The Peanut Grower

Inoculant Guide

Sponsored by VAULT® Peanut Inoculant
with exclusive BioStacked® Technology

Dear Grower,

One of the great things about agriculture is when one growing season comes to an end the opportunities of the next growing season are just around the corner. Now that 2008 is in the books, it's time to start thinking about 2009 and which crop inputs provide you the greatest opportunity to maximize yield and return on investment.

Inoculants have consistently proven their value and worth to peanut growers across the South. The *Rhizobia* they contain convert atmospheric nitrogen into a form that can be used by the plant, resulting in yield increases that can range from 200 to 1,500 pounds per acre.

When considering an inoculant, there are two very important factors I would ask you to keep in mind. First, take a hard look at yield data and ask yourself if it's credible. At Becker Underwood, we place a heavy emphasis on independent field trials conducted by respected universities in key peanut-producing states. When you compile all the trials from last year, seed treated with VAULT® delivered an average of 422 pounds per acre more than untreated seed.

Second, remember that the fresher your inoculant, the better. *Rhizobia* are living organisms. Inoculants are only effective if these organisms are alive and available in sufficient quantities to allow legume crops like peanuts to form beneficial root nodules. At Becker Underwood we make our VAULT® inoculants fresh every year for that specific growing season. This ensures that our products deliver strong, vigorous *Rhizobia* to your seed, which helps maximize both nitrogen fixation and yield in your peanuts.

Our VAULT® lineup features three peanut inoculants made fresh for the 2009 growing season:

- VAULT® liquid features BioStacked® Technology that combines advanced strains of *Rhizobia* with Integral® – an EPA-registered biofungicide that suppresses common soil-borne diseases – and other biological ingredients into one in-furrow application
- VAULT® SP is a highly potent sterile peat-based product that is applied on the seed
- VAULT® Spherical Granular, applied in-furrow, is a dry granular product with uniform shape and size that allows for better flowability and more uniform distribution in the seed furrow

We hope you find this inoculant guide useful as you think ahead to the 2009 growing season. If you'd like more information about VAULT® inoculants and where you can find them, please call (800) 892-2013.

On behalf of all the folks at Becker Underwood, we wish you all the best in the coming year.

Sincerely,

Glen Wiggins
Regional Sales Manger

VAULT®

Why An Inoculant Guide?

Peanut production is driven by science. We learn things and that helps perfect the production process. Then we build on what we know to learn even more. While some of the information provided here is based on things we have learned in the past, the "science" of the inoculation process continues to grow with new research data.

At one time, the recommendation was that an inoculant was not needed if peanuts had been planted in that field within the last five years. However, newer research casts doubt on that recommendation.

It's all about the science and making sure that what is recommended is accurate. The more we learn, the more assurance we have that we are giving the peanut crop every opportunity to grow well.

Science is also about solving problems. In 2008, several instances of fields with an improper soil pH were found, which can greatly affect inoculation. So, at times a reminder of things we already know is in order. That's why it is always good to review the conditions and factors affecting *Rhizobia* in the soil.

That's what the Inoculant Guide is all about – bringing you the latest research findings about inoculants and reminding you of those critical factors that affect how well the inoculant will work in your fields. PG

Inoculant Research From North Carolina

by David Jordan, North Carolina State University Peanut Agronomist

Growers understand the importance of inoculation with *Bradyrhizobium* to ensure peanut is capable of fixing atmospheric nitrogen into a plant usable form. In spite of this knowledge, not all growers inoculate, and there is considerable variation throughout the peanut belt relative to actual use.

Defining factors that influence response to inoculation can be important in developing peanut production strategies. One factor that could possibly affect response to inoculant is the time between peanut plantings.

Several trials were initiated in North Carolina in the late 1990s to establish a crop rotation history allowing comparison of varieties, fumigation treatment with metam sodium and inoculant in rotations with various sequences of peanut, cotton, corn and tobacco. In these experiments, rotations ranged from as many as five years out of peanut to continuous peanut.

In 2006, peanut was planted in all plots with and without an in-furrow commercial inoculant. Surprisingly, at least to me, was that a positive response to inoculation did not occur when I expected it to. For example, in one experiment with five years of corn between peanut plantings was no more responsive to inoculant than continuous peanut, alternating peanut and corn or cotton, and two years of corn or cotton between peanut plantings.

Take Home Message:
The cost of an inoculant is 1 percent or less of the total peanut budget, making it an input that needs to be included in all cases.

No Negative Impact To Inoculating

In contrast, a positive response to inoculant was noted when comparing similar rotations in a different experiment. Also, peanut did not respond positively to inoculant when five years of cotton separated peanut planting compared with several shorter rotations and continuous peanut.

We also noted a positive response to inoculant when only three years separated peanut plantings. In none of the experiments did inoculant negatively affect peanut yield.

These experiments indicate that predicting whether or not peanut will respond based on the number of years between peanut plantings is not the most appropriate technique. Several other researchers have pointed out the complexity of determining when peanut will respond to inoculant, and many factors can influence efficacy of inoculants in addition to the length of crop rotation. These experiments revealed that, in several instances, positive response was observed but not necessarily expected (short rotations, for example.)

Consequently, one take-home message is that inoculant should be routinely applied each time peanut is planted. In fact, cost of inoculant is 1 percent or less of the total peanut budget, making it an input that needs to be included in all cases. PG

Inoculants In Action

Seventy-nine percent of the air we breathe is made up of nitrogen. Like any agricultural crop, peanuts need nitrogen. But it's a little misleading to say that peanuts "fix" nitrogen from the air and turn it into a form usable to the plant. Actually, it is a specific bacteria that does all the work.

Rhizobium bacteria convert nitrogen from the air into a form that can be used by the peanut plant to grow and produce protein, fiber and seed. The plant supplies the bacteria with an environment and nutrients in which to live and multiply.

How Does It Happen?

Specifically, nitrogen fixation is mediated by the enzyme nitrogenase. *Rhizobia* symbiosis via the nitrogenase enzyme converts gaseous nitrogen to ammonia, which is then assimilated into amino acids that are transported throughout the plant. Most of this goes to the above ground parts of the plants where the plant uses it to make protein, nucleic acids and other necessary nitrogen-containing compounds needed for plant growth and seed production.

The process is no different than when the plant assimilates ammonia fertilizer. However, researchers agree that peanuts respond better to the nitrogen fixation provided by *Rhizobia* bacteria found naturally in the soil or provided through the application of a peanut-specific inoculant than it does to direct application of nitrogen fertilizer.

Take Home Message:
Peanuts respond better to *Rhizobia* provided through an applied crop-specific inoculant than to direct fertilizer applications.

What's The Catch?

It is well documented that *Rhizobia* can stay in the soil for some time. However, there is no way to test the soil to determine if the *Rhizobia* present are peanut-specific, are in sufficient quantities to effectively nodulate the crop or are still highly viable, given that bacteria are living organisms.

The best way to "know" this is to apply an inoculant at planting. The inoculant should be specific to peanuts and applied in the furrow as close to the seed as possible. This ensures that the bacteria is present, viable and ready to move into the roots, multiply and make nodules and begin fixing nitrogen. The result is a healthier crop from the beginning and quicker canopy closure.

Plus, it is best to have *Rhizobia* that is fresh and ready to work. As a living organism, it has a life span. You want *Rhizobia* in the prime of life, not ready for the old bacteria's home. This is another reason to apply an inoculant that delivers strong, vigorous *Rhizobia* to the seed.

Fresh And Ready To Work

Some growing areas simply have conditions that make it impossible for *Rhizobium* bacteria to survive from one year to the next. Because of this, growers routinely use inoculants every year at planting. However, planting too shallow, which means the inoculant is also placed too shallow, can lead to the bacteria being killed by the harsh conditions.

Research has shown that producers may lose much if not most of their *Rhizobia* by planting at a shallow depth, even if they are planting into moist soil and irrigate soon afterwards. While granular materials may buffer the bacteria from desiccating in arid soil conditions, liquid inoculants offer more nodulation at a planting depth of two to three inches. PG

Take Home Message:
Apply a fresh inoculant at the proper planting depth to keep it alive.

Inoculants In Application

Inoculation is the placement of *Rhizobium* bacteria either directly on the seed or into the soil in close proximity to the seed. Placing the inoculant in a high concentration where it can enter into the root quickly and begin multiplying, thus making nitrogen available to the plant, allows for a greater probability for achieving vigorous growth and quick canopy closure. A lack of nitrogen slows the process, and less vigorous plant growth is a prime target for disease and weed pressure.

Regardless of the type of inoculant used, the application process begins months in advance with a soil test. Peanuts grow best when soil pH ranges from 6.0 to 6.5. The availability of soil nutrients and the nitrogen-fixation process are optimized in this range.

In 2008, soils were found at a pH that was too low or too high, which resulted in toxicities and deficiencies. For more information on this, see the portion written by Glen Harris, University of Georgia soil scientist.

Soil type can also affect the levels of *Rhizobia* present. Peanuts grown in new soils or highly acidic soils should be supplied with *Rhizobia*. Peanuts grown in very light or very heavy soils may also benefit from inoculation. Flooding depletes the amount of oxygen in the root zone needed for bacteria to survive, therefore peanuts planted into waterlogged soils will also require the application of an inoculant.

Inoculant Application Tips

- Use a fresh, high-quality inoculant specific to peanuts
- Store product in cool, dry place; never store in direct sunlight
- Calibrate equipment to ensure proper delivery of the recommended rate
- Be sure granular drop tubes or spray nozzles are unobstructed and place the inoculant into the seed furrow around the seed
- Mix seed-applied products thoroughly
- Plant into moist soil at a depth to protect the seed and inoculant from harsh weather
- Set planting speed and equipment to ensure complete soil coverage of seed and inoculant to prevent drying out
- Do not use chlorinated water for liquid inoculants
- Read and follow product label
- Consult with product company or dealers about specific compatibility concerns

Soil pH A Critical Factor

by Glen Harris,
University of Georgia Soil Scientist

Soil pH is known to be one of the most important factors affecting nodulation and nitrogen fixation in all legume plants, including peanut. That is why legume crops generally require a somewhat higher "target pH" than non-leguminous crops – usually 6.0 - 6.5 instead of 6.0.

The activity of bacteria in soil, including the required *Rhizobium* species responsible for nitrogen fixation with peanut, are adversely affected by low soil pH. Extremely low pH, such as below 5.0, can even cancel the ability of soil bacteria to survive.

Native strains of *Rhizobia* bacteria, that is ones that survive long term in soil, may be more tolerant to adverse conditions such as low soil pH compared to strains introduced at planting in commercial inoculants. However, commercial inoculants contain the very best strains in terms of nitrogen fixation as long as soil pH is in the proper range. Therefore, regardless of whether you are depending on native *Rhizobium* bacteria present in the soil in a short-term rotation and/or commercial inoculants, maintaining the proper soil pH for nodulation and nitrogen fixation is critical. PG

Care and Handling Always Critical

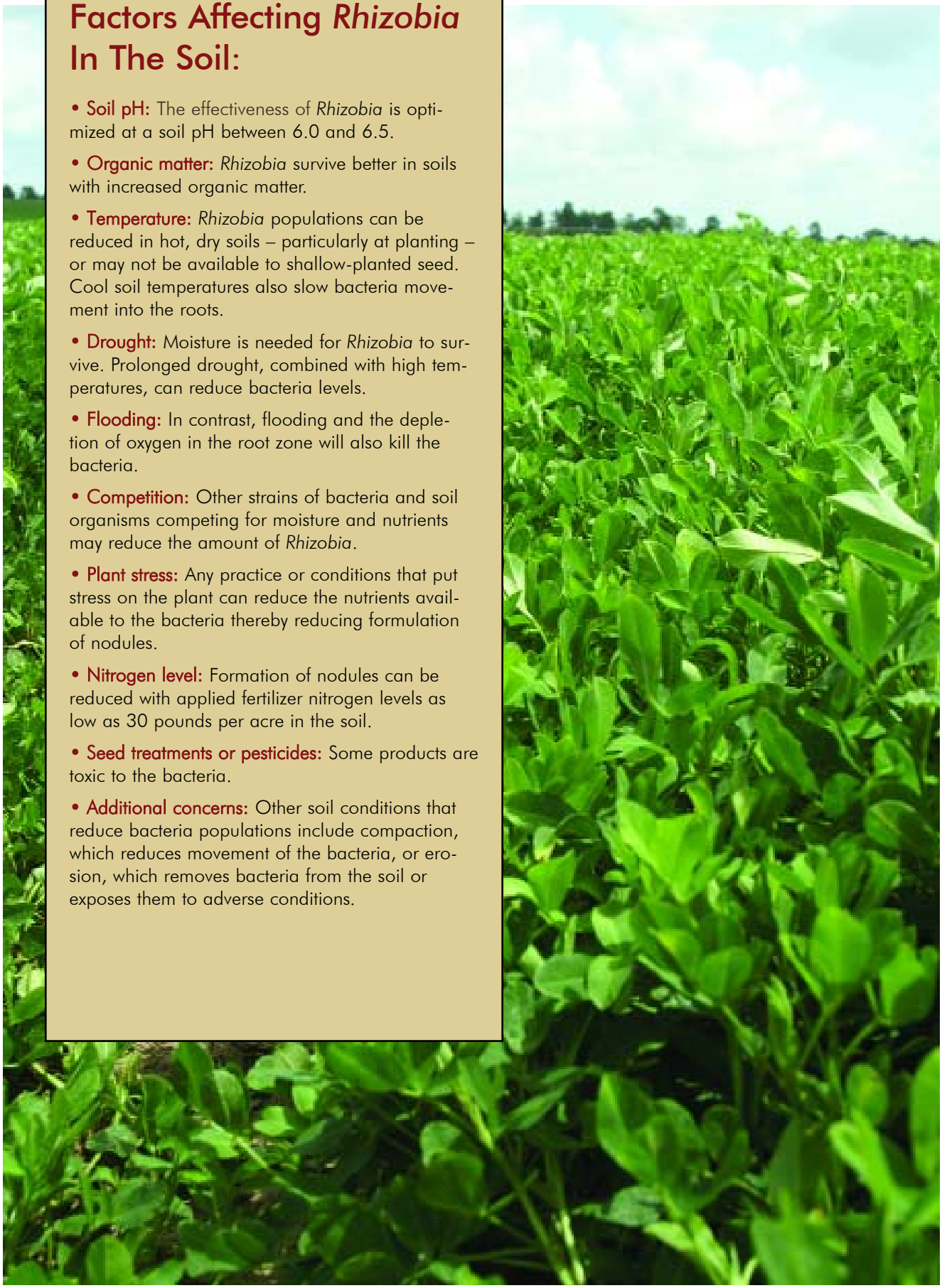
Remember to handle the inoculant product carefully. The product should be stored in a cool, dry area and never exposed to sunlight. In the field, keep the inoculant in an insulated cooler until used and do not mix liquid inoculants with chlorinated water. Before mixing an inoculant with fungicides or other seed treatments, consult the product label or inoculant dealer to find out about compatibility. Always read and follow product label directions. This will also help you calibrate equipment and ensure proper rates and placement of the product.

Placing an inoculant in a high concentration where it is available to enter into the root and begin making nitrogen for the plant quickly is another step towards achieving a good, high-yielding crop. Inattention to details can make any good inoculant product appear mediocre. PG

Take Home Message:
Careful handling and proper application of the inoculant into optimum conditions will give your crop every opportunity to grow well.

Factors Affecting *Rhizobia* In The Soil:

- **Soil pH:** The effectiveness of *Rhizobia* is optimized at a soil pH between 6.0 and 6.5.
- **Organic matter:** *Rhizobia* survive better in soils with increased organic matter.
- **Temperature:** *Rhizobia* populations can be reduced in hot, dry soils – particularly at planting – or may not be available to shallow-planted seed. Cool soil temperatures also slow bacteria movement into the roots.
- **Drought:** Moisture is needed for *Rhizobia* to survive. Prolonged drought, combined with high temperatures, can reduce bacteria levels.
- **Flooding:** In contrast, flooding and the depletion of oxygen in the root zone will also kill the bacteria.
- **Competition:** Other strains of bacteria and soil organisms competing for moisture and nutrients may reduce the amount of *Rhizobia*.
- **Plant stress:** Any practice or conditions that put stress on the plant can reduce the nutrients available to the bacteria thereby reducing formulation of nodules.
- **Nitrogen level:** Formation of nodules can be reduced with applied fertilizer nitrogen levels as low as 30 pounds per acre in the soil.
- **Seed treatments or pesticides:** Some products are toxic to the bacteria.
- **Additional concerns:** Other soil conditions that reduce bacteria populations include compaction, which reduces movement of the bacteria, or erosion, which removes bacteria from the soil or exposes them to adverse conditions.



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Inoculants For Assurance

Although you cannot easily determine if *Rhizobia* are present in the soil in sufficient amounts to inoculate the crop, fortunately, you don't have to guess. You can easily tell if the peanut plant has been inoculated through the formation of nodules on the root system.

Nodules are formed where *Rhizobium* bacteria enter the root hairs and begin to multiply. Within these nodules, bacteria convert nitrogen gas into ammonia nitrogen. Through translocation, this usable form of nitrogen moves through the plant's vascular system to the leafy tissue where it is used by the plant. By checking for active nodule formation, it is possible to tell if this chemical reaction is taking place.

Scout It Out

The scouting process is simple and straightforward. About five to six weeks after planting, carefully dig plants from several locations in the field. Be sure to use a shovel as nodules may slough off if the plant is pulled from the ground.

Examine the number of nodules on the roots. Fewer nodules may indicate a problem. However, even a great number of nodules does not mean that they are actively fixing nitrogen. To determine this, carefully slice open several nodules. Active nodules are pink to dark red inside. A white color inside indicates that the nodule is not yet active. Other colors may indicate that little nitrogen is being fixed.

If few nodules are found or the nodule color does not show active nitrogen fixation, wait approximately 10 days and check the field again. For various reasons, the bacteria may have been slow to enter the roots and multiply. If upon the second inspection, nodulation again appears poor, a nitrogen fertilizer will probably need to be applied to the crop. Remember, a lack of nitrogen will result in lighter colored or stunted plants, however, these symptoms are also caused by many other problems.

Whether or not you applied an inoculant at planting, always scout for nodulation anyway. It is the most efficient way to be assured nitrogen fixation is occurring. If poor nodulation is found, you will know to use an inoculant when next planting a peanut crop to that field. If an inoculant was used, but poor nodulation was found, then you will need to consider what went wrong and avoid making the same mistake twice.

Quick germination, a uniform stand and vigorous growth that leads to canopy closure should be your goal in peanut production. This is not possible without nitrogen. Providing it through the use of an inoculant is the most efficient way to provide the assurance that you have done all you can to maximize yields and quality. PG

Take Home Message:

Applying an inoculant and then scouting to make sure the nodulation process is occurring provides assurance that you have given your peanuts the opportunity to achieve maximum yields and quality.