

Virginia Soybean Update

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Dear Reader,

Soybean planting has begun. The warm temperatures should insure good emergence. However, remember that this is still May; temperatures will drop. Keep a check on the weather. Cool, rainy weather could rapidly drop soil temperatures and delay emergence, therefore increasing the likelihood of seedling disease. If cool, rainy weather is predicted, then a fungicide seed treatment may be in order.

As always, plant about 1 inch deep into a clean seedbed; early-season weed competition can dramatically lower yields.

Things are generally quite with soybean rust. The late frosts and dry weather have again stopped movement up the coast. There have been no new reports of soybean rust since late March and the disease can no longer be found in many of the previously-infected kudzu patches in Florida, Georgia or Alabama. That's good news.

This issue will focus on soybean inoculants, whether you need them or not. In summary, they are good insurance that will neither consistently make nor lose you money.

I call your attention to Tommy Hines' request to join the Virginia Soybean Association on p. 3. It is your opportunity to become involved in issues directly affecting your operation. Plus, it's a great opportunity gain new friends and interact with those in your profession.

Extension Soybean Specialist

In This Issue

Soybean Inoculants for Adequate N Fixation	1
Rules for Good Inoculation	2
Join the Virginia Soybean Association	3

Soybean Inoculants for Adequate N Fixation

Soybean seed contain 35 to 45% protein. Depending on the protein content, nitrogen (N) requirements can approach 5 pounds per bushel. Therefore, a 40 bushel crop may use over 200 pounds of N. This N comes from two sources: oxidation of soil organic matter and that produced by a symbiotic relationship between soybean and N-fixing soil bacteria.

In low organic matter soils, the bulk of N comes from the bacteria strain, *Bradyrhizobium japonicum*. The N-fixing process is initiated by the soybean when it releases chemical signals into the soil soon after emergence. These signals are picked up by the rhizobia in the soil or in the inoculation material applied with the seed. The bacteria then infect the roots and the roots form a specialized structure around the bacteria called a nodule. As the bacteria increase in numbers and size, an enzyme in the nodules fix N² from the air, which is unusable by the plant, into ammonia (NH₃), which can be used by the plant. The nitrogen-fixing process usually begins at the 2- to 3-leaf stage. When the process is working, nodules will have a pink or red interior. Nodules reach their full size in about 4 weeks and continue to fix N for another 2 to 3 weeks. Peak N fixation occurs during seed fill (R5-R6).



The process is called symbiotic because the soybean provides the energy

(carbohydrates and sugars) and a protective growing environment for the rhizobia. The rhizobia, in turn, provide the nutrient needed in the largest amount (N) to the soybean. This relationship needs to work well in order to meet the high N requirements of a high-yielding soybean crop.

Bradyrhizobia bacteria must be present in relatively high numbers at planting. If soybean has never been grown in a field, then seed must be inoculated with the bacteria. Stresses on the bacteria such as drought, cold temperatures, flooding, and low soil pH will reduce their numbers and interfere with the fixation process. Planting inoculated seed into dry soils will cause drying of the bacteria and death. Other stresses such as certain seed treatment chemicals and starter fertilizer can kill the bacteria and inhibit nodulation. Finally, soil N concentrations in excess of 30 to 50 pounds per acre can delay the N-fixing process.

When should inoculants be used? The process of introducing an organism into another is called inoculation. Rhizobia can be added directly to the soil (in-furrow with the seed) or as a seed coating. The later is most often used due to cost or lack of in-furrow injection equipment. In general, if soybean has been grown in the past 3 years, a field will normally have sufficient soil bacteria for adequate nodulation and N fixation. However, if soybean has not been grown in over 3 years, I recommend an inoculant. Still, I've seen sufficient nodulation in soils that haven't had soybean grown in them for over 5 years. But, that's a risk that should not be taken. The big question today is whether or not rotated soybean fields will benefit from inoculants. Before we answer that question, I should mention changes in inoculant technology.

(continued on next page)

New products. Inoculants have changed over the last 10-15 years. Instead of just peat-based products with relatively low numbers of bacteria, we now have sterile peat- and liquid-based products with much higher numbers and more strains of bacteria. Sterile inoculants contain no contaminants that can reduce the number of rhizobium. The number of viable bacteria cells has risen from less than 500 million to over 2 billion cells per gram of inoculant. Some inoculants contain new and multiple strains of bacteria. Combining strains that are productive in different environments result in inoculants that are vigorous over a wide range of environments. But, keep in mind that it is very difficult to replace the indigenous rhizobia population with an introduced strain. Some inoculants contain plant growth hormones and biological disease control organisms. Some include biological signals that supposedly speed up the inoculation process. Inoculants are now easier to apply. They stick to the seed better, insuring better coverage of every seed. One of the biggest improvements is the addition of extenders that allows the bacteria to be applied to the seed up to 30 days or more before the seed is planted. Inoculants without extenders should usually be applied within 24 hours or less of planting. The extenders also extend the life of bacteria cells when applied to seed treated with fungicides.

These improvements have resulted in more concentrated products with longer shelf life and ease of use. The outcome of these improvements is more effective inoculation. Now, instead of establishing less than ½ million rhizobia cells per seed, we're putting on ¾ million to 1.5 billion cells per seed if used at recommended rates. For new soybean land, this should result in a better establishment of this critical organism. But, do these improvements necessarily results in yield improvements on rotated land?

University tests results. Many trials have been conducted in the Midwest since the introduction of the new sterile inoculants with new strains. Although many studies did not result in a significant yield increase, the results show a long-term economic benefit from applying inoculant to rotated soybean land when results are averaged over time and locations. Keep in mind that the cost of inoculants was only \$2 to \$4 per acre, depending on the product.

In Ohio, the average yield increase from 64 field trials conducted over 11 years was 1.9 bushels per acre. In North Dakota, the average yield increase from 155 product evaluations was 2.7 bushels per acre. Michigan State trials (11 test sites) averaged 1.1 bushels per acre and Purdue tests (19 locations) averages 1.0 bushels per acre. A 3-year study in New York showed a 2 bushel per acre benefit of inoculants in fields with a history of soybean and a 3 bushel per acre benefit in fields with no soybean history.

In Virginia, our results have not been as promising. In 13 trials (11 in 2004; 1 in 1998; 1 in 1997), inoculants increased yield by an average of 0.4 bushels per acre.

Furthermore, in only 2 of the 13 trials was the response to inoculant significant. Nine of the 13 trials were planted in double-crop systems; the two significant responses were from double-crop plantings. Results from dozens of North Carolina trials are similar.

Why the difference between results in the Midwest and here? I'm not sure. It could be soil differences or higher yield potentials in the Midwest. Or, it could be the lower soil temperatures. Regardless, the likelihood of getting a consistent response, regardless of location, is small. If I average all of the studies in our region, we generally get less than a 0.5 bushel advantage in fields with a history of soybean. That will pay for the product, but that's about it. Still, we occasionally get the 3 to 5 bushel increase in some fields.

In summary, inoculants applied to fields with no history of soybean are necessary. The cost of the inoculant will pay for itself many times over. In fields where soybean has been grown in the last 3 years, the use of inoculant is an insurance treatment. This insurance will probably pay for itself, but not necessarily give a large return on investment.

Rules for Good Inoculation

Proper storage and mixing of inoculants with the seed are key to making sure you're getting the most bang for your buck. Improper storage or leaving the inoculant on the seed too long before planting will kill the bacteria. Not properly mixing the bacteria will result in a field where some plants have nodules and others don't. The photos below show a Virginia field with no soybean history and the inoculant was not properly mixed with the seed. The plants on the right contained nodules; the plants on the left did not.



Listed below are some tips for good soybean inoculation.

- Adjust your soil pH to 5.8 to 6.2 by regular liming. Acid soils will kill rhizobia.
- Choose a sterile inoculant product. These products have much higher numbers of living bacteria cells.
- Store in a cool place and out of direct sunlight. Rhizobia survive best at temperatures between 40 to 80 degrees F. The shelf life of products vary from a few months to two years; so check the label and expiration data. When transporting, keep out of the sun. Sunlight is a problem of heat, not radiation.
- Never use inoculants past their expiration date.
- After opening, use the entire contents of the product within the time period listed on the product label.
- If combining an inoculant with a fungicide or insecticide seed treatment, use an inoculant that contains a protector. Even with the protector, check for compatibility of other chemical seed treatments. Products containing captan or PCNB are detrimental. Others can be safely mixed, but one should check the label to determine the maximum amount of time the products can be mixed before planting. The inoculant should be applied after (sequentially) the seed treatment. Intervals between application and planting can range from a few hours to days or even weeks, depending on the product. If the inoculant and seed treatment is mixed together in a slurry, the seed will usually need to be planted within a few hours.
- If dilution of the product is necessary, never use chlorinated water
- Plant inoculated seed not having an extender within 12 hours, preferably 2 hours.
- Plant into soils with good moisture. Dry soils will dry out and kill the bacteria.
- Use the recommended rate of inoculant and mix thoroughly with the seed. All seed need to contain at least ½ to ¾ million cells to be effective.
- If loading a planter or drill with an auger or other bulk loading equipment, the inoculant can be metered as the seed enters the auger. Be sure to calibrate the flow rate of the seed and the inoculant. Manufacturers usually provide specific instructions for this.
- If applying as a seed box treatment, place about 3 to 4 inches of seed in the bottom of the planter or drill box, apply the proper amount of inoculant, and mix thoroughly. Repeat this process until the box has been filled.

Join the Virginia Soybean Association

Tommy Hines, VSA Membership Chair

Being the state membership chairman for the Virginia Soybean Association (VSA), I am asking for your support again to help make the Association even better. The VSA is working very hard to help with the usage of soybeans in the state and we need your support.

The VSA is your policy representative before Virginia's State Legislature. Recent efforts include voicing concerns and disagreement with such issues as: new nutrient management regulations proposed by DCR; new water withdrawal regulations proposed by DCR; eminent domain; estate tax; biofuels legislation allowing tax credits for production of 10 million gallons or more; transportation issues affecting agriculture; and soybean rust monitoring. These are just a few of the policy issues your Association has undertaken this year for soybean producers throughout the Commonwealth.

The American Soybean Association and your state Association office are your advocates on all national issues which impact every producer in the country. These issues include fair trade; farm bill; energy, and biodiesel. **This important policy work (federal and state) is paid for by your membership in your state and national soybean associations and cannot come from check-off dollars.** Check-off funds can only be used for education, domestic and international marketing, new uses/new products development and research, production research, and food assistance programs.

Membership in the VSA at year end totaled 264 members. We would like to get our membership up to at least 300 members so to have a better representation of Virginia farmers. I know sometimes memberships get misplaced or things happen that we can't control, but if a former member, please consider rejoining. If you have never been a member, I encourage you to join a great organization.

On the next page, you'll find a membership application. Please help support your Virginia Soybean Association. Make checks payable to VSA. Mail the application with payment to VSA, 151 Kristiansand Drive, Suite 115 E & F, Williamsburg, VA 23188.

Membership Application – Virginia Soybean Association (Affiliated with the American Soybean Assoc.)

Name: _____ Date: _____

Farm/Company Name: _____ Spouse's Name: _____

Address: _____

City: _____ State _____ Zip: _____

County: _____ Phone: _____

Age Category: (Please ✓ one) ___ 30 or under ___ 31-45 ___ 46-59 ___ 60 or above ___ Acres Farmed

Occupation: (Please ✓ one) ___ Farmer ___ Elevator ___ Finance ___ Extension ___ Agribusiness ___ Other

Dues Enclosed: ___ 1 Year Membership - \$60.00 ___ 3 Year Membership - \$165.00

Mail Application and Dues to:

Virginia Soybean Association, 151 Kristiansand Drive, Suite 115 E & F, Williamsburg, VA 23188

Recruiter: _____ County: _____