

Understanding Biologicals for Row Crop Production

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An Introduction to Biologicals

The biological product market available to corn and soybean growers has exploded recently with new technologies and management tools designed to enhance fertilizer use, reduce crop stress, stimulate soil microbial activity, manage crop residues, and improve soil health. Key questions for growers, however, are which products work best and under what conditions of crop management. The section will highlight efforts to categorize biological products based on their active ingredients and modes of action, and summarize which product types are available to growers, where and how they work, and most importantly what other management practices help to realize the full economic benefit of biologicals.

What Are Biologicals?

Biologicals is a common term that is used to represent a wide array of specialty products available to growers, and while this umbrella term is used for many different products it is key to remember that these 'biologicals' are all unique from each other. From a crop input perspective there are four major categories: seed, fertilizer, pesticides, and specialty products (biologicals). These are listed in this order as the crop starts with the seed, fertilizer helps provide nutrients needed to achieve yield needs, pesticides work to protect and maintain yield, and then specialty products (in this case biologicals) would be the final input sector for a grower to consider. Success of biologicals is largely dependent upon a good sound agronomic base that ensures good seed selection for the management system in place, ensuring adequate nutrient supply to meet yield demand, and then protecting the crop to achieve highest yield potential. Once these factors are set, biologicals can be a next step to improving crop yields. While there are many types of specialty products, there are three categories that fit the 'biological' space: plant growth regulators (PGRs), beneficial microbes (most often associated with the 'biological' term), and biostimulants (non-living products, targeted to stress mitigation).

Plant Growth Regulators

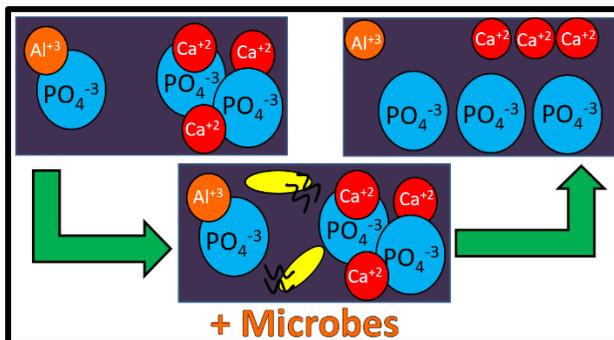
These are hormone-based products, and they have been around for decades as a tool for growers to improve their yields. Common active ingredients are *auxins*, *cytokinins*, and *gibberellins*. These are plant hormones, natural or synthetic, and they help benefit plants by directly increasing plant growth and development.

Beneficial Microbes

Beneficial microbes refer to the products that contain living microorganisms of bacteria or fungi. A teaspoon of soil can hold up to a billion different microbes, and it is these same soil organisms that are the active ingredients of beneficial microbe biological products. There are four major classes of beneficial microbes currently on the market:

- Nitrogen-fixing bacteria – bacteria that take atmospheric nitrogen (N_2) and convert it into a form useable by plants (NH_4). Commonly associated with nodules in legume crops, but new microbial species have been targeted to benefit grass crops, providing a new source of N beyond fertilizer or soil supply.

- Phosphorus-solubilizing bacteria/fungi – microorganisms that are particularly effective at releasing phosphorus from mineral complexes with cations like calcium, aluminum, and zinc in the soil of the rooting zone.

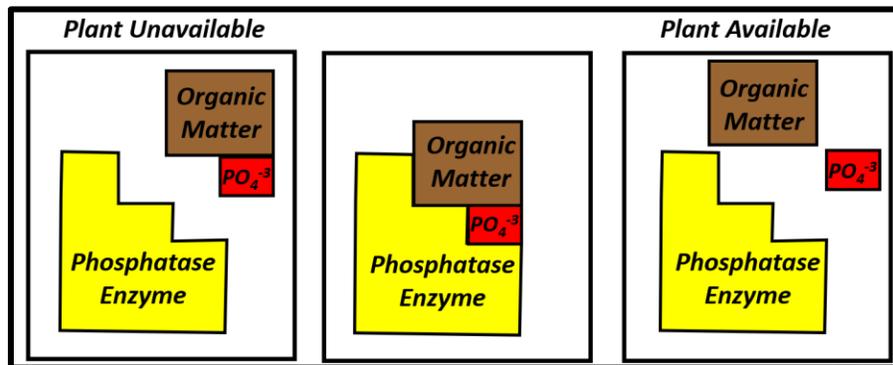


- Mycorrhizal Fungi – fungi that associate with crop roots to help build a network to explore the soil to acquire water and nutrients, in particular immobile nutrients like phosphorus.
- Residue Decomposers – an array of microorganisms fit this group and products are coming to market targeting residue management of continuous corn, cover crop, or double crop systems. Enhanced residue breakdown helps with crop emergence at planting, and releases nutrients back to the soil to benefit the current crop.

Biostimulants

Biostimulants are the 'non-living' products that fit under the biological term, largely as many of their active ingredients were derived from microbes or other biological sources like algae. While many of these products are targeted for mitigating plant stresses like drought, some can improve nutrient availability for plants. The list of individual biostimulant types is long, but a few of the more common categories are described below.

- Enzymes – these are the 'machines' of biology, doing much of the work that microorganisms need to survive. Made up of proteins, enzymes as biostimulants are those that target organic matter to release crop nutrients. The organic matter in soils or in crop residues is full of quality nutrition, in particular for N, P, and S, which are all important for crop growth and development. Applied enzymes help release nutrients from the organic pool in our soils, helping supplement fertilizer supplied nutrients and improve their efficiency.



- Humic/Fulvic Acids – carbon-based compounds derived from mineral or organic sources. These are highly negatively charged and can chelate cations to improve nutrient availability, as well as act as a carbon source for microbes.
- Marine Extracts & Sugars – Marine extracts contain the amino acids, sugars, and proteins from processed algae or kelp. Sugars are derived from an array of sources, but many products contain glucose, fructose, or sucrose. When applied, these biostimulant products stimulate both plants and microbes to upregulate their activity to enhance overall productivity or adapt to stress.

Conclusions and Considerations

While 'biologicals' is the common term, there is a wide range in products that fit this input sector, and as such a lot of opportunity for growers to utilize biologicals on their farm. However, it is essential to understand the type of biological you are working with to know its main function and what it can bring to your farm. Rather than let a biological product be brought to the farm and force it into your management system, consider what it is about your production practices you wish to change using a new input, then go and find the right biological product for that task.

