When do we need to inoculate our soybean seeds?

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When do we need to inoculate our soybean seeds?

Abstract
New soybean seed inoculants have been introduced in the market over the last year. However, there is a lot of inconsistency in results from inoculation of fields with a previous history of soybean from around the world. So when and how often do we really need to inoculate our fields?

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Nitrogen fixation is the process of converting atmospheric nitrogen into a usable form for the plant and is critical for producing higher yields in soybean. For nitrogen fixation to occur, the nitrogen-fixing bacteria known as *Bradyrhizobia japonicum* need to be readily available in the soil or must be applied to the seed to form nodules on the soybean root. When the seed germinates, the bacteria invade the root hairs of the seedling and begin to multiply. Nodules, which house the bacteria, form on the roots. Under field conditions, nodule formation can be seen shortly after emergence but active nitrogen fixation does not begin until about the V2 to V3 stage. After this, the number of nodules formed and the amount of nitrogen fixed increase with time until about R5.5 (midway between R5 and R6), when they decrease sharply.

There is a mutual benefit in the relationship between the *Bradyrhizobium* bacteria and the soybean plant. For nitrogen fixation to occur, *Bradyrhizobium* bacteria need to be present in the soil. The plant, in turn, provides the bacteria's carbohydrate supply. A relationship such as this, where both bacteria and plant profit from the other, is called a symbiotic relationship.

Nitrogen (N) fertilization of soybean is not recommended because it generally does not increase grain yields. The total number of root nodules that form decreases proportionately with increasing amounts of applied N. In addition, N fertilizer applied to a soybean plant with active nodules will render the nodules inactive or inefficient, proportionately to the amount of N applied. Thus, the soybean plant can use both fixed N from bacteria and soil N (both mineralized and fertilizer N), but soil N is used in preference to fixed N if available in large amounts. Although soybean does not respond with increased yield to the addition of N, plants remove a significant amount of it from the soil. In Iowa soils, which have appreciable residual N levels, up to 50 percent of the total plant N has been attributed to N2 fixation. Increasing nitrogen supply by adding fertilizer, animal manure, sludge, or a green manure crop simply substitutes nitrogen from these sources for nitrogen that would otherwise be fixed by the bacteria in nodules on the roots.

Most recommendations in the Midwest have been to inoculate the seed if nodulated soybean has not been grown in a field in the past 3-5 years and if soil pH has not been maintained above 6.0. The rule of thumb is that fields never planted to soybean or fields with sandy soils (low organic matter soils) need to be inoculated every year. This year, we also need to consider the fields that were flooded last July, particularly those in central Iowa. Some of these fields were flooded for an extended period of time, and plants were injured or died.
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These fields may need to be inoculated because the anaerobic conditions may have reduced the level of *Bradyrhizobium* bacteria in the soil.

*Flopped fields may have a reduced level of Bradyrhizobia japonicum bacteria in the soil.*

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