

## Corn Growth Stages and GDU Requirements

- A certain number of growing degree units (GDUs) are required by a corn plant to reach maturity, regardless of the number of calendar days it takes to accumulate.
- Knowing the relationship between GDU accumulation and corn development, and the estimated number of days to reach a certain growth stage, can help predict when important growth stages will occur.
- Growth stages can be used to help growers make timely applications of herbicides and fungicides.

### Corn Growth Stages

Corn plants all have the same general development steps; however, the time between stages and the total number of leaves on a plant can vary. For example, an early maturing product may produce fewer leaves or develop through growth stages faster than a slower paced late maturing product. Variation in the time of development may be due to differences in corn products, environmental stresses, locations, planting dates, and seasons.

### Germination

Once corn seed is planted into soil, metabolic reactions begin to take place within the seed. The radicle begins to elongate from the seed when adequate moisture is available and soil temperatures are above 50° F. Emergence of the radicle from the seed is called germination, which may occur from 2 to 3 days after planting or when 65 to 80 GDUs have accumulated. Germination may take several days longer depending on soil moisture, soil temperature, residue on the soil surface, and planting depth of the seed.

### VE to V8: Emergence and Stand Establishment

When the coleoptile is exposed to sunlight at emergence, elongation of the coleoptile and mesocotyl stop. The growing point of the plant is approximately 1 to 1.5 inches below the soil surface at this time.

**VE Stage**—Corn emergence occurs when the coleoptiles reach and break through the soil surface. Normally, corn requires approximately 100 to 120 GDUs to emerge, which under favorable conditions can be 4 to 5 days after planting.<sup>1</sup> If cool or dry conditions exist, emergence may be delayed several weeks. At the VE stage, growth is also taking place below the soil surface as the nodal root system begins to grow. At approximately 6 weeks, the nodal root system will replace the work of the lateral seminal roots in supplying the plant with water and nutrients.

Cloddy soil, herbicide injury to the seedling, soil crusting, or extremely cold soil temperatures may cause problems prior to emergence. One preemergence problem that can occur is coleoptiles that rupture below the soil surface. This makes it difficult for the seedlings to break through the soil surface resulting in seedlings that are yellow, twisted, or “leafout” below ground.

**V1 Stage**—The V1 stage occurs when the first leaf has fully emerged and the leaf collar is visible. The first leaf to emerge will have a rounded tip; later emerging leaves will have more pointed tips. The V1 stage typically occurs 3 to 4 days after emergence.

**V2 Stage**—The V2 stage is reached when 2 leaves are fully emerged with collars visible. The V2 stage occurs typically 7 to 10 days after emergence or around 200 GDUs.<sup>2</sup>

**V3 Stage**—The V3 stage marks the beginning of the photosynthetic process and the end of the seed being the main food source. The V3 stage is reached at 10 to 20 days after emergence or at around 350 GDUs.<sup>2</sup> At the V3 stage, the plant begins to rely on the nodal root system as these roots form root hairs and continue to increase in size. Growth of the seminal root system has stopped.

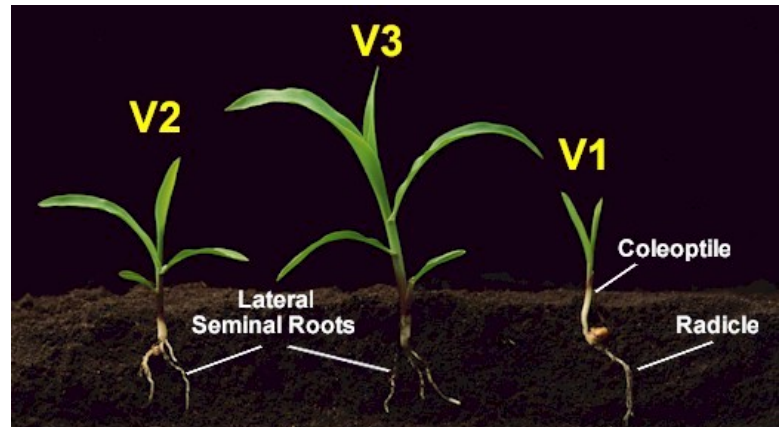


Figure 1. Corn seedlings at V1—V3 growth stages.

# Corn Growth Stages and GDU Requirements

**V5-V6 Stage**—During these stages the uppermost ear and tassel is initiated and kernel row numbers are determined. The growing point of the corn plant is near the surface. The V6 stage occurs at approximately 475 GDUs.<sup>2</sup>

**V7-V9 Stage**—A period of rapid growth begins during these stages. If the corn plant is stressed, lower leaves may die. At approximately 610 GDUs 8 leaves will have formed.<sup>2</sup>

## V10 to V17: Rapid Growth and Dry Matter Accumulation

During the V10 to V17 growth stages, any management practice that helps reduce plant stress and allows for adequate nutrient levels can help maximize yield potential. The number of kernels per row is determined by V17, or approximately 1 week before silking.

**V10 Stage**—At 740 GDUs, ten leaves have formed, the corn stalk elongates, and the tassel rapidly grows during this phase.<sup>2</sup>

**V12-V15 Stage**—At V12, kernel row determination is almost complete. As the plant nears pollination, soil moisture and nutrient availability becomes increasingly critical for yield determination.

## V18 to R1: Pollination

Pollination begins about 9 or 10 weeks after corn emergence. Moisture and heat stress during pollination can result in barren tips or loss of entire ears, which may cause significant yield reduction.

**VT Stage**—Tassel stage begins when the last branch of the tassel is visible, but silks have not emerged (Figure 2). This occurs after the accumulation of approximately 1135 GDUs.<sup>2</sup> Tassels normally appear 2 to 3 days before silk emergence. Pollen shed typically occurs in the morning or evening.



Figure 2. Corn plant at tassel or VT stage.



Figure 3. Corn plant at silking or R1 stage.

**R1 Stage**—Silking stage begins when the silk is visible outside the husk (Figure 3). Pollen falls onto the silks to potentially fertilize the ovules. Each ovule can produce an individual kernel. Moisture stress at this time can cause the desiccation of silks and/or pollen grains, which could reduce seed set.

## R2 to R6: Grain Fill

During the grain filling stages, the plant now provides nutrients for reproductive growth rather than vegetative growth. While the number of kernels has already been determined in earlier stages, the size of the kernels is set during grain fill stages. Frost or freezing before black layer may prematurely kill a plant, which will slow drydown and reduce grain quality and final yield potential.

**R2 Stage**—The blister stage (10 to 14 days after silking) occurs at approximately 1660 GDUs.<sup>2</sup> During this stage the kernel is white and shaped like a blister.

**R3 Stage**—Milk stage (18 to 22 days after silking) the kernel is yellow with a white milky inner liquid. At this stage dry matter accumulation is very rapid. Silks on the corn ear are brown and dry.

**R4 Stage**—During the dough stage (24 to 28 days after silking/1925 GDUs) the inner fluid begins to thicken due to starch accumulation. Kernels will have accumulated half of their total dry weight.

**R5 Stage**—At dent stage (35 to 42 days after silking/2190 to 2450 GDUs) the kernels begin to dry down from the top of the kernel towards the cob. Each kernel will have a dent at the top. If a frost occurs during this stage, the black layer can form prematurely, preventing additional dry matter accumulation.

**R6 Stage**—The kernels continue to gain weight until physiological maturity (black layer) occurs (55 to 65 days after silking/approximately 2700 GDUs). The black layer forms where the kernel attaches to the cob. Kernel moisture is at 30 to 35%.

\*The growing cycle and GDU requirement for different stages are based off a 2700 GDU corn product.

### Sources:

<sup>1</sup>Abendroth, L.J., Elmore, R.W., Boyer, M.J., and Marlay, S.R. 2011. Corn growth and development. PMR 1009. Iowa State University Extension.

<sup>2</sup>Neild, R.E. and Newman, J.E.. 1990. Growing season characteristics and requirements in the Corn Belt. National Corn Handbook, Purdue University, Cooperative Extension Service, West Lafayette, IN.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development, & Agronomy by Monsanto.

Individual results may vary, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible.

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