



Plant by Soil Temperature and Conditions Not According to the Calendar - IL

Planting corn and soybeans early has many benefits in Illinois. Yield potential can be maximized, pest pressure can be reduced, and the potential for early fall frost damage can be avoided. After a long winter and the arrival of spring, many growers want to get into the field. However, planting too early can have a negative impact on yield. It is important to plant according to soil temperature and conditions as opposed to the calendar.

Optimum Temperatures

Corn requires a soil temperature of 50° F to germinate and grow and soybeans require a soil temperature of 54° F. Temperatures below the optimum can cause seeds to sit dormant and become more vulnerable to diseases, insects, and animal predators. Crops should be planted when soil temperatures are optimal and within the target dates for the region. Keep in mind these dates are based on the average year and the use of short or long relative maturity corn products will affect these target dates. Planting into cold and/or wet soils can lead to numerous problems.

Chilling Injury

Imbibitional chilling injury can take place in both corn and soybean. Seed imbibition is a two step process; water is absorbed into the seed and the seed swells. Water intake activates enzymatic processes, such as increased respiration and cell duplication, which eventually result in germination and emergence. If the imbibed moisture comes from a cold source, such as melting snow or a chilling rain, the cell membrane can become rigid and rupture. This may result in damaged or aborted radicles, lower germination and delayed seedling growth (Figure 1). Such damage may limit or prevent nutrient uptake, restrict normal seedling development, and allow for soil disease and pest entry. In soybean, chilling injury appears to be related to how dry the seed is and/or cracks in the seed coat. This is because the seed coat moderates the imbibition (absorption) of water and other particles in and out of the seed. When the seed coat is thin, possibly from overly dry seed, or is cracked, it cannot regulate



Figure 1. A corn seedling that suffered from chilling injury.

imbibition properly. A thin or cracked seed coat coupled with a cold water source during imbibition further increases the chance of chilling injury.

Symptoms of chilling injury can also be caused by other factors and may be compounded by additional stresses during germination. These stresses may include herbicide injury, disease, or soil crusting. Since symptoms are not unique to chilling injury, they can be hard to decipher. Typical symptoms of chilling injury may include a swollen seed that has not germinated as well as a fragile or absent primary root.

Saturated and Flooded Soils

Saturated soils, which can include flooded or ponded soils, can have a negative impact on corn and soybean germination and emergence, even in high quality seed lots. The main side effects include plant growth restriction and decreased oxygen availability to the plant. For instance, saturated soils can inhibit root growth, leaf area expansion, and the photosynthetic process. Young plants may develop yellow leaves due to slowing of photosynthesis and plant growth. A prolonged period of saturated soil can reduce germination and emergence due to lack of oxygen. In addition, portions of roots may die as a result of no oxygen. However, there is still a chance for survival unless the growing point is damaged.

The longer an area remains saturated, the higher the risk of plant death. Experts believe that young corn can survive approximately 4 days of flooding if temperatures are relatively cool (mid-60°s F or cooler). If temperatures are warm (mid-70°s or warmer), survival will be less than 4 days. For soybean, the duration of time is different. Typically, yield losses are not noted in fields flooded for 2 days or less. Four days or more of flooding stresses the crop, delays plant growth, and causes shorter plants with fewer nodes. Six days can cause significant yield loss, and flooding for a week or more can result in entire loss of stand. Warmer weather may shorten all of these durations.

Soil Compaction

Soil compaction takes place when soil particles are pressed together resulting in decreased pore space and increased soil density. Compaction can result in yield reductions due to decreases in seedling germination, root and plant growth, and nutrient uptake. It is important to realize the majority of soil compaction can take place when equipment passes over a field. Research indicates approximately 80% of soil compaction

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happens on the first pass, while subsequent passes cause additional, but progressively less, compaction. The best form of management is prevention. That means staying out of the field until conditions are fit. If mud sticks to the tires and ruts are deeper than an inch, it is too wet to be in the field.

Soil Crusting

Soil crusting takes place when wet soils form a crust layer on the soil surface as they dry. The crust layer can delay or prevent seedling emergence. In addition, soybean hypocotyls can easily be broken when trying to push through the crust. Crusting may be more common in fields with fine textured soils, low organic matter, and little surface residue, especially where excessive tillage has taken place. A rotary hoe can break up the crust and aid seedling emergence. Timing is essential and breaking the crust as soon as possible is most beneficial. If seeds are not infected with disease, cooler soils will allow seedlings to survive longer when trying to break through the crust.

Corn Planting

Based on University of Illinois studies, optimal corn planting takes place between April 11 – April 20 in Illinois, with only minor yield effects through the end of April¹. Yield losses due to delayed planting can reach 1 bushel per day during the month of May (Table 1). Once planting commences, corn seed placement is critical to help maximize yield potential. Remember the following tips to help establish a good crop:

- **Do not plant too shallow.** Planting less than 1.25 inches deep can result in rootless corn or root lodging. Shallow planting can also increase the risk of injury from some soil applied herbicides.
- **Do not plant deeper than necessary.** When soil moisture is abundant, plant around 1.5 to 2 inches deep. When soil moisture is high, planting at depths of 2 to 3 inches can significantly delay emergence. If soil is dry, planting at 3 inches into moisture is less risky than planting shallow in anticipation of rain.

Soybean Planting

Soybeans require different planting conditions than corn. Upon emergence, the growing point of soybeans is immediately exposed to the elements. In comparison, the growing point of corn is underground until around the V6 growth stage (early-mid June). In Illinois, little yield difference is observed between soybeans planted in late April through the first week of May².

- **Do not plant too deep.** Plant soybeans at 1 to 1.5 inches deep and not deeper than 2 inches. Soybeans emerge as the hypocotyl straightens and carries the cotyledons to the

Table 1. Average yields and yield loss per day by date as planting is delayed throughout Illinois¹.

Period	Northern IL		Central IL		Southern IL	
	Avg yield (bu/A)	Loss/day (bu/A)	Avg yield (bu/A)	Loss/day (bu/A)	Avg yield (bu/A)	Loss/day (bu/A)
Apr 1-10	232	-0.3	171	-0.4	152	-0.3
Apr 11-20	233	0.1	174	-0.1	153	0.2
Apr 21-30	230	0.6	174	0.1	149	0.6
May 1-10	222	1.0	171	0.4	141	1.0
May 11-20	210	1.5	166	0.6	130	1.4
May 21-30	192	2.1	158	1.0	113	2.0
June 1-10	169	2.4	147	1.2	92	2.2
Maximum yield	April 12		April 20		April 11	

Data averaged over two sites and four years (2005-2008) for each of three regions in Illinois.

surface. The plant requires a lot of energy to complete this process. Therefore, planting too deep can burn energy that could be used later by the plant. In addition, planting too deep can inhibit emergence in stressful situations such as soil crusting and compaction.

Summary

Planting when soil temperature and conditions are favorable is very important to give the crop the best chance of emerging properly and getting off to a good start. Waiting for good soil temperatures and conditions may help avoid chilling injury, disease, lack of oxygen to the seeds, and restricted plant growth, which can all lead to poor emergence. However in some instances, such as a late spring frost, injury may be unavoidable. Although it is important to plant within the acceptable planting window for the region and crop, rushing to plant in cold, wet conditions can lead to yield reducing problems later.

Sources: ¹Nafziger, E. Corn planting date revisited. *The Bulletin. University of Illinois.* April 10, 2009; ²Davis, V. Should I start planting soybeans in April? *The Bulletin. University of Illinois.* April 23, 2010. Available On-line at <http://bulletin.ipm.illinois.edu>; Al-Kaisi, M. and Pedersen, P. 2007. Wet Conditions: Challenges and Opportunities. *Iowa State University Extension. Integrated Crop Management. ICM > 2007 > IC-498 (9) – May 7, 2007*; Bohner, Horst. 2003. Do soil temperatures at planting affect soybean yield. *Ministry of Agriculture Food and Rural Affairs. Ontario. Crop Talk; Elmore, R. and Abendroth, L. 2008. Flooded corn and saturated soils. Iowa State University Extension. May, 30, 2008; Extension educational partnership of 74 universities in the United States, Corn germination and emergence. October 2, 2008; Iowa State University. 2006. Did the recent cold weather affect corn germination and seedling growth? Integrated Crop Management. May 1, 2006; Kennel, H. S. 2011. Seed germination. *Washington State University Extension; Leopold, A.C. 1983. Volumetric components of seed imbibition. Plant Physiol. 73 (1983) 677-680; Nielsen, R.L., 2008. Effects of flooding or ponding on young corn. Corny News Network Articles. June 2008; Nielsen, R.L. 2008. Crappy stands of corn. Dept. of Agronomy. Purdue Univ. May 25, 2006; Nielsen, R.L. 2008. More thoughts on late corn planting. Purdue University. Corny News Network Articles. May 23, 2008.**

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