

## Forage Management

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### Considerations for N-fixing biologicals in corn production

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In recent year, products containing nitrogen (N) fixing bacteria have been marketed for their ability to supply N to a corn crop. With recent volatility in fertilizer markets, farmers are interested in using biologicals for nitrogen management, but data are needed to truly understand when and how they can provide a production benefit in our region, for cropping systems on both cash grain and dairy operations, with and without a manure history.

Numerous variables associated with field crop production increase the importance of evaluating any new product across a diverse range of conditions to better understand when and where it is most likely to work “as advertised” and it simply takes time to build this knowledge base.

Biologicals are generally understood to provide N throughout the growing season as microbes are active, which is a valuable contribution as corn has season-long needs. Some results suggest biologicals may enhance plant health and result in a higher yield as a plant may be less stressed during the growing season.

Main question is: **How do we determine if a biological (1) improves yield; and/or (2) reduces the need for fertilizer N?**

#### Considerations

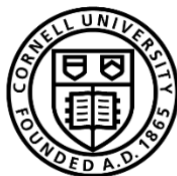
Before we can answer this question, here are some considerations:

##### Different types of biologicals

While this article focuses on products that include N-fixing bacteria, a summary of the many different types of biological products available for row crop production is at Dr. Connor Sible's overview: [cropphysiology.cropsci.illinois.edu/wp-content/uploads/2022/12/Biological-Summary.pdf](http://cropphysiology.cropsci.illinois.edu/wp-content/uploads/2022/12/Biological-Summary.pdf)

##### Nitrogen replacement versus nitrogen addition - Agronomic considerations

Corn takes up nitrogen from different sources. In the case of N-fixing bacteria, it needs to be recognized that their application should be credited as a source of N to meet the *overall* N needs of the crop, just as N from fertilizer, manure or previous crops are credited. In simple terms the expected N credit they provide should be added to your N balance equation, where the goal is for total N inputs to equal total corn N needs:



Total N inputs = soil N + manure N + rotation N + fertilizer N + biological N contribution

### Field history

If a crop does not need extra N, using a biological to bring in more N does not help increase yield.

Two possible examples:

- [First year corn after sod does not require additional N beyond a small starter application.](#) Therefore, the likelihood of any N benefit from N fixing bacterial products for first year corn after sod is very small.
- If all N needs are met with manure and other N sources already on the farm, addition of more N is also unlikely to increase yields.

### Testing biologicals on-farm

With any new product, it is highly recommended to do on-farm testing to see if the product is a good investment for the farm. Manured fields tend to yield higher than non-manured fields, reflecting greater soil health and nutrient cycling. It is likely that biologicals work differently in manured fields than they would in non-manured fields. Also, decide what the measure of success is (yield only, specific forage quality parameters, total economic impact) and then be sure to capture those at the end of the season.

### Yield benefits

If the goal is to test if a biological *enhances yield*, testing can be done using a with and without treatment while everything else is kept the same (same N rate, same seeding rate, etc.). You can also opt to do this comparison at two different N rates as shown in the examples below:

Example using one N rate:

Treatment	N rate	Biological used?	Example treatment scenario
1	Normal N rate	No	140 lbs applied N
2	Normal N rate	Yes	140 lbs applied N + biological

Example using two N rates:

Treatment	N rate	Biological used?	Example treatment scenario
1	Normal N rate	No	140 lbs applied N
2	Normal N rate	Yes	140 lbs applied N + biological
3	Normal N rate - expected N contribution	No	100 lbs applied N
4	Normal N rate - expected N contribution	Yes	100 lbs applied N + biological

Each treatment pair (1+2 for the first example or 1+2+3+4 in the second example) should be replicated at least three times (more is better). For specific guidance on designing these type of on-farm research trials, see: [nmsp.cals.cornell.edu/publications/factsheets/factsheet68.pdf](http://nmsp.cals.cornell.edu/publications/factsheets/factsheet68.pdf).

For farmers with yield monitor systems and yield stability zone maps, the Single-strip Spatial Evaluation Approach (SSEA) can be used as well. For information on this approach, see: [nmsp.cals.cornell.edu/publications/factsheets/factsheet124.pdf](http://nmsp.cals.cornell.edu/publications/factsheets/factsheet124.pdf). This approach is easier to implement but requires harvest with a well-calibrated yield monitor and a minimum of three years of past corn silage or corn grain yield monitor data.

Keep in mind that with these designs, if there are no differences, we cannot conclude that the biological saved us a specific amount of fertilizer. It can simply tell us if the biological enhanced yield. The reason is that it is possible that at the rates used, nitrogen was not the limiting factor. What we can conclude is if the biological enhances yield for the field where the on-farm research was done. If the results show no difference, it may also make you re-evaluate your nitrogen management in general.

### **Nitrogen benefits**

If the goal is to evaluate how much less N you can use when a biological is used, it is essential to do N rate studies with five to six N rates replicated within the *same field*. The use of N rates WITH AND WITHOUT the product in question is critical to determine the N credits from use of the biological. An example of this in the protocol for the [NMSP's Value of Manure Study](#) that uses manure instead of a biological product, but gives an idea of a trial designed to quantify N replacement.

### **Northeast region research needed**

Research is ongoing given the promise of biologicals. Most recently a summary was posted by researchers in the North Central region ([www.ndsu.edu/fileadmin/snrs/Files/SF2080\\_Performance\\_of\\_Selected\\_N-fixing\\_Products.pdf](http://www.ndsu.edu/fileadmin/snrs/Files/SF2080_Performance_of_Selected_N-fixing_Products.pdf)).

The summary of their studies is a good reminder to test products locally. As stated by the authors: ***“It is good for farmers to be curious; however, the wise grower needs to test products of interest on their own farm in a replicated manner and search for unbiased data on product performance before using them on whole fields.”*** We invite companies that sell biologicals in the region to work with us to test products for use in New York cash grain and dairy rotations.