Science Societies

Growing soybeans with microorganisms

New review compares the use of biostimulants in soybean production in the U.S. and Brazil

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A review comparing soybean biostimulant studies in the U.S. and Brazil found that microbial biostimulants—natural products that enhance nutrient uptake and plant growth—more consistently increased soybean yields in Brazil than in the United States. The difference appears linked to a combination of stricter Brazilian regulations and regional factors like soil, climate, and native microbes, highlighting a need for stronger science-based quality control in the U.S.

This article is part of our Down to Earth series, which breaks down and explains food, farming, and environmental sciences for readers of all backgrounds, including those without formal scientific training.

The farming industry needs to produce high-yielding crops, but as the global price of fertilizer increases (even climbing in price by 400% over the last 30 years), farmers need to look for alternative ways to boost crop productivity. Biological products have become a popular new option on farms because they come from beneficial organisms or natural organic compounds. Some examples—biopesticides, biofertilizers, and biostimulants—are promising environmentally sustainable alternatives to synthetic fertilizers and pesticides. The global market for this new industry is even expected to grow to $9.1 billion by 2028.

Soybean farmers can use biostimulants, microorganisms and growth-boosting organic substances, to help soybeans grow and increase yield. However, the responses to these treatments are inconsistent, especially across different countries.

The microbes present in these biological products can have a lot of benefits. For example, some species of bacteria can supply plants with lots of nutrients because they take certain kinds of nutritious elements (nitrogen) and convert them into forms that plants can easily use. One kind of bacterium (*Bradyrhizobium japonicum*) can even provide soybean plants with 50-60% of their nitrogen needs. Other microbes can also release hormones that plants use to grow—helping them uptake more nutrients from the soil—and suppress diseases. Though they're promising agents to help soybeans grow more and grow healthier, biostimulants haven't always been shown to help in the field.

Comparing performance in Brazil and the U.S.

Researchers from the Ohio State University reviewed studies that assessed the effects of biostimulants on soybean yield in either Brazil or the United Sates, two countries that have different biostimulant adoption rates and regulations. They analyzed the studies in order to get a better picture of how well these products work and to see if variability is linked at all to these legislative differences. This review, published in *Agronomy Journal*, summarized 40 articles that discuss how effective biostimulants are. Overall, the review found that biostimulants worked better on Brazilian fields than American ones.

The papers included in the review had to follow certain criteria. The research had to be conducted in American or Brazilian soybean fields, and biostimulants had to be used to treat soybean seeds. All the studies reviewed needed to be published between 2000

and 2023 in English or Portuguese, and the results needed to discuss grain yield. The team also looked into the policies behind plant biostimulants in both countries. What the researchers found was that:

- 16 studies from the U.S. and 24 studies from Brazil evaluated how certain microbes helped soybeans grow.

- Biostimulants could have a positive, a negative, or no impact on soybean growth, but on average, they increased soybean yield more frequently in Brazil compared with the U.S.

- Brazil has more policies for registering and commercializing biostimulant products than the United States.

In Brazil, biostimulants are regulated by the Ministry of Agriculture and Livestock to ensure product quality, effectiveness, and safeness for the environment, animals, and humans. They regulate how much bacteria should be present in the biostimulant product and have set expiration dates for products (with a minimum date of six months after development). On the other hand, U.S. legislators did not even introduce any legal language for biostimulants until 2018, and even now, regulations are not as strict, leaving the process of regulation up to state agriculture departments. Different state regulations can often lead to poor quality control, which can lead to multiple products with lower/differing levels of efficacy and safety.

However, the researchers stated that the difference in biostimulant effectiveness is likely not due to regulations alone. Regional differences in soil texture/type, climate, and soil microbes are possibly responsible for some of the variation in biostimulant

performance within and across countries. But if U.S. farmers want to be able to use more effective biological products, science-based quality control should be set in place, the review authors say.

To combat the lack of clearly defined/unified regulations for U.S. products, some different industry members have partnered together to make recommendations for how to best assess and regulate these products. The Biological Products Industry Alliance and The Fertilizer Institute–Biostimulant Council recommend running stricter tests with stats to analyze efficacy data. Some more specific recommendations are still needed, but it's a solid first step to making sure the products added to soybean fields have higher quality for use on U.S. farms.

Biostimulants are gaining popularity across the world as an alternative to chemical fertilizers. But soybean yield responses to biostimulants have varied greatly when compared between the U.S. and Brazil: Overall, the review shows us that biostimulants can be a sustainable tool to be used by soybean farmers to increase yield; however, there is a need to create a science-based regulatory and quality-control pathway to register and commercialize these products in the U.S.

Dig deeper

Colet, F., Lindsey, A. J., Ortez, O., Lopez-Nicora, H. D., & Lindsey, L. E. (2025). Soybean yield response to biostimulant seed treatments in Brazil and the United States: A review. *Agronomy Journal*, *117*, e70211. https://doi.org/10.1002/agj2.70211

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