend our plants from it. This allows us to manage insect pests better. For a gardener who is using an insecticide, this means that product can be used in a more timely and effective manner. It also means that we can use less of the insecticide. For an organic gardener, the timing of organic practices can be timed better and give better results. In either case, we save time and reduce plant damage.

Is this system perfect?

No. It is better than using the calendar method, but it is not perfect. There are things to consider. We always have to be aware of which base number is in use. If we are watching GDD collected using base 50, looking at a source using another base will give us inaccurate numbers. We must consistently use the same base as we track the development of insects. There are a variety of methods to track GDD (some complicated enough to employ calculus or computers). More advanced methods will give slightly different information. Maximum and minimum temperatures can vary greatly across the Chicago region, so GDD on the Lake Michigan shore will be quite different from an inland site on the same day. Sometimes temperatures may vary a bit in two locations that are only a few miles apart.

Do plants also respond to growing degree days?

Yes, they do. Plants grow as GDDs accumulate. Just as we use GDD to track insect emergence, we can use them to track the development of plants. We often look at the GDD range at which a plant flowers. Some plants, like magnolia trees, flower very early, even before we get o 100 GDD. Other plants will begin to flower at 100 GDD or 200 GDD, etc. This information allows us to use plants as 'indicator plants'. If we know that a tree flowers at 100 GDD, when we see it in flower we know that insects that emerge at 100 GDD will be active already (or in the near future). Indicator plants can be trees, shrubs perennials or weeds. Plants with short flowering times make better indicator plants as they give us a more precise window of time in which to look for insect emergence.

Sources of information about growing degree days:

Book: "Coincide" by Don Orton (limited availability)

On-line resources:

Michigan State's GDD tracker (https://gddtracker.msu.edu/)

USA National Phenology Network (www.usanpn.org/home)

The Morton Arboretum's "Plant Health Care Report" (https://mortonarb.org/about-arboretum/plant-health-care-report/)

GDD for conifer pests: https://www.agriculture.nh.gov/publications-forms/documents/conifer-pests.pdf

GDD for landscape pests: https://www.agriculture.nh.gov/publications-forms/documents/landscape-pests.pdf

GDD for tree fruit pests: https://www.agriculture.nh.gov/publications-forms/documents/tree-fruit-pests.pdf

GDD for flowering times of indicator plants: https://extension.unh.edu/sites/default/files/migrated_unmanaged_files/Resource000986_Rep2328.pdf