Early Growth and Development – Soybean

The soybean seed consists of two cotyledon leaves and an embryonic plant inside a seedcoat. Cotyledons are the food source for the seedling plant, and contain enough stored energy to support the plant from germination until about ten days after emergence. The other component of the soybean seed, the embryonic plant, has three parts: the radicle, the hypocotyl, and the epicotyl. Each of these parts has a distinct role in the development of the soybean plant, a process that begins at germination.

Germination and Emergence

A soybean seed must absorb 50 percent of its weight in water before germination can begin. During the germination process, the seed will begin to swell, changing from its basically round shape to a more oval shape. This transformation is actually the cotyledon leaves developing into their natural shape and size. Soon after the swelling process begins, the radicle begins to grow. The radicle develops into the primary root, which eventually gives rise to the entire root system. Hypocotyl growth begins shortly after the radicle emerges. The hypocotyl is a stem-like structure between the radicle and the cotyledons. Cell elongation in the hypocotyl transports the cotyledons to the soil surface. The epicotyl, located at the top of the hypocotyl between the two cotyledons, is the structure that gives rise to the above ground part of the plant.

The growth rate of soybeans is temperature dependent; the warmer it is, the faster soybeans grow. Fifty degrees is considered the minimum temperature for germination and/or plant growth. Radicle growth must occur very rapidly so that the plant will be well enough anchored to support the hypocotyl as it lifts the cotyledons to the soil surface. The hypocotyl has a half circle bend in it near where it attaches to the cotyledons. This bend, called the hypocotyl arch, orients the cotyledons in a downward position during their migration from the seed zone to the soil surface, reducing the volume of soil the seedling must move to emerge. After the cotyledons break the soil surface, the hypocotyl arch straightens to form a completely vertical stem segment and the cotyledons open away from each other, placing them in a parallel position with the soil surface.

The hypocotyl arch is fairly brittle, and since stem breakage in this region separates the plant from its root system, it kills the seedling. If the hypocotyl arch encounters resistance during emergence, the arch section will become significantly smaller in diameter compared to the more stem-like section of the hypocotyl just below it. Watch for this difference in

diameter if your fields are crusted or emerging slowly – it indicates seedlings are having trouble and may not emerge successfully.

The Emerged Seedling

By the time the cotyledon leaves begin to open and face the sun, the epicotyl has already begun differentiating the vegetative portion of the plant. The first two leaves to develop from the epicotyl are called unifoliate leaves, because they are comprised of only one (uni) leaflet per leaf. There are two unifoliate leaves, and they are borne on opposite sides of the stem a short distance above, and at a 90 degree offset to, the cotyledons. All leaves developing on the plant after the unifoliates will have three leaflets per leaf, and are called trifoliate leaves. Young soybean plants broken above the cotyledons can recover by resuming growth from lateral buds located on the stem just above where the cotyledons are attached.

Changes are also occurring below the soil surface during this time period. The soybean has a single primary root with many lateral, or side, branches. The first of these lateral roots appear about the time the cotyledons emerge. Soybeans fix their own nitrogen through a symbiotic relationship with a soil bacteria called *Rhizobium japonicum.* This process occurs in nodules (spherical growths) on the root system. The first nodules begin developing within a week after emergence. Healthy nodules will be a pinkish or red color inside.