



Soybean Nodulation

Nitrogen fixation is the process through which atmospheric nitrogen (N_2) is converted into a form useable to plants (NH_4^+).

- Nitrogen fixation in soybean is carried out by *Bradyrhizobium japonicum* bacteria that colonize the roots
- *B. japonicum* bacteria form a symbiotic relationship with soybean
 - The plant supplies energy to the bacteria in the form of carbohydrates
 - The bacteria provides useable nitrogen to the soybean plant



B. japonicum bacteria invade the roots and multiply in the cortex cells, forming round nodules that can grow to the size of a large pea. Each nodule contains a colony of bacteria.



Soybean Nodulation Timeline

- The first nodules will begin to form within a week after emergence.
- Nitrogen fixation begins around V2 to V3 stage
- By V3 to V4, there should be 8 to 10 healthy nodules per plant
- The number of nodules will increase until pod fill begins. Each plant can ultimately have several hundred nodules.



Healthy nodules that are actively fixing nitrogen are pink or red inside. Nodules are typically active for 6 to 7 weeks and are continually replaced during the growing season.

The nitrogen requirement of soybeans is one of the highest among agronomic crops due to the high concentration of protein in the seed. Soybeans require about 3.5 lb of N per bushel of yield.