



Growing Knowledge™

# Agronomic Spotlight



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24 MAY 2007

## Soybean Growth & Development

The yield potential of a soybean crop is determined by the interaction between the genetics of the seed and the environment in which it grows. The key to a successful soybean crop is to better understand soybean growth and development. Soybean growth and development is divided into two broad stages: vegetative (V) and reproductive (R). A soybean stage is reached when 50% or more of the soybeans have reached or are beyond that stage.

### Germination, Emergence & Early Development.

Soybean seeds begin to germinate at approximately 10°C. Germination accelerates as soil temperature climbs to 30°C. Planting soybeans in soils less than 13°C will slow germination and often reduces seedling vigor.

Given adequate moisture and favorable soil temperatures, the radicle is the first to emerge from the soybean seed.

Following primary root initiation, the hypocotyl begins elongation toward the soil surface pulling its weighty cotyledons through the soil surface. This process requires a lot of energy and for that reason it is recommended that soybeans be planted no deeper than 7.5 cm. Soybean emergence (VE) typically occurs 1 to 2 weeks after planting depending on soil moisture, soil temperature, and planting depth. Crusty surfaces restrict emergence, resulting in swollen hypocotyls. Shortly after VE, the unfolding of cotyledons exposes the growing epicotyl (young leaves, stem, and growing point). The subsequent expansion and unfolding of the unifoliate leaves marks the initiation of the VC stage, which is followed by the numbered Vn stages.

The cotyledons are very important to the young plant as they store all the energy reserves the plant will need to establish itself. Quickly emerging plants usually do not consume all of the food reserves and end up with thick, fleshy cotyledons at the unifoliate (V1) growth stage. Plants that require several weeks to emerge may have noticeably smaller cotyledons or may lose their cotyledons all together. These plants are at a substantial disadvantage with nearby healthy plants. Loss of both cotyledons at or soon after the VE stage may result in grain yield loss of 8 to 9%.

Nitrogen-fixing nodules can be seen on the roots shortly after VE, but active nitrogen-fixation does not begin until about the V2 to V3 stages. Nodules are pink inside when actively fixing nitrogen for the plant, but are white, brown or green when nitrogen-fixation is not occurring.

**Disease Potential.** Seedling diseases can be a concern in some years. Seed applied fungicides can typically provide

10-14 days of protection from soil-borne diseases such as *Phytophthora*, *Rhizoctonia*, and *Fusarium*. *Phytophthora* damping-off is common during wet years and the fungus is active when the soil temperatures are between 21 and 27°C. Dry spring weather favors seedling blight from *Rhizoctonia*. Cool temperatures (<16°C) favor infections of *Fusarium* root rot and *Pythium* damping-off.

**V3 to V6 Stages.** Plants at V3 are 17 to 23 cm tall and have four nodes with unfolded leaflets. Plants at V5 are about 25-31 cm tall and six nodes have leaves with unfolded leaflets. V5 is about one week from R1, or first flower. At V6, the unifoliate leaves and cotyledons may have fallen from the plant and the root system is expansive. New V stages are developing approximately every 3 days. At the V6 stage, a 50% loss of leaf area would equal approximately 3% yield loss.

**Hail or Wind Damage.** Soybean plants have multiple axillary buds (growing points on the main stem) that allow a soybean plant to recover from hail or wind damage to other buds. Although the stem apex (main growing point) is dominant, damage to this growing point will direct the axillary buds lower on the plant to suddenly branch and grow. Soybeans, therefore, are capable of producing new branches and leaves after hail destroys above ground foliage, as long as at least one axillary bud remains intact. The plant will die, however, if it is broken off below the cotyledonary node because there are no axillary buds below this point.

**Reproductive Stages,** or R stages, begin with flowering (R1) and continue through full maturity (R8). In Ontario, where most soybeans grown are indeterminate in growth habit, vegetative and reproductive stages overlap. Descriptions of the reproductive stages are found in Table 1.

**R1 Stage.** R1 in soybean is initiated when the flowers first appear on the 3rd to 6th node of the main stem. Branches begin flowering a few days later than the main stem.

**R2 Stage.** An open flower at one of the two uppermost nodes on the main stem initiates R2 in soybean. This stage marks the beginning of rapid and constant daily dry matter and nutrient accumulation rates by the plant that will continue until shortly after the R6 stage. Peak nodulation occurs at R2.

**R3 Stage.** A developed pod is 0.48 cm long at one of the top 4 nodes on the main stem at R3. Pods develop first on lower nodes where flowering began.

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Soybean yield is divided into the following three components: total number of pods per plant, seeds per pod, and weight per seed. Yield increases are generally due to higher numbers of pods per plant compared to the other yield components.

**R4 Stage.** A developed pod is 2 cm long at one of the top 4 nodes on the main stem at R4. This stage is characterized by rapid pod growth and by beginning seed development. This stage also marks the beginning of the most critical period of yield determination. Stress occurring anytime from R4 to shortly after R6, including moisture, nutrient deficiencies, lodging or defoliation, will reduce yields more than the same stress at any other period of development. The period between R4 and R5 is particularly critical because flowering ends and plants cannot compensate, and young pods are more likely to abort under stress than older pods and seeds. Yield reduction at this time results from fewer numbers of pods per plant. Compensation by increasing seed size can occur, however, it is limited.

**R5 Stage.** Seed is 0.3 cm long on one of the top 4 nodes on main stem at R5. This stage is characterized by rapid seed growth or seed filling. Demand for water and nutrients is high through this period. Stressful conditions from late R5 stage into the R6 stage may also cause large yield reductions due to

fewer pods per plant and fewer beans per pod.

**R6 Stage.** A green seed fills the pod cavity on one of the top 4 nodes on the main stem at R6. The R6 bean or “green bean” is characterized by being as wide as its pod cavity; however, wide variation in bean size may be found on the plant at this time. Total plant pod weight maximizes and leaf maturing and falling begins shortly after R6.

**R7 Stage.** Beginning maturity marks the R7 stage, with one pod on the main stem reaching its mature, brown or tan pod color, depending on the variety. Dry weight accumulation has essentially ceased. Stress occurring at R7 or thereafter has basically no effect on yield.

**R8 Stage.** Full maturity marks the R8 stage, with 95% of the pods reaching their mature pod color. After R8, 5 to 10 days of favorable drying weather are required before the soybean reaches less than 15% moisture.

Contact your local DEKALB® seed representative for more information.

*Sources: OMAFRA Staff. 2002. Soybeans: Growth Stages. Excerpt from Agronomy Field Guide for Field Crops (Chapter 4).*

*S. Ritchie and others. 1997. How a soybean plant develops. Iowa State Univ. of Sci. and Technol. Coop. Ext. Serv. Special Report 53.*

**Table 1. Reproductive Growth Stages in Soybeans**

R Stage	Growth Stage	Description
R1	Beginning Bloom	One open flower at any node on the main stem
R2	Full Bloom	Open flower at one of the two uppermost nodes on main stem with a fully developed flower
R3	Beginning Pod	Short pods at uppermost nodes on the main stem with a fully developed leaf
R4	Full Pod	Pods 2 cm long at uppermost node of main stem
R5	Beginning Seed	Seed 0.3 cm long in upper pods
R6	Full Seed	Seeds within pods fill cavity in upper pods
R7	Beginning Maturity	One normal pod on the main stem has reached its mature color
R8	Full Maturity	95% of pods have reached mature pod color

**Source: Soybeans: Growth Stages. OMAFRA, 2002.**

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