

## ***Agriculture and the Microbiome***

The term “microbiome” has [become part of our modern vocabulary](#) and refers to a community of microorganisms in a particular environment and includes the biological, chemical, and physical characteristics associated with both the microorganisms and their specific environment.

- [Bacteria, archaea, fungi, and animals](#) living on and around the plant can support—and be supported by—the plant. This community of plants, microbes, and animals, plus the geophysical environment, is together called the phytobiome.



[Plant-associated organisms](#) can have direct or indirect, beneficial, or deleterious impacts on plant health through interactions with other phytobiome members or changes to the environment.

- Recent advances in scientific analytical methods and new agricultural technologies create the ability to develop more advanced agricultural products based on single microbes, soil, or plant microbiomes, or the phytobiome as a whole.

[Microbes as a whole are not inherently “good” or “bad”](#) when it comes to their effect on organisms like humans and plants.

- Some bacteria and fungi can produce siderophores, which are small organic molecules that can harvest iron from soils and make it accessible to the plant.
- The balance or failings of interkingdom interactions may be the difference between a plant growing to its full potential and its destruction by fungal or bacterial pathogens.

[The use of biological products](#) (microbes or their derivatives) in agriculture, whether as a biocontrol or a biostimulant, has surged in recent years.

- The global commercialization of biologicals highlights the desire by both farmers and the general populace for more natural and sustainable agricultural practices, without sacrificing crop yields and by providing alternative modes of action for resistance management.

The process to produce a [new biological product](#) can be long, with a lot of regulations that must be met.

- For a product to be commercially viable, these minimum criteria must be met: it must be effective in the environment in which it will be used, manufactured reasonably at commercial scale, be robust and of good/consistent quality, and the company must have the legal right/ authority to commercialize the product.

[Advancement depends on adoption](#), and adoption depends on effective communication of potential benefits to growers and consumers.

- Without [clear communication](#) from researchers and industry about what to expect, stakeholders may be caught off guard when effects assumed to be guaranteed are not realized. This could engender mistrust, with microbial treatments considered “snake oil,” and the expansion of the use of microbes in agriculture would be severely curtailed.
- By communicating directly with growers, buyers, and consumers, it is possible to accelerate the adoption process of new technologies.

It will take [interdisciplinary training](#), collaborative team structures, and a full range of advancing technologies to match the complexity of microbiomes and the phytobiome.

- [To ensure success](#), it is imperative to increase training, incentives, and support for interdisciplinary research and academic-industry partnerships in order to create a multi-faceted path forward. Interdisciplinary research is key, and we won’t succeed without it.

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