



Plant Corn and Soybean by Soil Temperature and Conditions not According to the Calendar

Planting corn and soybeans early has many benefits in Minnesota. Yields 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 will 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. The injury occurs when seeds take in water prior to germination as part of a process called imbibition or rehydration. In soybean, chilling injury seems to be related to how dry the seed is. If the water is cold from melting snow or a chilling rain, it can cause cell membranes to 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.



Figure 1. A corn seedling that suffered from 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

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nutrient uptake. It is important to realize the majority of soil compaction can take place from equipment passes over a field. Research indicates approximately 80% of soil compaction 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 good. 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 high silt content, 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

Optimal corn planting takes place between April 21 – May 6 in southern Minnesota and is typically a few days later in Central and Northern Minnesota (Figure 2). Yield potential is reduced rapidly if planting takes place after mid-May. 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 Minnesota, planting soybeans in early May is optimal while planting late in June can reduce yields by 20-40%.

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. **ALWAYS READ AND FOLLOW PESTICIDE LABEL DIRECTIONS.** Technology Development by Monsanto and Design(SM) are trademarks of Monsanto Technology LLC. All other trademarks are the property of their respective owners. ©2010 Monsanto Company. AMB040510

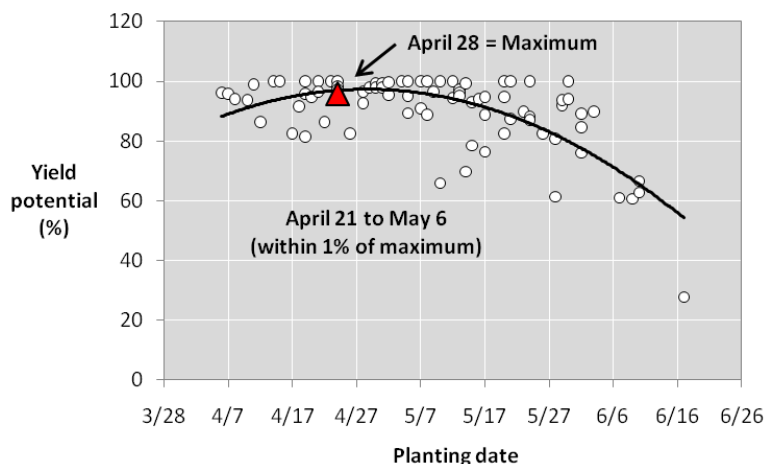


Figure 2. Response of corn grain yield to planting date from 1988 to 2003 at Lamberton, MN. Graph courtesy of Dr. Jeff Coulter, University of Minnesota and data are from Bruce Potter and Steve Quiring.

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

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