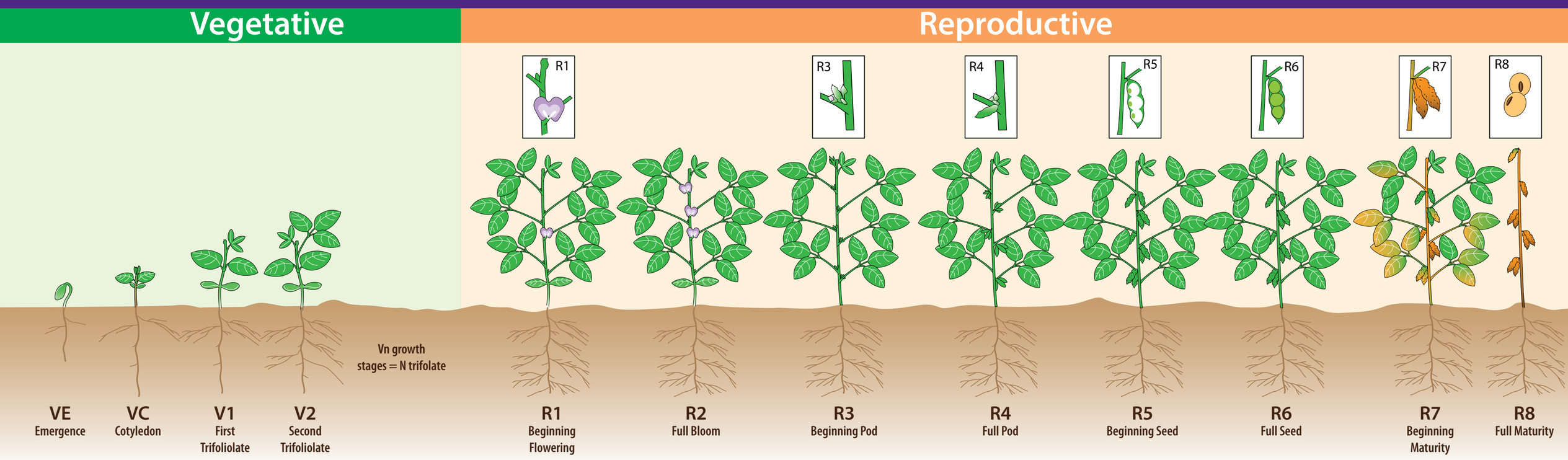
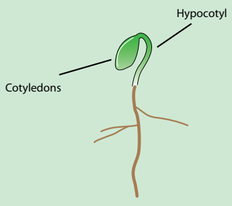
Soybean Growth and Development

K-STATE Research and Extension



Soybean Development Stages

Vegetative

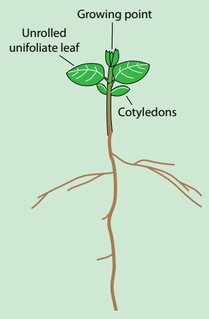


Emergence (VE)

During germination and emergence, the cotyledon pokes through the soil and primary and lateral root growth begins. Functional root hairs develop shortly after planting. Root hairs are essential to nutrient uptake and water absorption when the plant is at this early stage.

Management Practices

Scout for proper emergence; check final stand and uniformity. Optimum seed placement varies from 1 to 2 inches deep. Deeper planting depth (greater than 2 inches) and lower soil temperatures jeopardize final emergence. If the stand is poor, replanting may be needed.

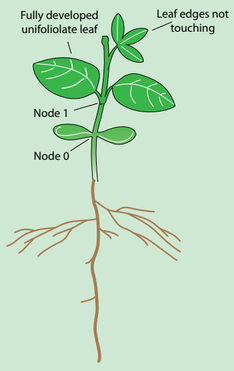


Cotyledon (VC)

Unifoliolate leaves expand (leaf edges are not touching). The cotyledons are the main nutrient reservoir for the young soybean plants (7 to 10 days after emergence). Damaged cotyledons can lower yields.

Management Practices

Scout for proper emergence. Weed control is important before and after soybeans emerge. If stand is poor, replanting may be needed.

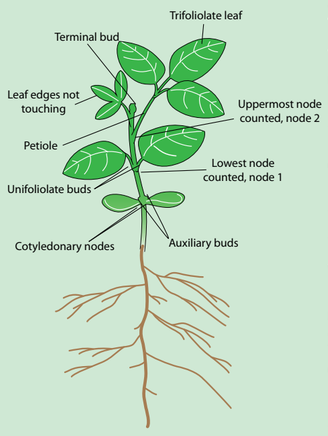


First trifoliolate (V1)

Trifoliolate leaf unrolls (fully developed leaves at the unifoliolate nodes). The plant becomes self-sustaining as newly developed leaves carry out photosynthesis. From this point onward, new nodes appear every 3 to 5 days until V5 stage (five-node stage), and then every 2 to 3 days until the last vegetative node.

Management Practices

Scout for early-season weeds, insects, and diseases.



Second trifoliolate (V2)

Two trifoliolates unroll (fully developed trifoliate leaves at node above the unifoliate node). Check for effective nodulation. Nodules have been initiated on the roots at this stage and nitrogen fixation continues until late reproductive stages. Effective nodulation results in higher yields and more seed protein when compared with a non-nodulated soybean plant.

Management Practices

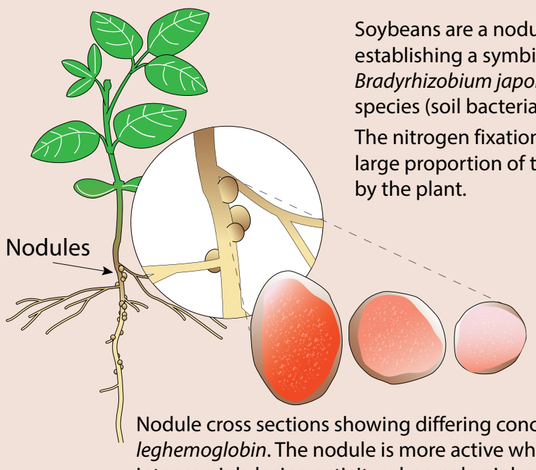
Scout for early-season weeds, insects, and diseases. Apply postemergence herbicides if needed. If nodulation has been established effectively, nitrogen fertilization is not recommended, and, if applied in large quantities, will inhibit nitrogen fixation activity.

Stages V3 through V6

The third trifoliolate (V3) stage takes place when three trifoliolates are unrolled. In case of damage to the growing point, axillary buds permit the plants to compensate for yield or final productivity.

The unrolling of six trifoliolates indicates the V6 stage. The root system continues to grow, even expanding across a 30-inch row spacing.

The V growth stages continue as long as a plant continues to produce trifoliolates. **Determinate** soybean plants complete most of their vegetative growth when flowering begins. **Indeterminate** plants produce trifoliolates until the beginning of the seed formation stage (late reproductive period).

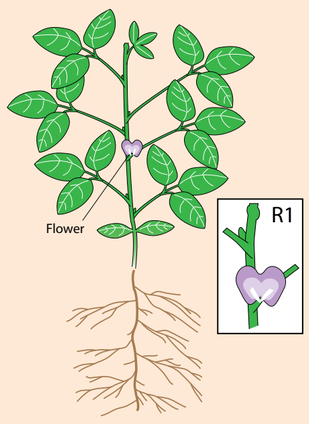


Soybeans are a nodulating legume, establishing a symbiotic relationship with *Bradyrhizobium japonicum* and *Sinorhuzobium* species (soil bacteria).

The nitrogen fixation process can contribute a large proportion of the total nitrogen needed by the plant.

Nodule cross sections showing differing concentrations of *leghemoglobin*. The nodule is more active when it is blood red or intense pink, losing activity when pale pink and not functional when light brown.

Reproductive

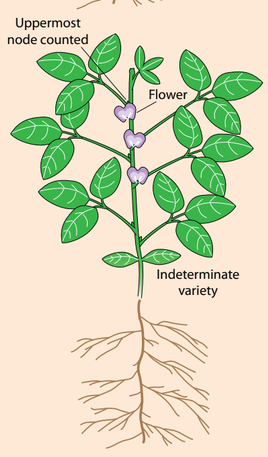


Beginning flowering (R1)

The plant has one flower open at any node on the main stem. Indeterminate plants start flowering at the low- or mid-canopy and flower upward. Determinate plants start flowering at one of the top four nodes, and then flowering proceeds up and down the stem.

Management Practices

Scout for insects and diseases. Spray foliar insecticide or fungicide, if needed.

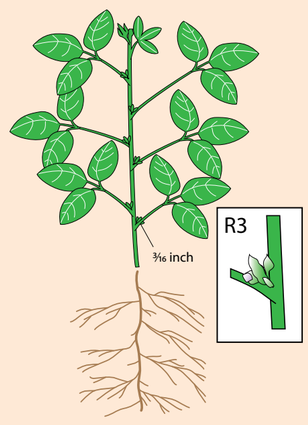


Full bloom (R2)

The soybean plant has one open flower on one of the two uppermost nodes on the main stem with a fully developed leaf.

Management Practices

Scout for insects and diseases. Spray foliar insecticide or fungicide, if needed.

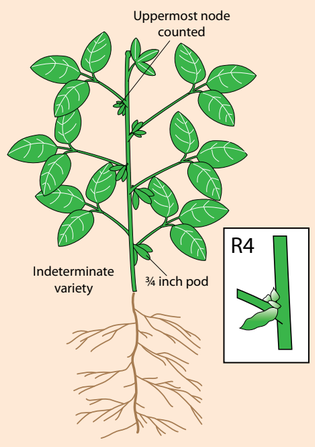


Beginning pod (R3)

Pods are 3⁄16 inch long on one of the four uppermost nodes on the main stem with a fully developed leaf.

Management Practices

Scout for insects and diseases. Spray foliar insecticide or fungicide, if needed. Identify water stress, which affects pod formation. If it is a common practice, irrigation is critical at this stage. Late-season hail damage to the leaf area at this stage severely affects final yields.

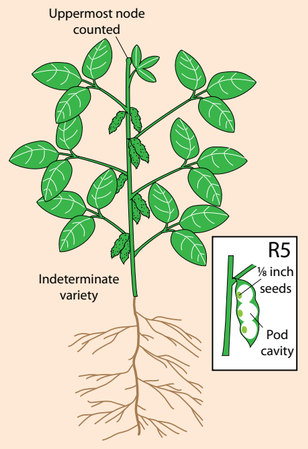


Full pod (R4)

Pods are ¾ inch long on one of the four uppermost nodes on the main stem with a fully developed leaf. Seasonal nitrogen uptake relative to the final amount attained at maturity occurs around this stage. When determining yield, stage R4 marks the beginning of the most crucial period of plant development.

Management Practices

Scout for insects and diseases. Late-season diseases can lower yields. Irrigation is also critical at this stage. Peak water use can reach 2.5 to 3 inches per week.

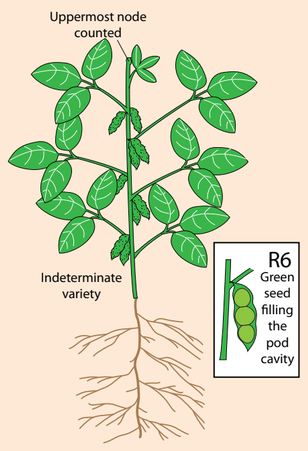


Beginning seed (R5)

Seed is ⅛ inch long in one of the four uppermost nodes on the main stem. Primary and lateral roots grow strong until R5. After R5, the shallower roots degenerate, but the deeper roots and laterals grow until R6.5 stage.

Management Practices

Scout for insects and diseases. Late-season diseases can severely lower yields.



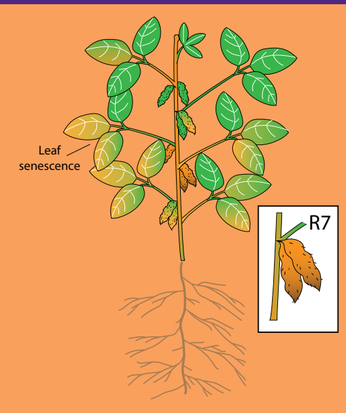
Full seed (R6)

Pods contain a green seed that fills the cavity in one of the four uppermost nodes on the main stem. Most nutrients have been taken up by the time the plant reaches R6 stage.

Management Practices

Scout for insects and diseases. Late-season diseases can severely affect yields. Spray foliar insecticide or fungicide, if needed. Late-season hail damage to the leaf area could lower yields but if it occurs later in the grain filling, final yield damage is reduced.

Reproductive

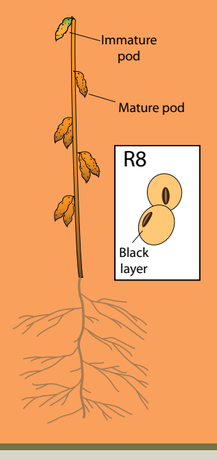


Beginning maturity (R7)

One pod on the main stem has reached mature pod color.

Management Practices

Scout for green stem syndrome, which is when the stem remains green while the seeds are mature and ready to harvest, and other issues before harvest (e.g. lodging, sprouting seeds, and pod shattering).



Full Maturity (R8)

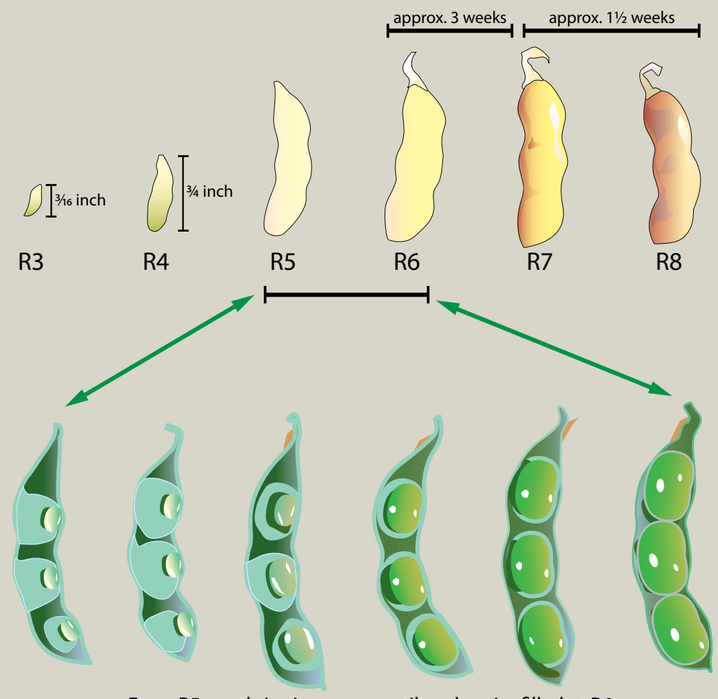
Approximately 5 to 10 days before harvest, pods should reach full maturity, where 95% of pods have reached mature pod color.

Management Practices

Scout for green stem syndrome. If the plant is still green, the best option is to harvest slowly and make sure the harvesting equipment is in excellent operating condition.

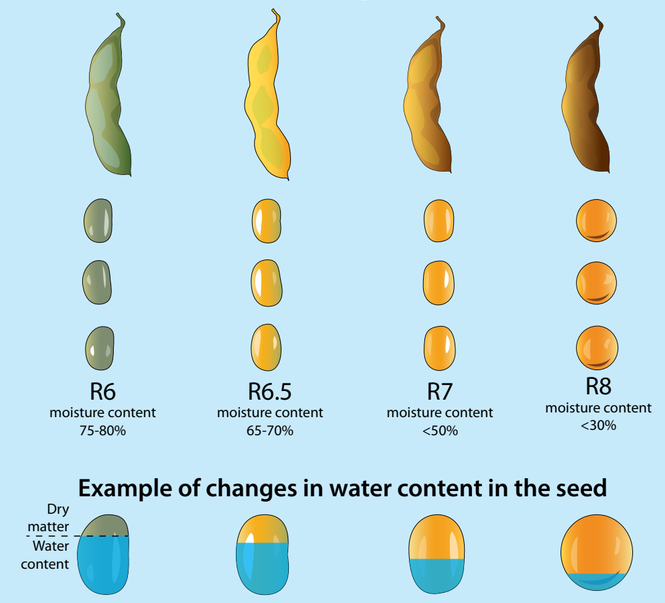
Pod Formation and Maturation

R3 is the beginning of pod formation, achieving maximum pod size at R5. Change in pod color from green to light yellow occurrs from R6 to R7, turning to brown at fully maturity (R8).



From R5, seed size increases until pod cavity filled at R6.
At R5, seeds are attached to the podwall and detach at R6.

Seed-filling process



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Information and drawings about developmental stages are adapted from Fehr and Caviness (1980).

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February 2017 | MF3339