agKnowledge Spotlight
Shedding light on the concerns of your fields.
ASGROW

Factors that Affect Soybean Germination and Emergence

- Soybean germination begins with the seed imbibing (absorbing) approximately 50% of its weight in water followed by the development of the radicle (primary root) and emergence of the cotyledons (seed leaves).
- Planting into a moist seedbed with good seed-to-soil contact is important for optimal germination.
- Temperature, moisture, oxygen, and soil conditions within the seed zone can affect soybean germination and emergence.

The Germination Process

Seeds, as living but dormant organisms, respire at a very low rate. They remain in this state of quiescence until desirable conditions that trigger germination occur. Soybean seeds can store for years in cool, dry conditions without a significant reduction in viability.[1]

Figure 1. (Left) Imbibition of a treated seed causes the radicle (red arrow) to emerge through the seed coat (yellow arrow). (Right) Seed hilum or scar where the seed was attached to the plant ovary within the pod.

Soybean seed germination is referred to as “epigeal” because food storage structures (cotyledons) are pulled above the soil surface. In contrast, corn germination is considered “hypogeal” because the storage structure remains below the surface when the seed germinates.

Upon being placed into the soil, the seed begins to absorb or imbibe water, and as a result, starts to swell. When enough water (approximately 50% of the seed’s weight) is taken in and with favorable temperatures, the radicle breaks through the seed coat (Figure 1) and rapidly develops into the primary seedling root. Lateral roots quickly emerge from the radicle as it elongates and root hairs grow from the radicle and lateral roots. Root hairs are barely visible and should not be confused with later developing and easily seen branch roots. The root hairs become the main absorbing structures.

Soon after the radicle appears, the hypocotyl starts elongating and forms a hook that pushes toward the surface (Figure 2). The cotyledons are attached to the hypocotyl and progress upward with the growth of the hypocotyl. The hypocotyl can be easily broken if the soil surface is too hard or crusted. If the hypocotyl breaks, the seedling usually dies.

Figure 2. Hooked hypocotyl and cotyledons breaking through the soil surface.

Figure 3. Cotyledons (yellow arrow) open to expose epicotyl (red arrow).

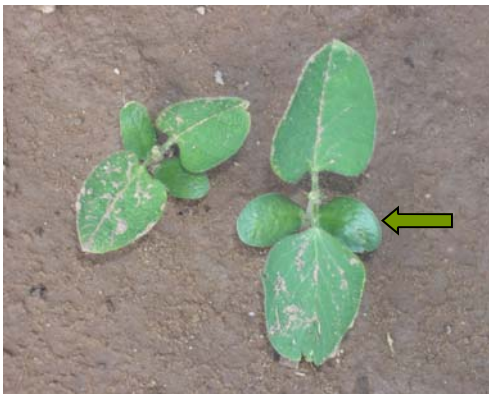

Figure 4. Soybean seedlings with fully expanded cotyledons (green arrow), unifoliate leaves, and growing point above the soil surface.

Factors that Affect Soybean Germination and Emergence

When the hypocotyl emerges it straightens, and in the process pulls the cotyledons out of the soil. The cotyledons start turning green from exposure to light, and as they open the epicotyl is revealed (Figure 3). The epicotyl contains small leaves, buds, and the main growing point.

Factors that Affect Germination and Emergence

Moisture. Planting into a moist seedbed with good seed-to-soil contact is necessary as moisture needs to move into the seed for germination to occur. If irrigation is required for good soil moisture, it should be applied ahead of soybean planting, and not immediately after planting. Planting into dry soil with rainfall or irrigation occurring too soon after can result in soil crusting and poor soybean emergence.

Soil Conditions. Soil crusting can delay or prevent seedling emergence and cause soybean hypocotyls to be swollen or broken when trying to push through the crust. Fields with fine-textured soils, low organic matter, and little surface residue can be vulnerable to crusting, especially where excessive tillage has taken place.

Temperature. Soybean seed can begin to germinate when soil temperatures are less than 55° F; however, germination is likely to be slow until soil temperatures warm to the upper 70s. Cold soil temperatures can cause seeds to remain dormant, increasing their vulnerability to seed and seedling diseases and feeding by insects and wildlife. When soil temperatures are between 70º F and 90º F, seedling emergence should occur in less than a week. Soil temperatures above 95º F can also cause poor soybean germination and emergence resulting in reduced stands.

Oxygen. Saturated, flooded, and compacted soils can reduce germination and emergence due to the lack of oxygen. Soil pore spaces filled with water reduce the amount of oxygen available for seed respiration. Compacted soil reduces the availability of water and oxygen required for germination, root and plant growth, and nutrient uptake.

Table 1. Soybean Seedling Structures

Structure	Function/Characteristic
Testa (Figure 1)	Seed coat
Seed hilum or scar (Figure 1)	Location where the seed was attached to the plant ovary within the pod
Radicle (Figure 1)	First part of the embryo to penetrate the seed coat; develops into main root
Hypocotyl (Figure 2)	Tissue between cotyledons and radicle that becomes the stem of the plant after germination
Cotyledons (Figures 2, 3, & 4)	First leaves to appear; serve as food storage structures
Epicotyl (Figure 3)	Stem area above the cotyledons that consists of a stem, two primary leaves, and a terminal bud

Sources:
[1] Soybean as a crop. Modern corn and soybean production. MCSP, http://www.mcsp-pubs.com.
Other sources: Hoeft, R.G., Nafziger, E.D., Johnson, R.R., and Aldrich, S.A. 2000. Modern corn and soybean production. First edition. MCSP Publications. Champaign, IL. Pedersen, P. 2007. Soybean growth stages. Soybean growth & development. PM 1945. Soybean Extension and Research Program. Iowa State University. http://extension.agron.iastate.edu. Pedersen, P. Soybean planting date. Iowa State University. http://extension.agron.iastate.edu
Web sources verified: 4/16/15

For additional agronomic information, please contact your local seed representative.
Developed in partnership with Technology, Development, & Agronomy by Monsanto.