

Corn Growth and Development – Reproductive Stages

As corn matures during the second half of the growing season, understanding kernel growth stages is important for anticipating yield, harvest moisture, and grain quality. Furthermore, watching the weather forecast and knowing how a cooler fall might impact kernel development can prepare growers for management of harvest activities and potential drying needs. Table 1 (shown on page 2) shows the different appearances of kernels for each respective growth stage during reproduction.

Grain Maturation and Dry Down Rate

There are different factors that can affect the rate of kernel dry down after R6 is achieved. The most prominent of these factors are:

1. Date of maturity – fields that mature earlier in the fall will have more time to dry down during the most favorable drying conditions.
2. Weather – dry down is influenced by temperature and humidity, with higher temperatures and lower humidity favoring more rapid dry down.
3. Hybrid characteristics – some hybrids dry faster compared to other hybrids in the same RM range. See Drydown Ratings in the Rob-See-Co Seed Guide.

Kernel dry down is the direct result of moisture evaporation after kernels have reached full maturity. This rate of evaporation is strongly influenced by temperature at the time of maturation. When predicting kernel moisture and the rate of dry down, there are two general guidelines we can follow.

1. GDU Method. Approximately 30 growing degree units (GDUs) are required to decrease corn moisture 1% from the beginning of black layer down to 25%, and drying corn from 25% down to 20% requires approximately 45 GDUs per moisture point decrease. To put this relationship in perspective, an early October day with a high of 75 degrees and a low of 55 degrees will generate 15 GDUs. For more information on calculating GDUs, see the Rob-See-Co agronomy tip sheet “*Growing Degrees and Crop Development-Corn.*”
2. Calendar Method. We can also assume a rate of dry down per day based on the calendar, as shown in Table 2. Keep in mind that conditions are not always favorable for consistent dry down during any of these date ranges, so individual fields may not behave as predicted. Growers can expect to lose moisture more rapidly in dry, warm weather, and less rapidly in cool, moist weather or under cloudy conditions. The rate of dry down for November 1 and later, shown to be negligible in this Minnesota study, could be above zero in the right conditions; a dry, sunny day with above average temperatures and a light breeze, for example.

Table 2. Rate of dry down of field corn in Minnesota

Date Range during Harvest Season	Points of Grain Moisture Loss per Day
Sept. 15 – Sept. 25	$\frac{3}{4}$ to 1
Sept. 26 – Oct. 5	$\frac{1}{2}$ to $\frac{3}{4}$
Oct. 6 – Oct. 15	$\frac{1}{4}$ to $\frac{1}{2}$
Oct. 16 – Oct. 31	0 to $\frac{1}{3}$
Nov 1 and later	0

Table 2 data courtesy of University of Minnesota Extension

Table 1. Kernel Appearance During Reproductive (R) Stages of Development.

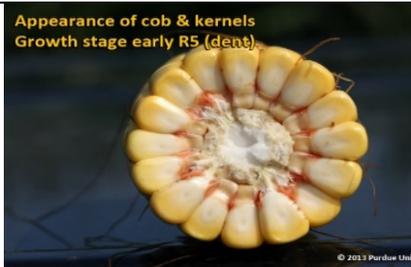
R Stage	Kernel Appearance	Description
1	 Cob and ovules at R1	Silk Stage. Beginning of reproduction. Silks emerge and are receptive to pollen. Pollen grains penetrate silk tissue, travel down pollen tubes, and fertilize ovules. Silks will continue to grow until fertilized. Under optimal growing conditions, all silks on an individual ear will emerge and be fertilized within a three-day period.
2	 Appearance of kernels at R2 Silk attachment point	Blister Stage. Kernels resemble white blisters. This stage is generally attained by 10 to 12 days after R1. Fertilized silks are rapidly becoming dry and turning brown. Kernel moisture is approximately 85% at the beginning of R2, and a developing embryo is becoming visible at the base of each kernel.
3	 Appearance of kernels at R3 (milk)	Milk Stage. This stage is generally attained by 18 to 20 days after silking. Kernels begin to turn yellow and consist of a milky fluid. Kernel moisture is approximately 80% at the beginning of R3, and kernel embryos are clearly visible. Increase in kernel size is now the result of cell expansion, as opposed to addition of new cells.
4	 Appearance of cob & kernels at R4 (dough)	Dough Stage. This stage is generally attained by 24 to 26 days after silking and is characterized by the milky fluid taking on a doughy consistency as starch continues to accumulate in the kernels. Late in the dough stage, crowns of kernels begin to dent, first at the base of the ear and then up the ear toward the tip as the plant progresses to R5 (Dent). Kernel moisture is approximately 70% at the beginning of R4.
5	 Appearance of cob & kernels at R5 (dent)	Dent Stage. This stage is generally attained by about 30 days after silking and begins when all, or nearly all, of the kernels have dented. A milk line appears at the kernel cap when the dent forms. This milk line moves down the kernel towards the cob as the milky fluid turns into a hard starch. The milk line can be used for estimating whole plant moisture for growers harvesting corn for silage. More information on using milk line to time silage harvest can be found in the Rob-See-Co tip sheet " <i>Silage Harvest Moisture Recommendations and Analysis.</i> " Kernel moisture is approximately 60% at the beginning of R5.
6	 Appearance of kernels at R6 (physiological maturity) Embryo	Black Layer Stage or physiological maturity. This stage is generally attained by about 55 to 65 days after silking. The milk line has disappeared, and a black layer has formed at the base, or cob end, of the kernel. Kernels have reached their maximum dry weight and are safe from damage by frost. Kernel moisture at R6 can vary based on hybrid and growing conditions, but average kernel moisture at black layer is around 30%.

Table 1 photos courtesy of Bob Nielsen, Purdue University