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RELATIVE HYBRID MATURITY:
ARE GDD RATINGS BETTER THAN 'DAYS TO MATURITY'?

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Why The Interest in Hybrid Maturity Differences?

It's no great secret that corn hybrids vary for the length of growing season required to successfully grow, develop, and mature. We talk about 'early' and 'late' corns as well as 'short' and 'full' season corns. We also talk about 'days to maturity', as in '112' day corn or '102' day corn. Why all the interest in wanting to accurately distinguish among hybrid maturities?

Pre-Season Hybrid Selection

For most corn growers, hybrid selection occurs well in advance of the growing season. Their interest in selecting a range of hybrid maturities varies depending on their particular wants and desires. Almost all corn growers are interested in identifying hybrids with the best combination of yield and grain moisture at harvest. Some select a range of hybrid maturities to time their planting and harvest operations to ensure that each field is harvested at an optimum grain moisture. Other growers desire to spread the timing of pollination across their farming operations to hopefully spread the risk of severe weather during pollination. Finally, some growers have the opportunity to capitalize on early grain markets by growing 'early' maturity hybrids. For these types of pre-season hybrid selection decisions, precise definitions of hybrid maturity are not necessarily critical.

Delayed Planting or Replanting Hybrid Selection

At some point, all growers are faced with the need to select hybrids for a delayed planting or replanting situation. Such a decision is influenced by the need to manage the risk of a shortened growing season. You would like to ensure that a hybrid planted later than normal will mature physiologically (kernel black layer) before the first occurrence of a killing fall frost. Additionally, it would be nice if the grain would dry down as much as possible before the cold days of late fall arrive. For these types of hybrid selection decisions, precise definitions of hybrid maturity are more critical than in pre-season hybrid selection.
The Problem With Hybrid Maturity Rating Systems

The problem with hybrid maturity rating systems today, though, is that there is no accepted industry standard for rating relative maturities among hybrids! Growers can easily become confused when attempting to compare relative maturities among hybrids from different seed companies.

'Days to Maturity' Is A Common Relative Maturity System for Corn

The most common maturity rating system in use today is the 'days to maturity' system. But, it is important to remember that this system does not reflect actual calendar time between planting and maturity. A '106-day' hybrid does not actually mature 106 days after you plant it. A 'days to maturity' rating is based, rather, on relative differences within a group of hybrids for grain moistures at harvest.

Interpretation of 'Days to Maturity' Ratings

A 1 'day' difference between two hybrids is typically equal to 1/2 to 3/4 percentage points difference in grain moisture. For example, a '106-day' hybrid would average 3 to 4.5 points drier than a fuller season '112-day' hybrid if they were planted the same day (6 'days' multiplied by 0.5 or 0.75).

This relationship is usually dependable when comparing hybrid maturities within a single seed company. However, because of a lack of standardization of rating methods, grain moisture comparisons of hybrid maturities from different seed companies are often poor to say the least.

Bottom Line on 'Days to Maturity' Ratings

In summary, 'days to maturity' ratings are not absolute and are not standardized throughout the industry. Because of their relative nature, 'days to maturity' ratings are satisfactory primarily for pre-season hybrid maturity selection. For most pre-season selection needs, absolute maturity ratings are not important because the length of the growing season is usually not an issue.

In my opinion, 'days to maturity' ratings are not satisfactory for delayed planting or replanting hybrid selection needs. Growers need more absolute descriptions of hybrids’ growing season requirements in order to manage the risk of a killing fall frost on late-planted corn.
How Do You Choose a Hybrid For Replant or Delayed Planting?

**Corn Responds to Thermal Time**

Let's remember that, more so than calendar time, corn responds to thermal time. Corn grows faster as temperatures rise and grows more slowly as temperatures fall. Thermal time is defined as the accumulation of heat over calendar time. Thermal time is measured as Growing Degree Days (GDD).

The GDD calculation method most commonly used for corn in the US is the '86/50 Cutoff Method'. GDD are simply calculated as the average daily temperature minus 50. If the maximum daily temperature is greater than 86F, only 86 can be used in determining the daily average. Similarly, if the minimum daily temperature is less than 50F, only 50 can be used in determining the daily average. GDD are calculated daily and summed over time to define thermal time for a given period of time.

**GDD and Hybrid Maturity**

Hybrids can vary for GDD to silking and/or kernel black layer. Remember that kernel black layer is the point of physiological maturity for corn. The black layer is a thin layer of placental cells near the tip of the kernel that die, collapse, and turn black as the grain matures. The cell death signals the end of photosynthate flow into the kernel and, thus, the point of maximum kernel dry weight.

'Early' maturity hybrids typically require fewer GDD to reach silking and/or fewer GDD to progress from silking to kernel black layer. Seed companies often advertise GDD ratings in addition to 'days to maturity' ratings as a measure of relative hybrid maturity. Hybrid GDD ratings are linked to kernel black layer development rather than to harvest grain moisture differences.

**Using Hybrid GDD Ratings**

In theory, hybrid GDD ratings should be much easier to use and more accurate when making hybrid maturity decisions for delayed planting or replanting situations. First, you would determine how many GDD your area could expect to receive from the point of delayed planting until the average date of a killing frost. To do this, you need 'normal' frost dates for your area as well as 'normal' GDD accumulation data. This information is usually available from local National Weather Service reporting stations.

Once you've determined how many GDD are expected until the frost date, you would simply match these expected remaining GDD to a hybrid's GDD needs. One should aim for
kernel black layer 1 to 2 weeks prior to the frost date to provide some buffer against an early frost and to provide more field drydown time.

The Big Question Is...

Are hybrid GDD maturity ratings dependable and accurate?

Problems With Hybrid GDD Ratings

Inconsistency Within the Seed Industry

While the idea of using GDD ratings for hybrid maturities sounds appealing, there are a few kinks in the system. First of all, GDD ratings of hybrids with similar 'days to maturity' ratings don't always agree, especially if the hybrids are from different companies. Part of the problem is related to the previously mentioned differences among companies in assigning 'days to maturity' to hybrids.

Beyond that, however, is the fact that some seed companies start counting GDD from the day of planting while others begin from the day of emergence. When this occurs, similar maturity hybrids may vary by 100-150 GDD since it usually takes this amount of GDD for emergence to occur in corn. Secondly, some companies use entirely different methods to calculate GDD.

Influence of the Environment

A second problem with hybrid GDD ratings is that the environment can influence the GDD needs of a hybrid. Most of the information presented in the remainder of this paper is from a study being conducted in Indiana and Ohio by myself and Dr. Peter Thomison. We are interested in determining the influence of locations, years, and planting dates on corn hybrid responses to GDD accumulation from planting. We've been evaluating season-long growth and development responses of 3-5 hybrids planted in early May, late May, and early June at 2-4 locations in Indiana and Ohio since 1991.

Hybrids grown at different locations often mature (black layer) at different GDD accumulations. These location differences may flip-flop from year to year. Topography, latitude, climate, diurnal temperatures, and daylength all may be involved in these location effects.

1Not that I am promoting Pioneer Hi-Bred International, but their literature clearly states that their hybrid GDD ratings are from planting. So, use their varieties as a kind of benchmark for GDD maturity ratings if you think the GDD ratings of a similar hybrid maturity from another company doesn't look right.

2Dr. Peter Thomison, Agronomy Dept., The Ohio State Univ., 2021 Coffey Road, Columbus OH 43210.
Variable plant stresses from year to year may also influence corn’s developmental responses to thermal time. Recall the Ice Age Summer of 1992 and the effect it had on hybrid maturity. Hybrids in our study matured approximately 35 days later in 1992 than in the much warmer 1991 season. However, on a thermal time basis, corn actually matured much sooner in 1992! Kernel black layer development occurred over 300 GDD sooner in 1992 than in 1991.

A logical question to ask in 1992 was: Did corn mature prematurely? Many symptoms associated with premature kernel black layer were evident. Smaller than normal kernels, higher grain moisture at black layer, lower test weights, and air cavities near the black layer areas of the kernels. Furthermore, sub-optimal temperatures were more frequent late in the season in 1992, even though the first true killing freeze did not occur until October 19. But, premature black layer development was not the only culprit in 1992, since fewer GDD were required by the hybrids in our study all season long.

Influence of Planting Date

A third problem with hybrid GDD ratings is that delayed planting appears to decrease the GDD needs of hybrids, both in terms of GDD to silking (Fig. 1) and GDD to black layer (Fig. 2). The decrease in GDD to kernel black layer appears to be in the neighborhood of 5-6 GDD per day of delayed planting from early May through early June.

![Fig. 1. Influence of delayed planting on GDD accumulations from planting to 50% silk emergence for three corn hybrids in westcentral Indiana, 1993. R. Nielsen, Agronomy Dept., Purdue Univ.](image-url)

Why does delayed planting seemingly decrease the needed GDD from planting to kernel black layer? We have to be honest and say that we are not sure of the answers yet. However, we can speculate that the later plantings were subject to more frequent spells of sub-optimal
temperatures late in the grain fill period. The early June plantings were subject to killing freezes before grain was mature. The result of both of these phenomena is that the hybrids likely developed kernel black layer prematurely.

Fig. 2. Influence of delayed planting on GDD accumulations from planting to 50% kernel black layer for three corn hybrids in southwest Ohio, 1991. P. Thomison, Agronomy Dept., The Ohio State Univ.

Secondly, the planting date effects were partially due to additive GDD decreases throughout the growing season (Fig. 3). As planting was delayed, fewer GDD were required from planting to silk emergence, silking to half-milk line stage, and from half-milk line stage to kernel black layer. We are not sure of the causes of the reduction in required GDD early in the season.

Fig. 3. Influence of delayed planting on accumulated GDD to silking, half-milk line, and kernel black layer in southwest Ohio, 1991. Pioneer brand 3527. P. Thomison, Agronomy Dept., The Ohio State Univ.
Are GDD Ratings Better Than 'Days to Maturity'?

In summary, can we say that hybrid GDD ratings for maturity are better than 'days to maturity'? In theory, yes, but we obviously need a better understanding of the effects of location, environment, and planting dates on hybrids' GDD needs. If we can model these effects, then perhaps GDD ratings can be made useful.

Just as importantly, the seed industry needs to adopt uniform standards for both the traditional 'days to maturity' rating system as well as the hybrid GDD rating system. Such a standardization of techniques will go a long ways towards making hybrid maturity selection a less difficult task for delayed planting or replanting.