Staging Corn Growth

CROP BULLETIN

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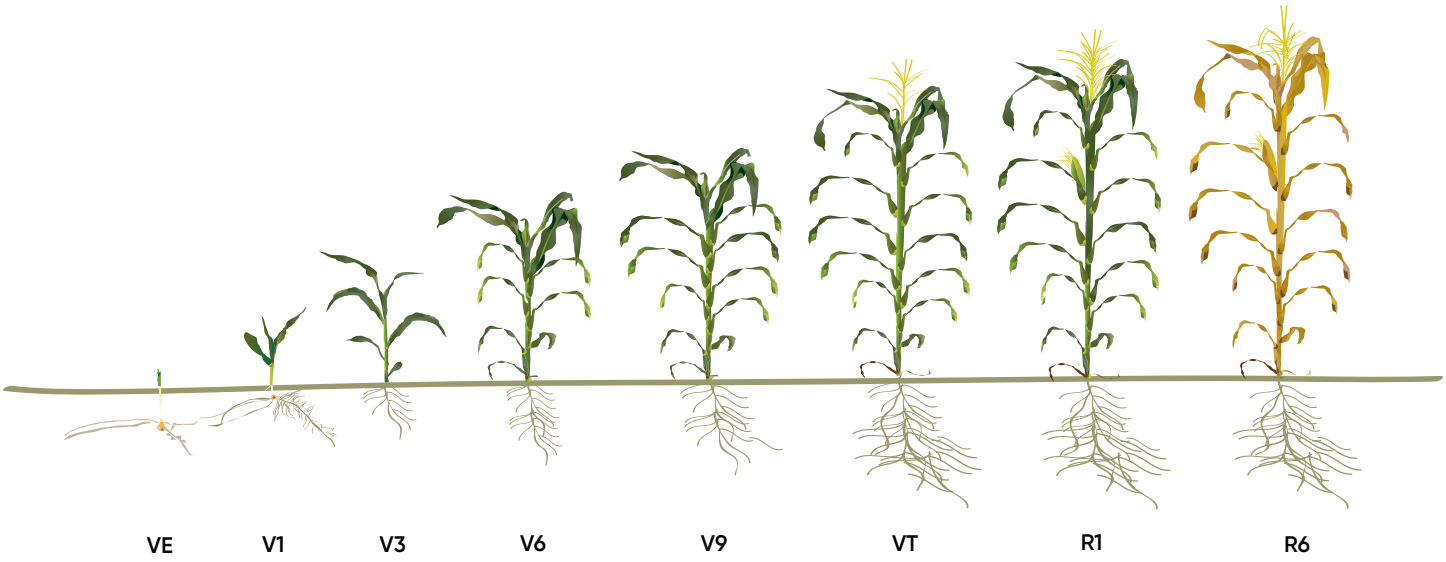
CORN GROWTH STAGES DEFINED

Growth stages of corn are divided into vegetative stages (V) and reproductive stages (R) as outlined in Table 1. Subdivisions of the V stages are designated numerically as V1, V2, V3, etc. through V(n), where (n) represents the last leaf stage before VT for the specific hybrid under consideration. The first and last V stages are designated as VE (emergence) and VT (tasseling). The number of leaves (n) will fluctuate with hybrid and environment differences. The vegetative stages and six subdivisions of the reproductive stages are designated numerically with their common names in Table 1.

Table 1. Growth and development stages.

Vegetative Stages	Reproductive Stages
VE = emergence	R1 = silking
V1= first leaf collar	R2 = blister
V2 = second leaf collar	R3 = milk
V3 = third leaf collar	R4 = dough
V(n) = nth leaf collar	R5 = dent
VT = tasseling	R6 = maturity



STAGING A CORN SEEDLING

Each leaf stage is defined according to the uppermost leaf whose leaf collar is visible. The first part of the collar that is visible is the back, which appears as a discolored line between the leaf blade and leaf sheath. The characteristically oval-shaped first leaf is a reference point for counting upward to the top visible leaf collar as demonstrated in Figure 1.

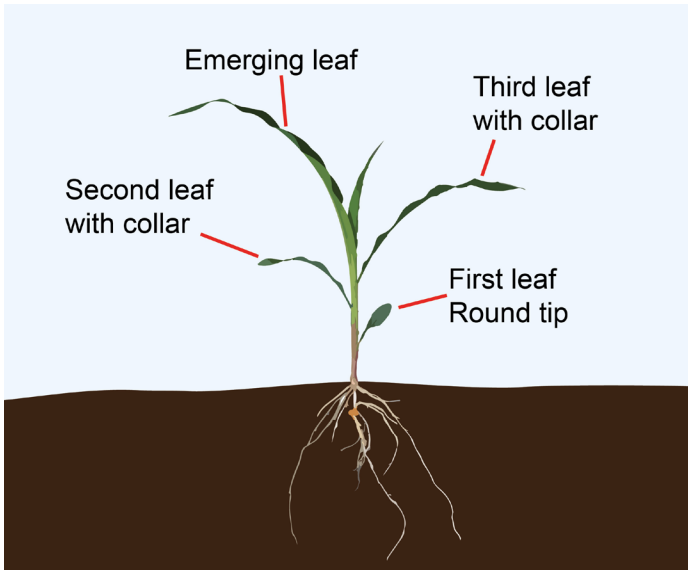


Figure 1. V3 corn plant.

STAGING LARGER PLANTS

Beginning at about V6 increasing stalk and nodal root growth combine to tear the small lowest leaves from the plant. Degeneration and eventual loss of the lowest leaves results. To determine the leaf stage after lower leaf loss, split the lower stalk lengthwise (Figure 2) and inspect for the internode elongation. The first node above the first elongated stalk internode generally is the fifth leaf node. This internode is usually a little less than ½ inch in length. This fifth leaf node may be used as a replacement reference point for counting to the top leaf collar.

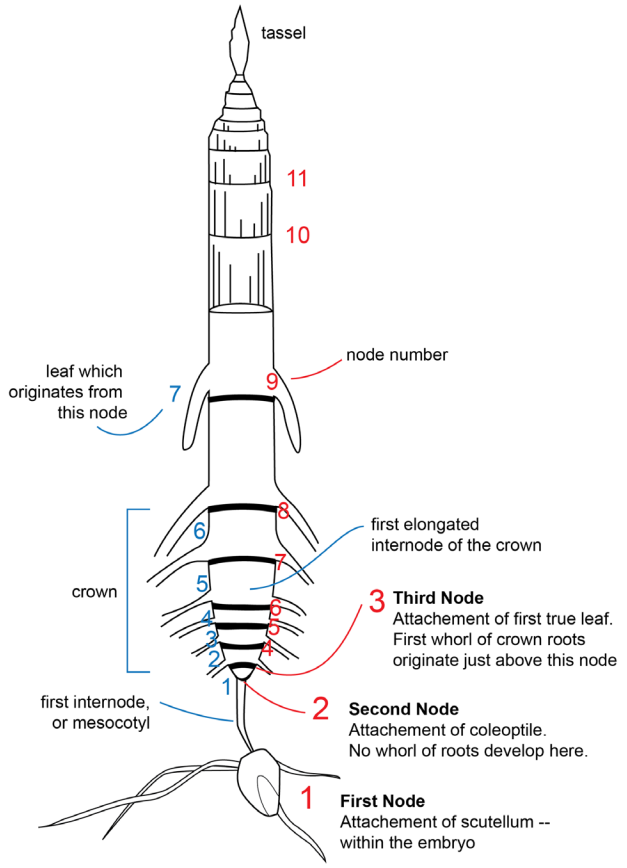


Figure 2. Staging after V6.

STAGING AFTER SILKING

After silks are visible, staging is based on examination of kernels from the middle of the primary ear. The kernels change in several significant ways following fertilization that are used to differentiate between stages. The color will change from white to deep yellow, moisture content will decrease, the embryo will develop, and starch will accumulate.

OTHER STAGING METHODS

Some herbicide labels refer to the stage of development of corn based on plant height or leaf stage. Corn height is generally defined as "free standing" or the height of the arch of the highest leaf that is at least 50% developed. Corn height is less accurate than leaf number in determining growth stage.

Other staging methods include leaf tip and horizontal or "droopy" leaf. The leaf tip method is based on the uppermost leaf tip emerged from within the whorl. The horizontal leaf method is based on the number of leaves with 40% to 50% of their leaf area exposed, along with the tip of the uppermost leaf point below horizontal.

VEGETATIVE STAGES

VE – Emergence

- Occurs when the coleoptile or spike pushes through the soil surface just prior to first leaf collar emerging.
- Seedling will emerge after approximately 100-120 Growing Degree Days (GDD) have accumulated from planting.
- The mesocotyl is the white internode tissue located between the seed and the coleoptilar node elongates to push the coleoptile to the soil surface.
- The seminal root system will consist of the radicle and several lateral roots.

V1 – First Leaf Collar

- Tip of the first leaf is rounded and visible.
- Growing point remains below the soil surface.
- Below ground, one or two nodal roots may be visible.

Figure 3. Corn plant at the V1 growth stage

V3 – Third Leaf Collar

- Nodal and seminal root systems are approximately the same size.
- All leaves and ear shoots produced will form from V3 to V5.
- At this stage, the plant is able to stand because of the combined strength of leaf sheaths layered on top of one another. The developing stalk remains below the surface at V3.
- Since the growing point is still below the surface, the plant can often recover from injury caused by hail, wind, or frost; however, flooding at this stage can kill the plant.

V6 – Sixth Leaf Collar

- All leaves are initiated.
- The growing point and tassel rise above the soil surface.
- The nodal root system is dominant.
- Nodal roots grow from 3-4 lowest stalk nodes.
- Ear shoots are being initiated, first present at lower nodes.
- Kernel row number is determined around V7.

Figure 4. Corn split in half showing the growing point above ground.

V9 – Ninth Leaf Collar

- Lower 2-3 leaves are usually fully or partially decomposed.
- Growing point continues to move upward.
- Brace roots may be present at the soil surface.
- All ear shoots are actively growing.

V12 – Twelfth Leaf Collar

- Approximately 10% of the plant's total dry matter is accumulated.
- Tassel is rapidly growing and becoming more yellow-green in color.
- Number of potential kernels on each ear and the length of the ear are determined.

Figure 5. Dissected corn plant showing immature tassel inside the stalk at V8.

V15 – Fifteenth Leaf Collar

- Every 1-2 days a new leaf stage occurs.
- Approximately 25% of the plant's total dry matter is accumulated.
- Upper ear shoots will continue to grow, growth of lower ear shoots cease.
- Upper two ear shoots are similar in size; primary ear will receive more resources and dominate.
- Number of kernels per row is at or near final as kernel initiation is finished.
- Silks of uppermost ears are now starting to elongate from the base kernels.

V18 – Eighteenth Leaf Collar

- Approximately 35% of the plant's total dry matter is accumulated.
- Tassel continues to grow and is nearly full size.
- Silks from the base ear kernels elongate first, followed by silks from the ear tip kernels.
- Brace roots grow from the nodes above the soil surface to help support the plant and take in water and nutrients during reproductive stages.

Figure 6. Brace root development during the late vegetative stages.

VT – Tasseling

- All branches of the tassel are fully visible.
- At or near maximum plant height.
- Silks have not yet emerged.

REPRODUCTIVE GROWTH STAGES

R1 – Silking – silks visible outside the husks.

- Kernel is white on the outside, inner material is clear with little fluid present.
- Number of kernels per row is determined.
- Both pollination and fertilization occur.
- Flowering period for corn is relatively short, and yield can be significantly reduced by stress during this period.

Figure 7. Ear at R1 with silks.

R2 – Blister – kernels white on outside, clear liquid inside.

- 85% kernel moisture.
- Ear is at its final length.
- Silks begin to darken and dry out.
- Kernel abortion may occur.

R3 – Milk – kernels yellow outside, milky white fluid inside.

- Changes occur due to accumulating starch.
- Kernel moisture is at 80%.
- Most of the kernel has grown out from the cob.
- Silks are brown and dry or becoming dry.
- Kernel abortion can still occur at this stage.

Figure 8. Ear at milk stage with yellowing kernels and milky white fluid.

R4 – Dough – kernel fluid thick/pasty, cob pink or red.

- Kernel moisture is approximately 70%
- Husk leaves begin to turn brown on the edges.
- Just before R5, kernels begin to indent due to starch deposition and moisture loss.
- Stress during and beyond this stage will not result in kernel abortion but can reduce kernel weight.

R5 – Dent – most kernels at least partially dented.

- Kernels dry down from the top, toward the cob, where a small hard layer of starch is forming.
- Starch layer appears shortly after denting as a line across the back of the kernel (non-embryo side) called a “milk line”.
- Accumulated starch is hard above the line, but still soft below the line.
- With maturity, the hard starch layer will advance toward the cob.

Figure 9. Corn ear at early dent stage.

R6 – Physiological Maturity – milk line no longer evident, black layer formed. Maximum dry weight is attained.

- Environmental factors such as temperature, drought, and disease can cause premature formation of the black layer.
- Kernel moisture averages 30-35%.
- Husks and many leaves are no longer green although the stalk may be.

Figure 10. Kernel at maturity showing black layer.

Table 2. R5 to R6 kernel stages, grain moisture, and GDUs remaining to maturity.

STAGE R5
Beginning Dent

Grain Moist.**~50-55%**

~400 GDUs remaining to maturity

STAGE R5.25
1/4 Milk Line

Grain Moist.**~45-50%**

~300 GDUs remaining to maturity

STAGE R5.5
1/2 Milk Line

Grain Moist.**~40-45%**

~200 GDUs remaining to maturity

STAGE R5.75
3/4 Milk Line

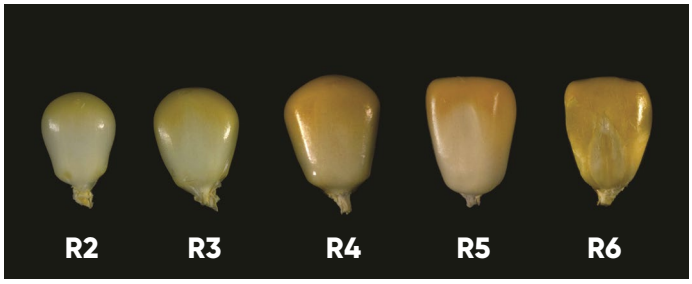
Grain Moist.**~35-40%**

~100 GDUs remaining to maturity

STAGE R6
Physiological Maturity

Grain Moist.**~30-35%**

0 GDUs remaining to maturity



RATE OF DEVELOPMENT

Emergence may occur as rapidly as 4 or 5 days after planting in warm moist soil or may take 3 weeks or more in cool soils. A new leaf will appear about every 3 days during early growth, while later leaves developing during warmer conditions may appear in 1 to 2 days. Full season hybrids in the central Corn Belt typically can produce 21 to 22 leaves. Earlier maturing hybrids will produce fewer leaves. The rate of development after pollination is given in Table 2. Bear in mind that development may be faster than suggested here under higher than normal temperatures or slower under lower than normal temperatures.

Table 2. Days after pollination for reproductive growth stages.

Kernel Growth Stage	Days After Pollination
Pre-blister	9
Blister	13
Early Milk	17
Milk	21
Late Milk	25
Soft Dough	30
Early Dent	35
Dented	40
Late Dent	45
Half Milk Line	50
Mature	55

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