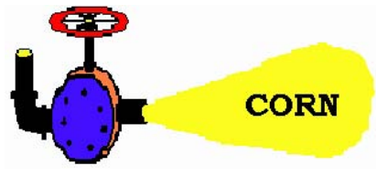
CCS Pipeline™



PIPELINE

CORN - *Zea Mays* .

GROWING CYCLE FOR CORN

The growing cycle of corn consists of vegetative, reproductive and maturation phases, but there are more detailed stages of development within these phases.

Different maturity classes require different GDD accumulations to reach these stages. The growing cycle and GDD requirement for different stages of a 2700 GDD hybrid are discussed in this example.

VEGETATIVE

When seed is planted in moist soil, about 200 GDD above 50° F is required for a seed to germinate and the young seedling to become established. By this time, it has two functioning leaves and a root system so it is no longer dependent on the diminished food supply that was stored in the seed endosperm. When corn is planted too early when a season is cool, it takes too long to accumulate the needed 200 GDD. Consequently, the seedling becomes weak and vulnerable to soil fungus diseases, which then result in a poor stand.

When 475 GDD is accumulated, six leaves have formed and the growing point has risen above the soil surface. At 870 GDD, 12 leaves have formed and a small embryonic ear starts to develop within the plant tissue. It is at this time that the vegetative phase starts to cease and the reproductive stage begins.

REPRODUCTIVE

At 1400 GDD, all the leaves have developed, the tassel has emerged, and the plant has reached its full height; then the silks emerge from the ear and are receptive to the shedding pollen. Grainfill starts to cease, maturation begins, and some kernels become dented at 2190 GDD.

MATURATION

At 2700 GDD, a black layer forms near the base of the kernel indicating that dry matter is no longer being translocated to the grain. The corn is at physiological maturity and safe from a freeze; however, the corn is still 35 to 40 % moisture and will need to dry down before it can be harvested.

The temperature available for growth during different development phases varies with time of planting. Because of cooler temperatures, early plantings have longer vegetative stages while later plantings require more time to accumulate the GDD necessary to mature grain. The reproductive phase, from ear formation to denting, is less affected by planting time. The variation is days to maturity at different planting times is largely the result of differences in the rates of maturity in the vegetative and maturation phases.

CORN GRAIN DEVELOPMENT

The primary ear is initiated about 10 days after emergence with normal growing degree days. At this time, the number of rows around the cob are determined. A loss or gain of two rows relates to about 13% grain yield potential. The potential kernels are being set throughout the 6 to 10 leaf stage and climax at the 12 to 14 leaf stage, where the optimum yield potential is reached.

Any time after ear initiation, stress on the corn plant may impact final yield potential. Cold temperatures (around 40° F) 10 to 11 days after emergence can cause malformed ears, and barren stalks may also be determined at this stage.

At the 12 to 14 leaf stage, the optimum yield potential is reached. Normal full season varieties take a longer time to reach this stage and have a greater yield potential than shorter season varieties, although there are exceptions to this rule. Once silk starts growing, the next phase of development is a function of day length and growing degree days more than planting date.

Pollen grains shed by the tassel germinate when they lodge on the silks. The germinated pollen grain sends down a pollen tube that ultimately terminates in the ovary. Following the fertilization of the ovary by the pollen nucleus, kernel development begins in about 24 hours. The embryo development continues and is morphologically mature in about 45 days.

Except for the surface layer, the endosperm consists chiefly of starch grains. Starch formation begins two weeks or less after fertilization. The kernel reaches physiological maturity in 50 - 60 days after fertilization on an average. This varies with environment and hybrids. Physiological maturity is defined as the time when the kernel reaches its maximum dry matter content. Scientists are not in agreement on the exact moisture content of a kernel of corn when it reaches physiological maturity. Undoubtedly it varies with the genetic background of hybrids. Once a kernel has reached physiological maturity it will only lose moisture; thus, harvest can begin without any loss of yield, however, grain quality may be affected.

At the present time the "black layer" development is considered to be a physical manifestation of physiological maturity. The connective or placenta tissue matures and turns black. Thus, no more nutrients can be transferred into the kernel when the black layer forms.

PLANTING DEPTH FOR CORN When the coleoptile tip is exposed to light, mesocotyl elongation stops. At this time, if the seed was placed at least 1 1/2 inches deep, the growing point of the plant is approximately 3/4 to 1 inch below the soil surface.

Planting depth can be determined by carefully digging up the seedling, being careful not to break off the root system. Measure the length of the mesocotyl (from seed attachment to the base of the crown or nodal roots) and add 3/4 of an inch.

If you plant a seed at 1 1/2 inches deep the nodal roots will be 3/4 to 1 inch below the surface of the soil. If you plant a seed at 2 1/2 inches deep the nodal roots will still be approximately 3/4 to 1 inch below the surface of the soil. The crown from which the plant will develop will always be from 3/4 to 1 inch below the surface of the ground. This is why the mesocotyl length plus 3/4 of an inch closely estimates planting depth. This will only vary a few tenths of an inch.

If you plant a corn seed too shallow (< 1 inch), then the nodal roots will be just below or on the surface of the soil. This will result in rootless corn (holding on only by the mesocotyl), and growth problems or injury from direct exposure of the growing point can occur.

If seed is planted too shallow (< 1.25 ") these symptoms will (can) be seen:
1 -Weak root systems, plant falling over lower soil moisture levels...
2 -Short and stumpy plants. Brace roots can be long and weak.
3 -Reduced yield because the root system is not fully expanded.
4 -Increased disease problems.

If seed is planted too deep (>2.75 ") these symptoms will (can) be seen:
1 -Small... slow growing plants... too much energy used reaching surface.
2 -Coleoptile may split causing the plant to leaf-out under the soil.
3 -Wet, cold, compacted soil can aggravate this situation.
4 -Reduced hybrid vigor.

FOR MORE INFORMATION ON CORN GROWTH AND DEVELOPMENT PLEASE CONTACT
Creech Crop Services, LLC. AT THIS EMAL: creechcrop@aol.com
Or call Buford Creech, CCA at 941-737-2719

GROW DEGREE DAYS (GDD) REQUIREMENT FOR DIFFERENT PHENOLOGY STAGES OF A 2700 GDD HYBRID

PHASE	DEVELOPMENT STAGES	GDD	FERTILITY
Vegetative	Planted		Pre-Plant (N-P-K)
	Emergence	100	Pop-Up (Phosphorus)
	Two leaves fully emerged (Ear Shoot Established)	200	(All T.M. down)
	Four leaves fully emerged	345	
	Six leaves fully emerged (# Rows Determined) (growing point above soil)	475	1st Side-Dressing (N & K)
	Eight leaves fully emerged (tassel beginning to develop)	610	Tissue Analysis (Last T.M. Period)
	Ten leaves fully emerged (#Kernels/Row Established)	740	
Reproductive	Twelve leaves fully emerged (ear formation)	870	2nd Side-Dressing (N & K)
	Fourteen leaves fully emerged (silks developing on ear)	1000	
	Sixteen leaves fully emerged (tip of tassel emerging)	1135	Last Practical (N) Fertilization Period
	Silks emerging/Pollen shedding (Ovule Fertilization) (plant at full height)	1400	
	Kernels in blister stage (Fresh Harvest Time)	1660	
	Kernels in dough stage (End of Fresh Harvest Time)	1925	
Maturation	Kernels denting (Ensilage Time - Plant DM ~ 35%)	2190	
	Kernel dented	2450	
	Physiological maturity (Black Layer Formed)	2700	
	Dry Corn	2720	

CHRONOLOGICAL DEVELOPMENT OF THE CORN ROOT

~ PLANT Growth Stage	Day After Plant (Emergence)	Growth Event	Importance to Plant Development
PLANTING	0 - 2 2 - 3 (0)	¤ With adequate soil moisture and temperature (above 50°F) radicle emerges from seed ¤ 3 to 4 lateral seminal roots emerge	¤ Radicle anchors the germinating seed ¤ Seedling Vigor
VE Emergence	7 (0)	¤ Seminal root system growth complete (collective term for radicle and lateral seminal root	¤ Seminal root system supplies water and nutrients to developing seedling
V1	8-10	¤ Nodal roots initiated ¤ The 1st set (whorl) of nodal roots begins elongation from just above the 3rd node (first leaf node)	¤ Primary root system
V3	18-19 (9-12)	¤ Root hairs are growing from the nodal roots	
V6	30-34 (21-25)	¤ All whorls of nodal roots developed	¤ Nodal roots system becomes the major supplier of water and nutrients.
V8	35-38 (28-31)	¤ Nodal roots 18 inches (46 cm) deep and 15 inches (38cm) wide ¤ Nodal roots grow at an angle of 25 - 30 degrees from horizontal	
V16-V18 Tassel	63 (56)	¤ Brace roots initiated from lowest node above soil surface	
R1 Silking	70 (63)	¤ Brace roots developed and have penetrated the soil surface	¤ Brace roots offer support to the elongated stalk and developing ear
R2 Blister			
R3 Milk	89 (82) DAS* 18-22	¤ Nodal root expansion complete	
R4 Soft Dough			
R5 Full Dent			
R6 Physiological Maturity	130 (124) DAS 55-65		
		*(DAS = Days after silking)	

CHRONOLOGICAL DEVELOPMENT OF THE CORN EAR

~ PLANT Growth Stage	Day After Plant (Emergence)	Growth Event	Importance to Plant Development
PLANTING	0 - 6	¤ Root and shoot growth (cell division, expansion and differentiation)	¤ Radicle anchors the germinating seed
VE Emergence	7 (0)	¤ Leaves initiated	
V3 I	16 - 19 (9 - 12)	¤ Ear Shoot initiated	¤ Ear established
V4-5 II	21 - 30 (14 - 21)	¤ Leaf and ear shoot initiation complete ¤ Tassle initiated in stem apex tip ¤ Stem apex just under or at soil surface ¤ Tillers are forming ¤ Above ground height is 8 in. (20 cm)	¤ Number of rows of Kernels determined ¤ In normal cornbelt hybrids there are 16, 18 or 20 rows of potential kernels per ear
V6	30 - 34 (21 - 25)	¤ Increased stalk elongation initiated ¤ Nodal root system established ¤ Early whorl	
V8-10	35 - 42 (28 - 35)	¤ Nodal roots 18 inches (46 cm) deep and 15 inches (38 cm) wide ¤ Degeneration and loss of lower leaves ¤ Mid-whorl	
V12-14 III	49 - 56 (42 - 49)	¤ Ovule number being determined (potential kernels) ¤ Brace roots beginning ¤ Late whorl	¤ Number of kernels per row determined (will not be complete until V17) ¤ Potential is about 50 kernels per row
V16-18 IV Tassel	63 (56)	¤ Tassel is full size ¤ Silk is forming	¤ Ovule fertilization (most critical period of seed yield is determined)
R1 V Silking	70 (63)	¤ Silk emerged ¤ Pollen shed begins ¤ Brace root development completed ¤ Root mass reaches maximum size	¤ On a well developed ear there are about 750 to 1,000 potential ovules
R2 Blister	81 (74) DAS 10-14		¤ Kernal growth (R2-R5)
R3 Milk	89 (82) DAS* 18-22		
R4 Soft Dough	97 (90) DAS 24-28		
R5 Full Dent	107 (100) DAS 35-42		
R6 Physiological Maturity	130 (124) DAS 55-65		¤ Maximum kernel and ear weight potential under existing growth parameters
		*(DAS = Days after silking)	

GDD CALCULATIONS FOR CORN

Growing degree days (GDD) is ameasure of the number of heat units accumulated each day after a seed has been planted. GDD is used to determine when a corn hybrid/variety will reach various stages of growth, particularly maturity. Daily GDD are added together to give the accumulative GDD for a given time period.

GDD concept assumes that:

- there is a base temperature below which plants do not grow or grow very slowly. (50° F or 10°C)
- The rate of growth increases as temperature increases above a base temperature. (Base is 50° F)
- Plant growth and development are more closely related to mean daily temperature accumulations above a base value, in the absence of other limiting conditions. (Above 86° F or 30° C no credit is given)

GDD Formula

$$\frac{\text{Maximum to 86 daily temperature} + \text{Minimum above 50 daily temperature}}{2} - 50 = \text{Grow Degree Days}$$

Each day the temperature is not within the 50 to 86° F (10-30°C) range, 50° F (10° C) is substituted as the minimum temperature. When the temperature is above 86° F (30° C), 86° F (30° C) is substituted for the maximum temperature in the above formula.

Insect Heat Unit Calculation begins when soil temperature is above 50° F. Plant GDD begins at planting or emergence if soil Temperature is below 50° F.