AGR-202

Corn Growth Stages and Growing Degree Days: A Quick Reference Guide

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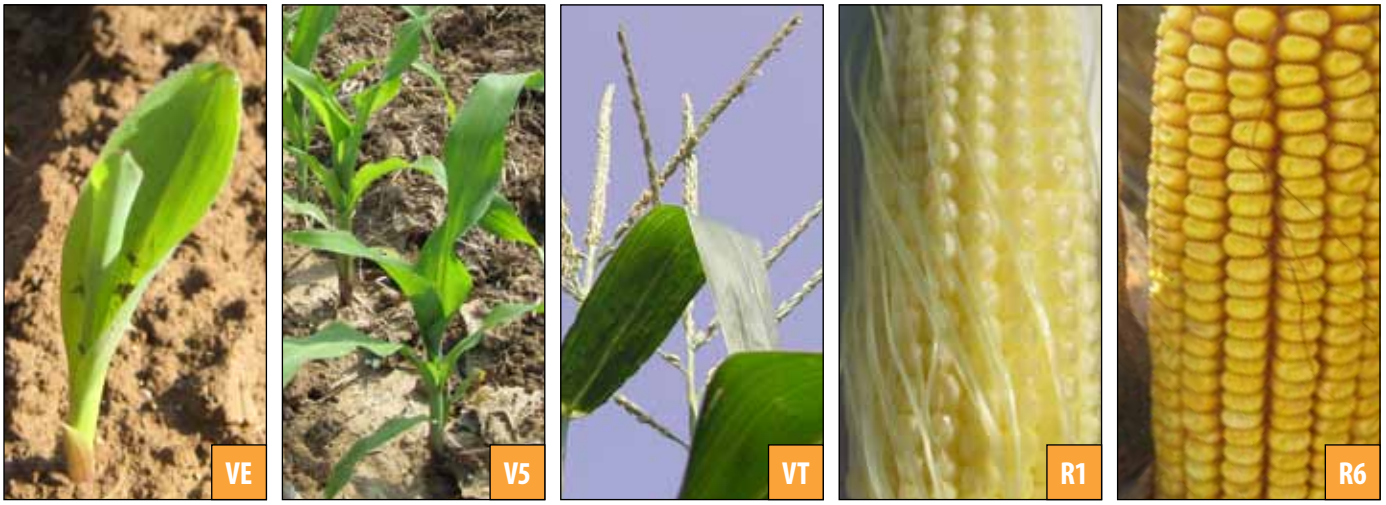

Corn growth stages are based on the leaf collar method, where fully emerged leaves (leaf collar visible) are used to stage vegetative development. Key growth stages and brief descriptions are listed in Table 1. For more detail on staging corn, consult *Corn Growth and Development* from Iowa State University Extension.

Corn Growing Degree Day Calculations

Growing degree days (GDDs) are used to relate temperature to corn growth and development (Table 2). Seed corn companies report hybrid maturity in days, based on the expected number of days necessary to reach enough GDDs to complete growth and development. For example, a 111-day hybrid is expected to require 111 days in the Corn Belt to obtain enough GGDs to reach harvest maturity. GDD's are calculated as:

$$GDD = \frac{Tmax + Tmin}{2} - Tbase$$

Where Tmax or maximum temperature is limited to 86°F, Tmin or minimum temperature is limited to 50°F, and Tbase or base temperature is set to 50°F.

Table 1. Key growth stages in corn.

Growth stage	Appearance	Comments
VE	Emergence	Mesocotyl pushes through the soil surface. Seminal root system active.
V3	3 Collars	3 leaves are fully extended with visible collars. Nodal roots active. Growing point below ground.
V6	6 collars	Growing point above ground. Tassel and ear development starting.
V12	12 collars	12 leaves have fully expanded, but bottom two to three leaves may be gone. Ear size, kernel size and kernel number being determined. Limits on water and/or nutrients will reduce yields.
V15	15 collars	Potential kernel number is set. Upper two ears are similar in size, but the uppermost ear will be dominant.
VT	tassel	Last tassel branch is fully visible. Complete leaf loss will cause nearly 100% yield loss. Pollination may occur while tassel is emerging.
R1	Silking	One or more silks extending from the husk leaves. Most sensitive period for stress. Pollination occurring. N and P uptake are rapid. About 60, 40 and 75% of total uptake of N, P and K, respectively.
R2	Blister	Plant height complete. Ear length complete. Vegetative weight complete. A miniature corn plant is being formed in each fertilized kernel.
R4	Dough	Kernel interior is similar to "dough". Kernel is about 70% moisture at start of R4.
R5	Dent	Kernels at top of ear have dented. Starch layer "milk line" has formed and progresses down the kernel. Kernels are about 45% of total dry weight at start of R5 and near 90% total dry weight at half milk line.
R6	Physiological Maturity	Blacklayer has formed at bottom of kernel. Kernel is about 30 to 35% moisture.

Source: Abendroth, Elmore, Boyer and Marlay. 2011.

Example 1

High temperature: 75
Low temperature: 55

Average Daily Temperature =
(75 + 55) ÷ 2 = 65
65 – 50 = 15 GDDs

Example 2

High temperature: 97
Low temperature: 66

Average Daily Temperature =
(86+66) ÷ 2 = 76
76 – 50 = 26 GDDs

In Example 2, the maximum daily temperature was 97, but 86 was used in the equation because Tmax is limited to 86° F.

Most hybrids in Kentucky will require about 2700 to 3100 GDDs or heat units to reach R6 (physiological maturity or blacklayer). For the example in Table 2, the corn hybrid needs about 200 GDDs to each V2 (2 fully emerged leaves) and 1400 GDDs to reach R1 (silking).

Table 2. Example of GDD requirements for development of a 2700 GDD corn hybrid.

Growth Stage	GDD
V2	200
V6	475
V12	870
VT	1135
R1	1400
R6	2700

Source: Neild and Newman. 1987.

Growing Degree Days accumulate more rapidly with later planting dates. For example, hybrid DKC66-96 is a "116-day" hybrid that reaches mid-pollination by 1350 and black layer by 2820 GDDs. When planted on April 1 in Mayfield, the hybrid should reach 2820 GDDs by early August (Table 3); the same hybrid planted May 15 will reach 2820 GDDs by early September. A 6-week delay in planting should result in about a 3-week delay in black layer.

Resources

- Growing Degree Day calculator, available online at http://wwwagwx.ca.uky.edu/.
- University of Kentucky Ag Weather Center, available online at http://wwwagwx.ca.uky.edu/.

References

- Abendroth, L.J., R.W. Elmore, M.J. Boyer and S.K. Marlay. 2011. Corn Growth and Development. PMR 1009. Iowa State University Extension. Ames, Iowa.
- Monstanto Co. 2010. Seed Resource Guide, South. St. Louis, MO.
- Neild, R.E., and J.E. Newman. 1987. NCH-40 Growing Season Characteristics and Requirements in the Corn Belt. National Corn Handbook.

Table 3. GDDs expected to accumulate during the growing season based on 30 years of weather data.

Planting Date	Mayfield, KY			Henderson, KY			Bowling Green, KY			Bardstown, KY		
	Expected GDDs accumulated by:											
	31-Jul	31-Aug	30-Sep	31-Jul	31-Aug	30-Sep	31-Jul	31-Aug	30-Sep	31-Jul	31-Aug	30-Sep
1-Apr	2545	3322	3908	2512	3289	3875	2411	3150	3677	2356	3095	3622
15-Apr	2349	3126	3713	2335	3112	3698	2225	2965	3492	2194	2933	3460
1-May	2121	2898	3485	2121	2898	3485	1993	2732	3259	1993	2732	3259
15-May	1896	2672	3259	1896	2672	3259	1797	2536	3063	1797	2536	3063
1-Jun	1548	2325	2912	1548	2325	2912	1483	2223	2750	1483	2223	2750

Issued 9-2011