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High Energy Forages and Soil Building Cover Crops

Growing degree days and growth requirements for Corn.

Growing Degree days are a daily accumulation of heat for crop growth. Corn does not grow when temperatures are below 50°F, and temperatures above 86°F do not increase plant growth rate. The hybrid seed tag GDD ratings are determined from planting to black layer formation. Hybrids typically use about 200 fewer GDD's to mature in PA compared to some Midwestern locations.

Corn Growing Degree Day Formula (Daily High + Daily Low) / 2 – 50

If the number from this equation is a negative number we use "0" GDD's for Corn.

Also a daily high temperature above 86°F is entered as 86°F, above that temperature we do not get significant growth.

Examples

(51°F Daily High + 29°F Daily Low)/2-50 = (80)/2=40-50 = -10 A negative number is recorded as 0 Corn GDD for that day or 0 Corn daily heat units.

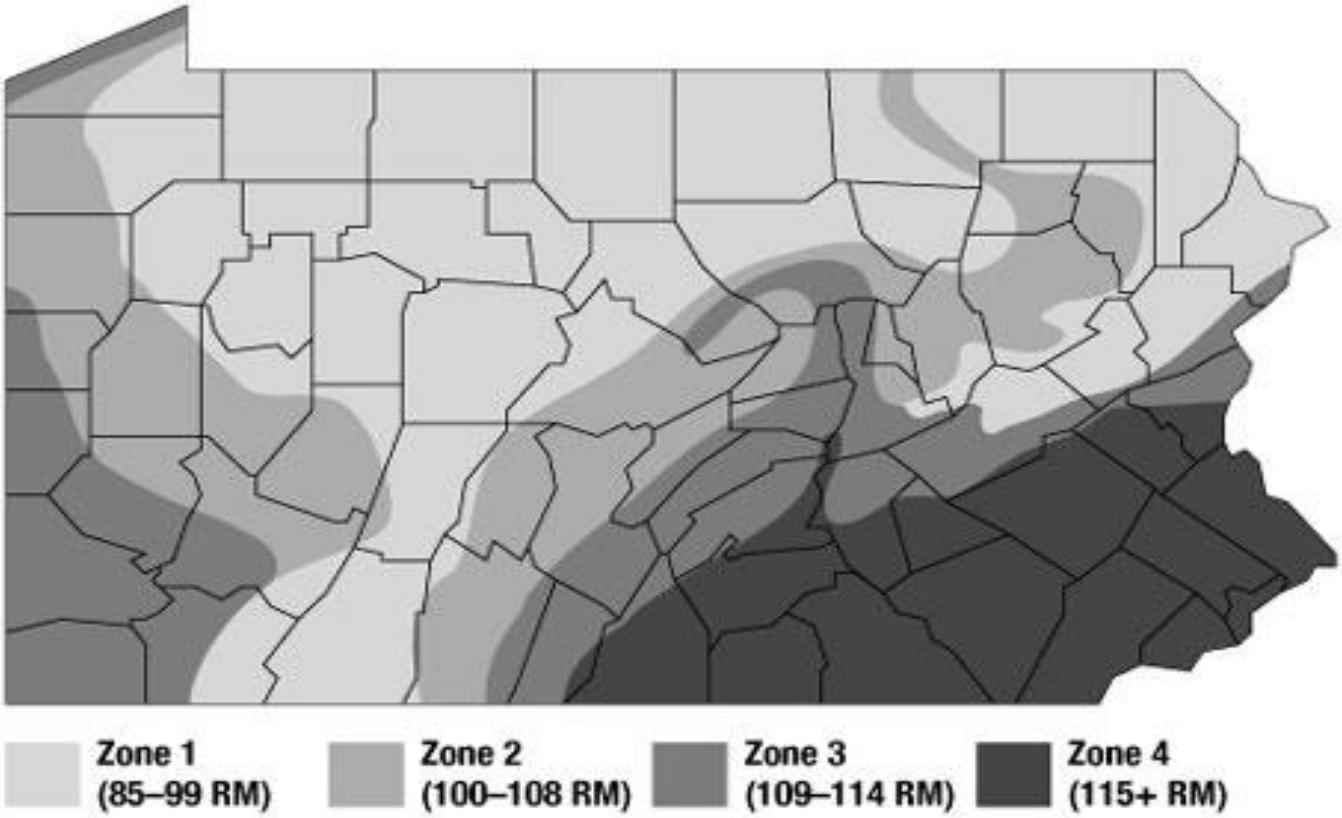
(76°F Daily High + 40°F Daily Low)/2-50 = (116)/2=58-50 = 8 8 Corn GDD's for that day or 8 Corn daily heat units.

(94°F Daily High + 67°F Daily Low)/2-50 = in this case we enter 86°F as the high (anything over 86°F is entered as 86) so this will be (86+ 67) = (153)/2=76.5-50 = 26.5 So we have 26.5 Corn GDD's for that day or 26.5 Corn daily heat units.

Each day we add the daily heat units from the time the corn has emerged and accumulate them day after day.

Pennsylvania corn maturity zones from the Penn State Agronomy guide, below

Figure 1.4-1. Pennsylvania corn maturity zones and the approximate maximum relative maturity (RM) of adapted hybrids for full season grain production.



Approximate relative maturity rating and growing degree days available for Pennsylvania corn maturity zones.

Maturity Zone	Approximate Relative Maturity Value	Growing Degree Days	Planting date
1	90-95	1,600 - 1,824	May 15-25
	96-100	1,825 - 2,024	
2	101-105	2,025 - 2,350	May 1 - 15
	106-110	2,350 - 2,499	
3	111-115	2,500 - 2,724	April 25 - May 7
	>115	2,725 - 2,949	
4	>115	2,950 - 3,174	April 15 - May 1
	>115	3,175 or >	

It should be noted that this map of corn maturity zones is for "full season" grain production and it will assume an early planting date in these growing zones. That early planting date was determined using the typical planting dates for conventionally grown corn. **No-till soils typically warm up slower compared to conventionally tilled soils, no-till planting corn may delay planting dates, or delay corn seed germination and subsequent emergence date.** Also organically produced corn is typically planted later than conventional corn for a number of reasons.

1. Typically in organic systems, in the spring before planting the corn, a legume cover crop or a surface application of manure or a combination of both is plowed under to incorporate for fertility purposes. This plowing doubles also as a weed management practice.
2. If a legume cover crop is being grown for nitrogen production, the spring growth of the cover crop during the period of time from the middle of April until the middle of May is critical for the abundant production of the cover crop biomass containing nitrogen-rich proteins in the leaves of the legume plant. This growth is dependent upon adequate heat units required by the cover crop to grow. These heat units are lower than what is required for corn. So by delaying the planting of corn we are maximizing the use of heat units to grow our legume cover crop biomass, but as we get into the month of May we begin to lose growing degree day heat units for corn, this in turn makes our growing season shorter in a typical organic system compared to an earlier planted conventional system.
3. Insecticides and fungicides are not allowed as seed treatments on certified organic seed corn. Early planted conventional corn that is treated will resist fungus damage due to colder and wetter soil conditions that are typically experienced with early spring corn planting dates. To avoid these conditions in organic systems, the planting date is delayed until soil temperatures reach 50°F (10°C) and rising. This practice reduces the chances of fungus infection of the seed and seedling and also insures a quicker corn seed germination and subsequent emergence. This quicker emergence also is beneficial for early plant competition with weed seeds that will emerge.

Corn, ESTABLISHMENT, Planting date

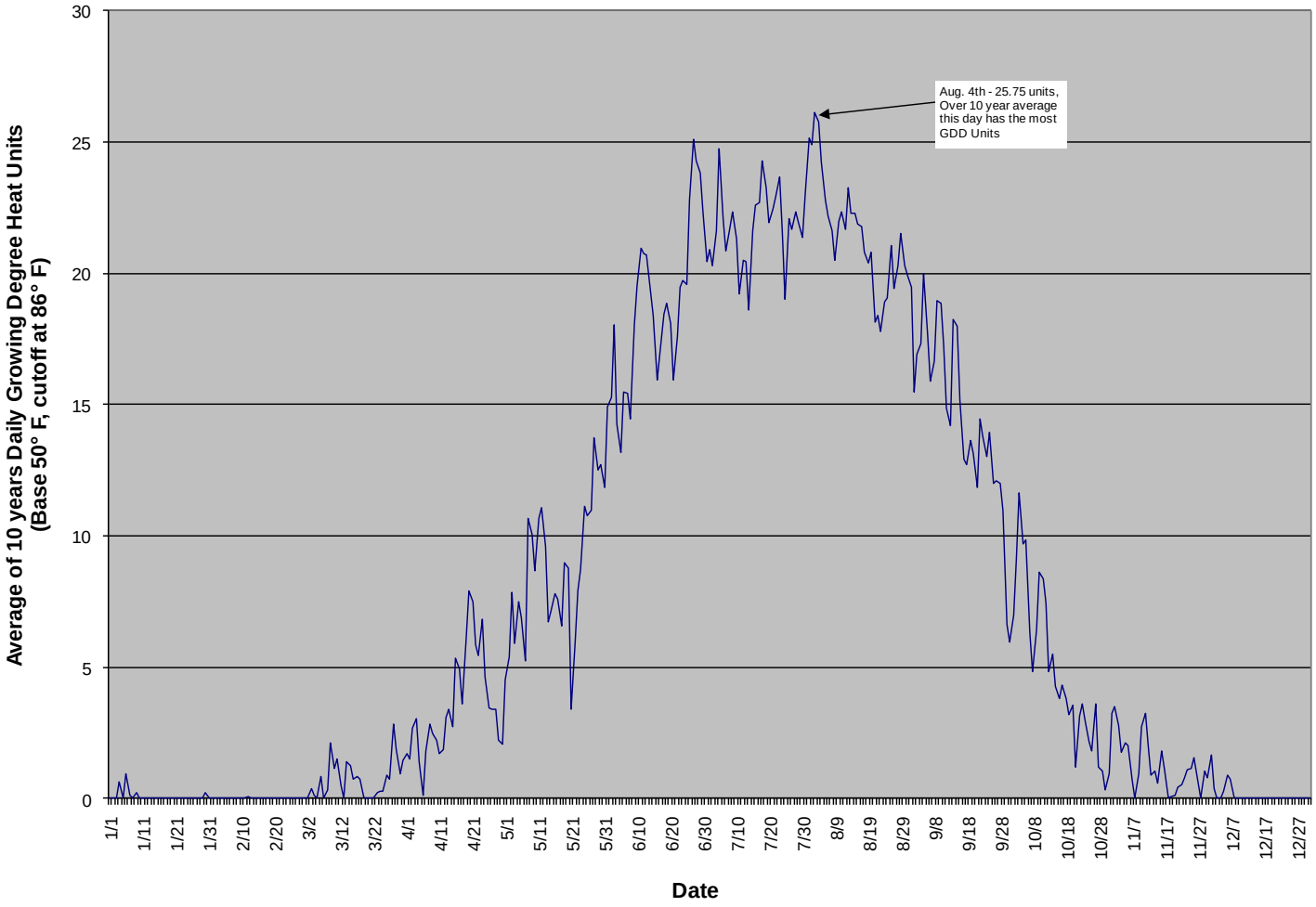
The "ideal" planting time for any given location is only a few days long if maximizing the growing season for corn is the goal. In most years, each day's delay past this period can reduce yields up to 1 bushel per acre per day. Consequently, corn planting should begin early enough to ensure that the bulk of the crop can be planted during this optimum period. On large farms with considerable acreage this becomes a function of how many acres can be planted in a day which depends on weather conditions so the soil is not too wet for planting.

Normally, for large farms that are pushing the envelope, corn can be planted safely 10 to 14 days before the average date of the last killing frost. This date ranges from April 15 in long-season areas to May 15 in cooler regions of the state. Ideally, soil temperatures in the seed zone at 8:00 A.M. should be 50°F (10°C) or above, and the 5-day extended weather forecast should indicate continued warm, or warmer, conditions. However, soil physical conditions for good seed coverage are equally important in deciding to plant. The conventional corn with conventional tillage can be targeted for planting as early as April 22, some conventional farms in the Berks County area plant as early as April 15.

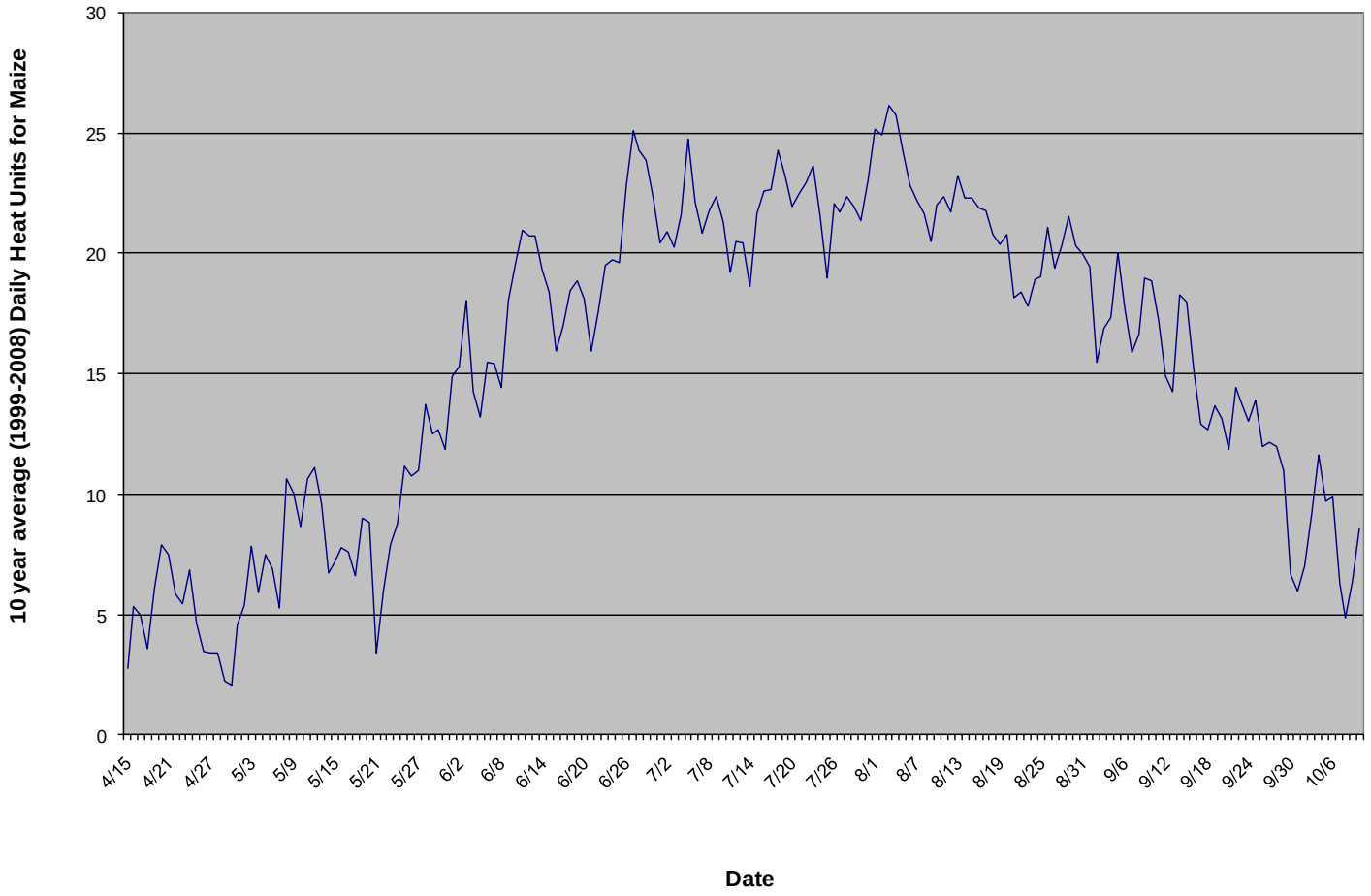
"Scope and scale" are important factors to consider. The necessary practices that prepare a soil for planting organic corn at on a few acres can be accomplished in a short period of time, as we increase the number of acres that we want to apply this then we must also increase the timing factor needed accordingly for larger amounts of acreage. As we get into the application of this model to hundreds or thousands of acres we need to realistically consider what weather events such as rainfall may occur during that extended planting date time range required for plowing and preparing the soil. Once a significant rainfall event occurs during this period of time, this will further delay the continued planting of the corn.

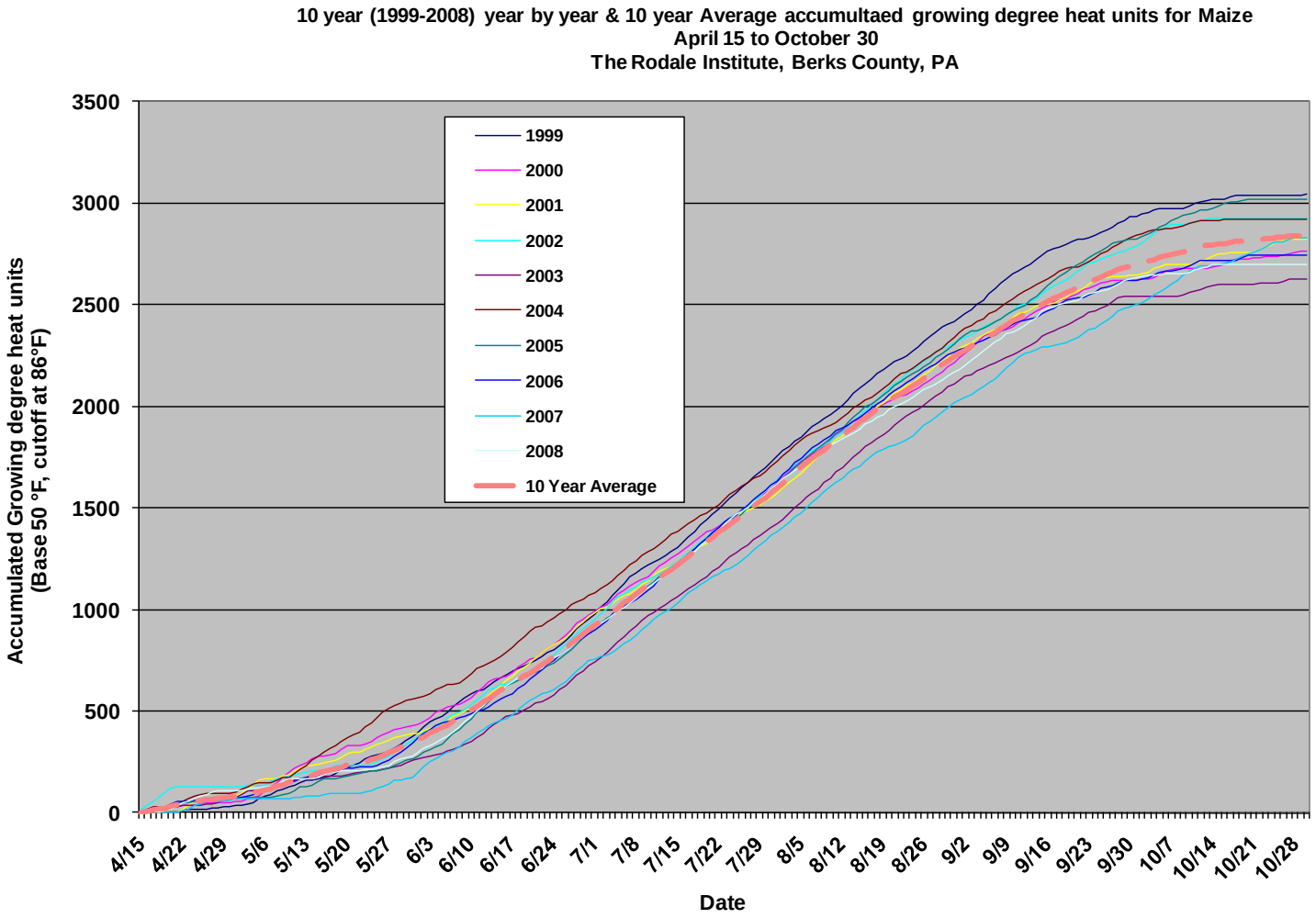
In addition we need to consider that on the larger scale for every day we delay planting we are also losing heat units for the corn. If all things are equal such as corn genetics, moisture availability, soil type and soil fertility nutrient availability; then heat units in combination with irradiance or light intensity will become the factors that will limit our yield. Photosynthesis is dependent on temperature. It is a reaction catalysed by enzymes. As the enzymes approach their optimum temperatures the overall rate increases. Above the optimum temperature the rate begins to decrease until it stops.

10 year average (1999-2008) Maize Growing Degree Day Daily Heat Units
The Rodale Institute, Berks County, PA



10 Year Average (1999 to 2008)
Daily Growing Degree Day Heat Units for Maize (Base 50°F, cutoff at 86° F)
April 15 to Oct 7, The Rodale Institute, Berks County, PA




10 year (1999-2008) year by year & 10 year Average accumultaed growing degree heat units for Maize
April 15 to October 30
The Rodale Institute, Berks County, PA
Accumulated Growing degree heat units
(Base 50 °F, cutoff at 86°F)
3500
3000
2500
2000
1500
1000
500
0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
10 Year Average
4/15
4/22
4/29
5/6
5/13
5/20
5/27
6/3
6/10
6/17
6/24
7/1
7/8
7/15
7/22
7/29
8/5
8/12
8/19
8/26
9/2
9/9
9/16
9/23
9/30
10/7
10/14
10/21
10/28
Date

Using the 10 Year Average (1999 to 2008) 'Accumulated' growing degree heat units for Maize
(Base 50°F, cutoff at 86°F)
Starting at 7 different dates 4-15 through 6-25, to estimate GDD's for various planting dates
The Rodale Institute, Berks County, PA