

Imbibitional Chilling Injury to Soybeans: Planting Date and Soil Temperature

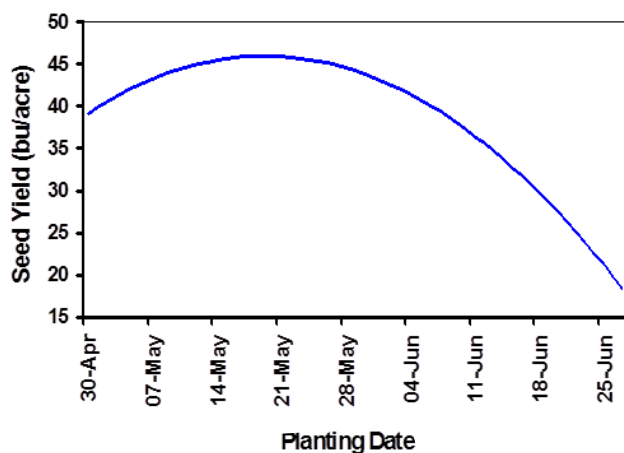
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Soybean Planting Recommendations

- The optimum planting dates in this area are generally from May 10 to May 20.
- Although soil temperature varies by location, time of day, residue level, etc. – avoid planting into soils that are below, or are expected to be below, 50°F in the 24 hours following seeding.
- Growers should consider planting earlier if:
 - ▶ The season has been unusually warm and planting conditions are good.
 - ▶ They require an extended period to plant due to equipment and acres to cover. (Keep in mind that only about 50% of calendar days are good planting days due to rainfall. If a grower requires 10 days to plant all his soybean acres he should plan on 20 calendar days. He may want to start on May 5 with the expectation of finishing around May 25.)
 - ▶ Planting during the warmest part of the day (10:00 am to 4:00 pm) may be beneficial when planting into cooler soils

Soybean Yield Response to Planting Date

Pioneer Agronomy Sciences (Data from three years and three locations, Group 0 and I zones).



It is a common recommendation that corn and soybeans should not be planted before soil temperatures reach a minimum of 50°F. It is true that germination and growth are slow or stopped at soil temperatures below 50°F. However, fluctuations in soil temperature and variation from one location to the next make it difficult to know the soil temperature at any given time and place. Many factors influence soil temperature including time of day, depth at which temperature is taken, soil cover, soil moisture content, and amount of solar radiation.

Soil temperature is highly variable and unpredictable; however it does affect germination and plant growth. Below are details from an interesting study conducted by Ontario Ministry for Agriculture and Food in Canada in 2003, showing the impact of **imbibitional chilling** to soybean seeds.

Soybean seeds are extremely vulnerable to cold soil temperatures especially during the first 6 to 24 hours after planting. Before seeds can begin to germinate, they must take in water. This process is called imbibition. Seeds make the transition from a dry state, in which they have been for several months or years, to a metabolically active state within a short period of time. For this reason, soil temperature at planting time and the next 24 hours is crucial and more important than the temperature following that period. After the initial hours of imbibition, seeds become far less sensitive to cooler temperatures.



Figure #1

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Figure #1 (above) shows the results of planting seed into warm soil (77°F) and then keeping it there for 17 days. The plant stand is essentially perfect.

Figure #2 (below) demonstrates how planting seed from the same bag into cold soil (45°F) may dramatically reduce the plant stand. Interestingly, seeds were only kept at 45°F for 20 hours, then warmed to 77°F for the remainder of the 17 days. The reduced plant stand is obvious.



Figure #2.

To prove that it was the initial soil temperature that caused the injury in Figure #2, another tray was set up where the soil was warm at planting to prove that it was the initial soil temperature that caused the injury in Figure #2. Another tray was set up where the soil was warm at planting time (for 8 hours following planting) and then cooled to 45°F for four days. After that, the soil was again warmed up to 77°F for the remainder of the 17 days.

Figure #3 (below) shows how this treatment resulted in no injury to the seed. A full plant stand resulted.



Figure #3.

The injury demonstrated in the above pictures is called **imbibitional chilling injury**. If the initial water imbibed by soybean seed is too cold, it disrupts membrane integrity, increases electrolyte leakage and may result in lower germination. This leakage may also result in increased pre-emergent damping off, since some pathogens use the leakage as an energy source. Cold temperatures also reduce hypocotyl elongation, which may also lower emergence. If the seed is very dry or the seed coat is cracked, soybeans are even more vulnerable to this kind of injury. A good seed coat is important during imbibition because it moderates the absorption of water and other particles in and out of the seed. When the seed coat is thin or cracked, it does not regulate these functions properly, which will increase injury. However, if seeds are placed into warm soils (for 6-24 hours) which then become cold, no damage occurs to the seed since a large percentage of the water has already been imbibed and cell membranes have had a chance to re-hydrate normally.