1970

A New Corn Maturity Rating: Growing Degree Days (GDD)

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Recommended Citation
SDSU Extension Fact Sheets. 1458.
https://openprairie.sdstate.edu/extension_fact/1458

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A New CORN Maturity Rating

Growing Degree Days (GDD)

Cooperative Extension Service
South Dakota State University, Brookings
U. S. Department of Agriculture

Issued in furtherance of Cooperative Extension work, acts of May 8 and June 30, 1914, in cooperation with the United States Department of Agriculture. John T. Stone, Dean of Extension, South Dakota State University, Brookings.

10M—12-70—File 1.124—845
There is a new way of rating the maturity of corn. It is more accurate than the old "days-of-maturity" ratings. It will help you estimate which hybrids will use all of your growing season and yet produce mature corn.

This new method is called "Growing-Degree-Days" (GDD) or "Heat Units" because it is based on the number of growing degree days between planting time and physiologic maturity (or first killing frost). Most seed corn companies are now using this rating. This publication will help you determine which hybrids are of the right maturity for you.

Two new terms are being used: Growing Degree Days (or heat units), and the black layer on the tip of the kernel to denote when the seed is mature. It is not necessary for you to understand either term. You can simply use the map, or the table or both to determine the number of growing degrees for your area.

Use Map or Table

Since most corn in South Dakota is planted after May 3 and is physiologically mature by October 3, the map was developed to give a rough estimate of the number of growing degree days for the 5-month period in all areas of the state. If you plant in early May and hope to have mature corn by early October, all you need to do is select a hybrid with a lower growing degree day rating than shown for your area on the map.

For example, if you live in Minnehaha County, you probably plant corn early in May and plan to have it mature by early October. The map shows that you usually have 2,600 to 2,700 growing degree days between May 3 and October 3. So you select a hybrid with a maturity rating of 2,600 or less. By selecting a hybrid that requires fewer GDD, you have a safety factor for years when you get an early frost.

Different Planting Dates

You can use the table to estimate the growing degree days for a different season. You may not plant corn as early as May 3 or you may not ordinarily have the first killing frost until after October 3. It is not necessary to have corn mature before the first killing frost.

For example, you live in Minnehaha County and used the map to help you decide on a hybrid with a GDD rating of 2,600. But your corn was hailed out in late May. You plan to replant on May 27. You can look in the table at columns for May 23 and May 30 for Sioux Falls and see that you can expect to have between 2,421 and 2,511 growing degree days before
you expect to have a killing frost on October 9 (last column of the table). So you select a hybrid with a GDD rating of around 2,400.

Or, you live in Codington County where you may not plan to plant corn until around the middle of May. You ignore the map which shows that you can expect to have between 2,300 and 2,400 GDD, and use the column for May 16 in the table. It shows 2,193 GDD for Watertown so you pick a hybrid with a rating of 2,200 or less.

By using these examples as a guide, you can determine the GDD for your area from the map or table. If you wish to know more about the GDD concept, however, a more detailed discussion of growing degree days and physiological maturity follows.

**Growing Degree Days**

A "Growing Degree Day" is not the same as a calendar day. The term "Growing Degree Day" or GDD is used to designate calculations based on temperature factors or "heat units." The sum of these "heat units" for each calendar day of the growing season provides a figure ranging from 2,300 to 2,900 in South Dakota—that may better pin down the maturity period or rating of corn.

Growing degree days are calculated by subtracting a base temperature from the average of the maximum and minimum temperatures for the day. Corn doesn’t grow much at temperatures of 50° to 53° (F). As temperature rises to a range of 80° to 86°, corn grows faster if moisture is plentiful. But at a temperature above 86° the roots have increasing difficulty taking in water fast enough to keep the plant cells turgid (full of water) and working at top speed.

Consequently only temperature extremes of 50° and 86° are used in calculating GDD. The mathematical expression for calculating GDD is:

\[
\text{GDD} = \text{Max Temp.} + \text{Min Temp.} - \text{Base Temp.}
\]

The maximum temperature is the highest temperature for that day and the minimum temperature is the lowest for the day. The base temperature (below which there’s very little corn growth) is 50°. The formula is adjusted to correct for extreme high or low temperatures. Minimum temperatures below 50° are counted as 50° and temperatures above 86° are counted as 86°.

For example, if the maximum temperature for the day is 84° and the minimum is 60° so:

\[
\text{GDD} = 84 + 60 - 50 = \frac{2}{2} = 22
\]

Then 22 growing degree days occurred on that day. Or, another day the high temperature is 90° and the low is 40°, so:

\[
\text{GDD} = 86 + 50 - 50 = \frac{2}{2} = 50
\]

Then 18 growing degree days occurred that day.

This method is used because temperature is one of the most important environmental factors affecting the rate of plant development. It is recognized that growth is also affected by several other environmental factors such as moisture, nutrients, length of time temperature is above 50°, and photoperiod. Perhaps some of these environmental factors can eventually be used in a formula to help estimate maturity ratings, but "Growing Degree Days" seems to be the best rating developed to date.
Black Layer Denotes Maturity

Cross-sections of corn kernels show the black layer that develops near the tip of the kernel when corn is physiologically mature.

Physiologic Maturity

Physiologic maturity of corn is the stage of development when no more dry matter will be stored in the kernel. Once corn is at this stage it has reached its yield potential. Until recently we have used moisture percentage as a measuring stick. We have said that more dry matter will be produced until the corn kernel dries down to about 35% moisture. Another common guide is that corn reaches maturity 60 to 65 days after silking.

An easier and more accurate method has been discovered. All you need to do is check the tips of the kernels. Just split the kernel and look for a dark, black layer near the tip. If a black layer is visible near the end of the kernel just under the outside layer (see photograph), it indicates the corn kernel has stopped receiving nutrients from the stalk. Unless the plant has dried prematurely from disease or freezing, this means the grain is physiologically mature.

Varying Development

Not all kernels develop this black layer the same day. It is developed at approximately the same time for all kernels in the central portion of the ear. Its appearance is delayed a few days in the larger kernels at the butt of the ear and it appears earliest in kernels at the tip of the ear.

The movement of plant food into the kernels and the development of the black layer seem to be closely related. An environmental stress such as drought, shading, shortage of nutrients, or intense heat causes a reduction in the supply of plant food being moved to the ear. Kernels on the butt of the ear are nearest the source of supply. They continue to assimilate plant food but there may not be enough for the tip kernels. The black layer forms on the tip kernels and they abort, leaving a barren tip. If the stress occurs shortly after pollination, the tip kernels may abort, those in the central part of the ear may form a layer when only partially filled, and the butt kernels may mature normally. In completely developed kernels, the black layer appears to develop soon after starch granule formation has been completed at the base of the endosperm. The storage capacity of the kernel may diminish to such a level as to trigger the disintegration of translocation tissues in the basal endosperm and black-layer formation.

Plant Nutrient Flow Stopped

Regardless of stage of development, formation of the black layer stops the flow of plant nutrients into the kernel. When all kernels on an ear have developed the black layer, that ear has reached its maximum dry weight of shelled corn. Corn is mature at this point. Yield and quality will not be affected by frost, hail or drought and it is ready to pick or cut for silage.

The time required to reach maturity varies by several days, even among corn plants of the same variety in the same field. So for practical purposes, we believe a hybrid is mature when kernels of 75% of the ears have developed the black layer.

This black layer is being used by most seed corn companies to determine when the hybrid is physiologically mature. The GDD or “heat unit” rating is based on the number of GDD between planting time and the time that the black layer is formed.

Secure These Fact Sheets for Additional Information on Corn Production

- Planting Corn in South Dakota
- Fertilizing Corn in South Dakota
- Weed Control in Corn
- Control of Corn Rootworm
- Control of European Corn Borer
- Diseases of Corn
  - Stalk Rot, Ear Rot, Smut, Leaf Blight
- Drying Corn