

## WHAT ARE NODULES?

Nodules are masses that form on the roots of plants that associate with symbiotic nitrogen-fixing bacteria, like *Bradyrhizobium japonicum*, to convert atmospheric nitrogen into a form the plant can use.

Keep an eye out for light green and/or stunted growth for potential nodulation issues.

## HOW DO NODULES FORM?

Nodulation occurs when plants need additional nitrogen. Soybeans send flavonoids into the soil through their root systems. Rhizobia bacteria in the soil sense the flavonoids and send a signal called LCO back to the plant. The plant responds with root hair curling where the Rhizobia enter the plant and nodules are formed around them.

## HOW DO I KNOW IF I HAVE NODULES?

The only verifiable way to see if your soybeans are getting the Nitrogen they need, and forming nodules, is to do a root dig.

Nodule color should be inspected

Red/Pink nodules are actively fixing Nitrogen

Brown/Green nodules do not fix Nitrogen for the plant.

## WHEN DO NODULES FORM?

Nodule formation on soybean roots can happen shortly after emergence. They will continue to grow and begin fixing Nitrogen around the V2 to V3 stage<sup>1</sup>.

Nodules will continue to form and the amount of Nitrogen fixed will continue to increase until just after R5 (about 6-7 weeks).

For more information on how you can promote nodulation on your crops, visit [MonsantoBioAg.com](http://MonsantoBioAg.com)

Healthy soybean roots should show between **8-20** nodules<sup>2</sup>

## HOW CAN I INCREASE NODULES?

Monsanto BioAg™ products help make nutrients in the soil more available to crops, resulting in healthier plants that can meet their maximum yield potential.

- TagTeam® LCO XC combines the LCO molecule, *Penicillium bilaiae* and a *Bradyrhizobium japonicum* inoculant to develop a stronger root system and a healthier plant.
- Optimize® XC is a dual-action inoculant that combines LCO and Rhizobia to improve nodule formation, nitrogen fixation and overall nutrient capability.

Sources:

<sup>1</sup><https://mdc.itap.purdue.edu/item.asp?itemID=16942#.VjEGBBCrSVk>

<sup>2</sup>[http://msue.anr.msu.edu/news/evaluating\\_soybean\\_nodulation](http://msue.anr.msu.edu/news/evaluating_soybean_nodulation)

**Individual results may vary**, and performance may vary from location to location and from year to year. This result may not be an indicator of results you may obtain as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible. ALWAYS READ AND FOLLOW LABEL DIRECTIONS. Monsanto BioAg & Design™, Optimize® and TagTeam® are trademarks of Monsanto Technology LLC. All other trademarks are the property of their respective owners.  
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