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Current Issues in Mississippi Soybean Production

Dr. Trey Koger, Extension Soybean Specialist

Week of February 25, 2008: Over the past several weeks a lot of questions and discussion have been coming my way regarding the need and use of inoculants on soybean seed. Before I go into a discussion about inoculants and when inoculants are needed, it is important to discuss how a soybean plant just like any other crop plant such as corn, rice, or cotton requires nitrogen to function. However, soybean being a legume species, is able to produce its own nitrogen through a relationship with a bacteria commonly found in soils commonly grown to soybean.

A soybean plant is able to produce its own nitrogen without any nitrogen-based fertilizer inputs through a relationship formed with a bacteria commonly found in soils grown to soybean year after year or in a soybean/rice rotation. The bacteria forms a relationship with the soybean plant allowing the bacteria to thrive on minimal amounts of nutrients consumed from the soybean roots without any negative effect on the soybean plant itself. More importantly, the soybean plant benefits tremendously from this relationship because the bacteria, once inside the root system, produces or "fixes" nitrogen into a form readily used by the soybean plant at no expense to the soybean plant itself. Nitrogen derived from this relationship is formed through a basic four step process detailed in Figure 1.

Figure 1.

Rhizobia bacteria enters soybean root system

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Bacteria are harbored within nodules that form on the plants root system

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Nitrogen is produced by bacteria within nodules

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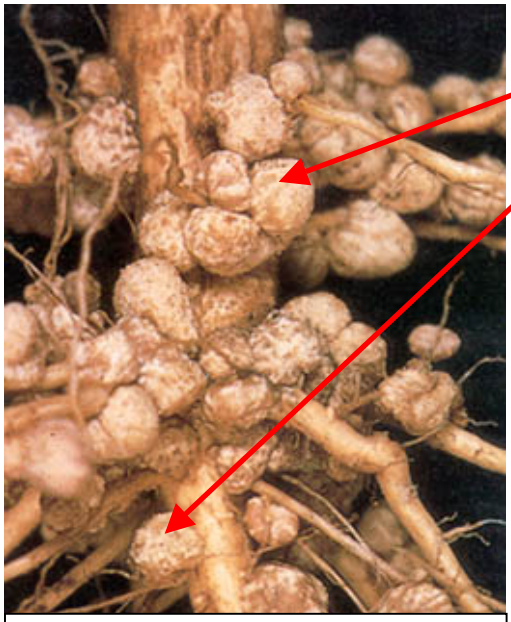
Soybean plants begin to produce nodules on the taproot approximately 3-4 weeks after planting, but nitrogen fixation typically doesn't begin until the soybean plant has 2-3 true leaves. See figure 2 for picture of soybean root system containing nodules.

Figure 2. Cluster of healthy nodules formed at top of root system, just below soil line. Additional nodules have formed up and down the taproot.



Nodules containing rhizobia bacteria

www.agnet.org/images/library/ac19944e1.jpg

Figure 3. Healthy nodule that is producing nitrogen

The insides of healthy, active nodules (Figure 3) that are actively producing nitrogen are dark brown to red in color. The health of nodules can be inspected by cutting the nodules in a cross-section as in figure 3 and evaluated for the dark brown to red color. Soybean plants should have a minimum of 7 to 14 nodules to produce ample amounts of required nitrogen. Plants continue to produce additional nodules until late in the growing season (approx. R5 growth stage or beginning stages of pod fill). The number of nodules a plant produces depends on presence of sufficient numbers of rhizobia bacteria, overall soil fertility levels, maturity group, soil type, soil moisture, and other environmental and plant physiological conditions.

Soybean is provided ample amounts of nitrogen from the soil-borne rhizobia bacteria only when the bacteria are present in sufficient numbers in the soil. If the bacteria are not present or present at levels too low to provide ample amounts of nitrogen to soybean plants, then soybean plants can suffer from nitrogen deficiencies like any other crop. Fields that have been planted to soybean year after year or in a soybean/rice rotation often have sufficient numbers of the bacteria present in the soil. A general rule of thumb is a field that has been in soybean within the past three years should have sufficient numbers of rhizobia bacteria to facilitate nitrogen fixation and satisfy the soybean crops nitrogen needs without having to add nitrogen fertilizer. However, in some cases we have even been concerned that prolonged flooded conditions in the rice crop may have an adverse affect on the rhizobia bacteria numbers for the following years' soybean crop. This is difficult to determine, but adding an inoculant is never going to hurt and is a relatively cheap insurance.

The largest concern and where the biggest need to add an inoculant product is in fields that have not been in soybean for an extended period of time. This is especially true this year where soybean is going to be planted on a vast amount of acreage that has been in cotton production for several or in some cases many years in a row. In these cases, no rhizobia bacteria have been introduced to the field and there is likely a tremendous need to add an inoculant. Spending less than $3.00 on an inoculant vs. applying 100 lb/A of urea that costs in the neighborhood of $500 per ton is a pretty easy decision to make. To make matters worse, when you apply nitrogen fertilizer to soybean there is no incentive for the plant to produce its own nitrogen through nitrogen fixation via rhizobia bacteria. So in cases, where nitrogen fertilizer is applied due to

apparent nitrogen deficiency symptoms and/or poor nodulation resulting in little nitrogen fixation the plant becomes dependant upon that nitrogen fertilizer for its nitrogen requirements. Because of this dependency when nitrogen fertilizer is applied, more than one nitrogen fertilizer application may be needed to satisfy season long nitrogen needs. This is especially true if nitrogen deficiency symptoms show up and nitrogen fertilizer is applied early in the season to overcome nitrogen deficiency symptoms or poor nodulation. So, the addition of a relatively inexpensive inoculant can go a long way to ensure that the soybean plant has ample numbers of rhizobia bacteria to ensure nitrogen fixation and essentially eliminate the need for applying expensive nitrogen fertilizer. Inoculants are a cheap insurance.

Inoculants are commercial products containing rhizobia bacteria required for nodulation and nitrogen fixation. There are many inoculant products available. They can be broken down into the three following groups.

Liquid inoculants*:* These products can be added directly to the seed similar to a fungicide and/or insecticide seed treatment. These are the newest types of inoculants and since they are in liquid form they often provide the most uniform coverage of seed when applied correctly. There are multiple liquid inoculants, but the ones we are seeing utilized most often in the midsouth are Optimize, Excalibur, and Vault. Again, there are likely additional products, but these are the ones we are seeing used the most in our area. These products are compatible with many of our commonly used fungicide and/or insecticide seed treatments. If you elect to let your distributor treat your seed for you, they will know of the compatibility issues associated with the inoculants and fungicide/insecticide seed treatments. You can refer to the inoculant package to find listings of what fungicide/insecticide seed treatments your inoculant is compatible with. According to the label, most of the liquid inoculants can be applied to the seed up to 120 days before planting. However, keep in mind, these inoculants contain a living organism (rhizobia bacteria) and the closer to planting you can wait to treat the seed with the inoculant the better. Some distributors are trying to wait to treat seed with the inoculants approximately 30 days or less from planting. This is not required by label, but it doesn't hurt to wait closer to planting to treat the seed with an inoculant. **A very important point to make is liquid inoculants should not be mixed with chlorinated water. The chlorine can kill the bacteria. Use distilled water or water that does not contain chlorine to make your inoculant containing slurry.** Also, molybdenum ("moly") containing fungicide seed treatments are not to be used with many of these liquid inoculants. Constituents of the "moly" products in the fungicide seed treatment can be toxic to the rhizobia bacteria. Refer to the inoculant label, ask your dealer, consultant, or contact me or any MSU Extension Service county director or area agronomist regarding questions about "moly" compatibility issues with inoculants.

Another feature of the liquid inoculants is that many of them contain a promoter product in addition to the inoculant itself. The promoter is designed to speed up the process of the rhizobia bacteria entering the root system and nodulation formulation. This promoter product may be especially useful when planting early in cool soils, since the process of bacteria entering the root system and subsequent nodulation is temperature dependant. Planting into cool soils in early April can potentially delay nodulation and may be a good situation for utilizing a liquid inoculant containing a promoter that helps to speed up the nodulation process.

Granular inoculants: Can be applied in-furrow through insecticide hopper boxes on the planter. These products can be added to the insecticide hopper boxes in the field on the turn-row.

Powder inoculants: In the past, powder "peat" based products have been the most widely used inoculants. These products can be added directly to the seed in the field after the hopper boxes are filled. These products have their advantages and disadvantages. Advantages are that they are very easy to use, can be applied in the field on the turn-row, easy to handle, and are relatively inexpensive. Disadvantages include insufficient coverage of all seed because it's a powder that is most often applied to the top of the hopper boxes and must trickle down to all the seed. Most of

the time, there is a substantial amount of powder inoculant remaining in the bottom of each hopper when finished planting. This is a sign that we probably didn't get sufficient coverage of all seed in the hopper. Secondly, these products must be handled appropriately. The peat-based powder contains live rhizobia bacteria that is sensitive to heat and sunlight. These products don't need to be left on the truck dashboard for a while before being used. Keep these products in a cool, relatively dark place before use. However, keep in mind, using a powder peat-based inoculant is always better than using no inoculant at all.

Inoculants are a cheap insurance to ensuring there are sufficient numbers of rhizobia bacteria in the soil to ensure adequate nodulation and formation of ample amounts of nitrogen required by soybean. Soils that have not been in soybean for at least two years or have been in other crops such as cotton several years in a row are excellent candidates for using some type of inoculant. Please feel free to contact me or any of us in the MSU Extension Service if you have questions regarding the use of inoculants or any other soybean production issue. Good luck this spring getting your crop planted and be looking for future Current Issues in MS Soybean Production press releases. The next issue will focus on seed quality and seeding rates for MS soybean production systems.

IF YOU WOULD LIKE TO BE TAKEN OFF OF THE LIST, UPDATE YOUR ADDRESS, OR BE ADDED TO THE EMAIL DISTRIBUTION LIST PLEASE CONTACT SHERRY MCMULLIN AT (662) 325-2085 OR EMAIL HER AT: smcmullin@entomology.msstate.edu WITH **CIS NEWSLETTER** IN THE SUBJECT LINE TO BE ADDED TO THE ELECTRONIC NEWSLETTER LIST OR MAKE ANY CHANGES.

Row Crop Contact List			
State Specialist Contact Information			
Darrin Dodds	**Cotton Specialist**	**662 418-1024 cell**	**dmd76@pss.msstate.edu**
Erick Larson	**Grain Crop Specialist**	**662 418-7802 cell**	**elarson@pss.msstate.edu**
Trey Koger	**Soybean Specialist**	**662 207-1604 cell**	**tkoger@drec.msstate.edu**
Chris Daves	**Corn Entomology Specialist**	**662 418-1492 cell**	**cdaves@ext.msstate.edu**
Angus Catchot	**Entomology Specialist**	**662 418-8163 cell**	**acatchot@ext.msstate.edu**
Nathan Buehring	**Rice Specialist**	**662 822-7359 cell**	**nathanb@ext.msstate.edu**
Mike Howell	**Peanut Specialist**	**601 795-1425 cell**	**mshowell@ext.msstate.edu**
Area Specialist Contact Information			
Don Cook	**Northeast MS – Entomology**	**662 255-1899 cell**	**dcook@ext.msstate.edu**
Tom Allen	**Delta – Plant Pathology**	**662 402-9995 cell**	**tallen@ext.msstate.edu**
Gordon Andrews	**Delta - Entomology**	**662 820-8808 cell**	**gordona@ext.msstate.edu**
Chris Daves	**South MS - Entomology**	**662 418-1492 cell**	**cdaves@ext.msstate.edu**
Dan Poston	**Delta - Soybean**	**662 820-0893 cell**	**dposton@drec.msstate.edu**
Area Agronomist Contact Information			
Art Smith	**North Delta**	**901 239-3283 cell**	**arts@ext.msstate.edu**
Jerry Singleton	**Central South Delta**	**662 299-7092 cell**	**jerrys@ext.msstate.edu**
Ernie Flint	**Central MS**	**662 582-1211 cell**	**ernestf@ext.msstate.edu**
Bill Maily	**South West**	**601 540-5582 cell**	**billm@ext.msstate.edu**
Jay Phelps	**North**	**662 488-5500 cell**	**jayp@ext.mssate.edu**
Bill Burdine	**North Central**	**662 456-0517 cell**	**bburdine@ext.msstate.edu**
Charlie Stokes	**North East**	**662 386-7307 cell**	**charlies@ext.msstate.edu**
Dennis Reginelli	**East Central**	**662 418-4480 cell**	**dennisr@ext.msstate.edu**
Randy Smith	**South Central**	**601 813-7166 cell**	**hsmith@ext.msstate.edu**
Mike Howell	**South**	**601 795-1425 cell**	**mshowell@ext.msstate.edu**