

Department of Horticulture and Crop Science

Microbes in OMRI-listed Products Advertised to Enhance Crop Growth

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Growers want to know more about microbial-based products and use them more effectively. An important early step in the process is being familiar with the names and types of organisms in commercially available products. We completed a review of microbial-based products listed by the Organic Materials Review Institute (OMRI) on October 23, 2018 to identify which microbes manufacturers are including as active ingredients and in what combinations.

The microbial-based products included in the review shared four characteristics:

- 1) contain at least one type of living or dormant microbe based on label information,
- 2) crop growth enhancement is the primary advertised use,
- 3) found at the manufacturer's website and
- 4) permitted for use in the U.S. as of the listing date.

In total, 344 products were found that meet these criteria and collectively these contained **76 distinct species of bacteria** and **51 species of fungi**.

Additionally,

- Products with **multiple species outnumbered single species** products.
- Products that contain **only fungi or only bacteria were more common than products that contain a mixture** of both.
- Within the **bacterial category**, members of the ***Bacillus* genus were most plentiful**. *Bacillus* is a plant growth promoting rhizobacteria (bacteria associated with the roots).
- Within the **fungal category**, **arbuscular endomycorrhizal fungi** of the ***Glomus* genus were most plentiful**.

Considerations when selecting products

Both *Bacillus* and *Glomus* have been studied for their ability to increase plant capacity to uptake nutrients and water while also providing increased tolerance to abiotic

stressors such as drought, salinity, and extreme temperatures.

Relationships that plants and microbes form or will not form should be considered when selecting a microbial product. These relationships can be very specific. This specificity leads microbes to have widely varying effects on plants and to create these effects in different ways.

For example, rhizobial bacteria form symbiotic associations only with legume crops (e.g., alfalfa, clover, soybean). That association allows nodules to form on legume roots and for the bacteria to fix atmospheric nitrogen and share it with the crop. However, rhizobial bacteria can also live on (*not in* as when nodules form) the roots of non-legume crops and promote their growth in other ways not considered symbiotic.

Similarly, mycorrhizal fungi form symbiotic associations with many plants, but not with most Brassica or Goosefoot crops (e.g., broccoli, cabbage, cauliflower or spinach). Therefore, when selecting a microbial product, focus on the types of crop-microbe associations that are possible and outcomes you want to create. Consult product labels and/or contact product manufacturers to obtain more information on appropriate microbe-crop combinations.

Microbes in microbial-based products

We created tables to display the genus and species of bacteria and fungi identified in our product ingredient review. These tables can be used as references to become more familiar with the most common microbes used as active ingredients in microbial biostimulant products in agriculture.

We have also compiled a companion list identifying companies that manufacture microbial biostimulant and biofertilizer products for use in crop production, <https://u.osu.edu/vegprolab/research-areas/vegebiostimsferts/microbial-biostimulants-and-biofertilizers-for-crop-production-database/> The resource leads you straight to vital information about the manufacturer, product, and distributors via manufacturer website and is a tool for growers to search and select products.



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Microbe Names: Bacteria

Rhizobia (nitrogen-fixing bacterium)	Other Bacteria	
Genus Azorhizobium <i>Azorhizobium caulinodans</i>	Genus Achromobacter	Genus Clostridium <i>Clostridium pasteurianum</i>
Genus Bradyrhizobium <i>Bradyrhizobium japonicum</i> <i>Bradyrhizobium sp.</i>	Genus Aeromonads	Genus Enterobacter
Genus Mesorhizobium <i>Mesorhizobium ciceri</i>	Genus Alcaligin	Genus Flavanones
Genus Rhizobium <i>Rhizobium etli</i> <i>Rhizobium leguminosarum</i> <i>Rhizobium leguminosarum biovar phaseoli</i> <i>Rhizobium leguminosarum biovar trifolii</i> <i>Rhizobium leguminosarum biovar viciae</i> <i>Rhizobium meliloti</i> <i>Rhizobium phaseoli</i> <i>Rhizobium trifoli</i>	Genus Arthrobacter <i>Arthrobacter globiformis</i> <i>Arthrobacter simplex</i>	Genus Frateuria <i>Frateuria spp.</i>
Genus Sinorhizobium <i>Sinorhizobium meliloti</i> <i>Sinorhizobium meliloti strain NRG-185-1</i>	Genus Azospirillum <i>Azospirillum brasilense</i> <i>Azospirillum caulinodans</i> <i>Azospirillum lipoferum</i>	Genus Geobacillus <i>Geobacillus stearothermophilus</i>
	Genus Azotobacter <i>Azotobacter chroococcum</i> <i>Azotobacter paspali</i> <i>Azotobacter polymyxa</i> <i>Azotobacter vinelandii</i>	Genus Lactobacillus <i>Lactobacillus casei</i>
	Genus Bacillus <i>Bacillus altitudinis</i> <i>Bacillus amyloliquefaciens</i> <i>Bacillus atropheus</i> <i>Bacillus azotofixans</i> <i>Bacillus azotoformans</i> <i>Bacillus cereus</i> <i>Bacillus chitinosporus</i> <i>Bacillus coagulans</i> <i>Bacillus firmus</i> <i>Bacillus laterosporus</i> <i>Bacillus licheniformis</i> <i>Bacillus macerans</i> <i>Bacillus methylotrophicus</i> <i>Bacillus megaterium</i> <i>Bacillus megaterium strain HM87</i> <i>Bacillus mojavensis</i> <i>Bacillus mucilaginosus</i> <i>Bacillus polymyxa</i> <i>Bacillus pumilus</i> <i>Bacillus sonorensis</i> <i>Bacillus sp.</i> <i>Bacillus stearothermophilus</i> <i>Bacillus subtilis</i> <i>Bacillus thuringiensis</i>	Genus Micrococcus <i>Micrococcus luteus</i>
		Genus Paenibacillus <i>Paenibacillus azotofixans</i> <i>Paenibacillus brasiliensis</i> <i>Paenibacillus durum</i> <i>Paenibacillus exotofixans</i> <i>Paenibacillus florescence</i> <i>Paenibacillus gordonae</i> <i>Paenibacillus macerans</i> <i>Paenibacillus polymyxa</i>
		Genus Pseudomonas <i>Pseudomonas aureofaciens</i> <i>Pseudomonas fluorescens</i> <i>Pseudomonas montellii</i> <i>Pseudomonas putida</i> <i>Pseudomonas stutzeri</i>
		Genus Rhodopseudomonas <i>Rhodopseudomonas palustris</i> <i>Rhodopseudomonas sphaeroides</i>
		Genus Rhodospirillum <i>Streptomyces albidoflavus</i> <i>Streptomyces coelicolor</i> <i>Streptomyces ghanaensis</i> <i>Streptomyces griseoflavus</i> <i>Streptomyces griseus</i> <i>Streptomyces lybicus</i> <i>Streptomyces nigrescent MR541</i>
	Genus Brevibacillus <i>Brevibacillus brevis</i>	
	Genus Cellulomonas <i>Cellulomonas cellasea</i>	
	Genus Citrobacter	

Please note the names of individual microbes can have multiple spellings depending on author. Names used in the table are common in scientific literature.

Microbe Names: Fungi

Mycorrhizal Fungi	Other Fungi
Genus Funneliformis	Genus Acremonium
<i>Funneliformis mosseae</i>	<i>Acremonium butyri</i>
Genus Gigaspora	Genus Arthrobotrys
<i>Gigaspora margarita</i>	<i>Arthrobotrys oligospora</i>
Genus Glomus	Genus Chaetomium
<i>Glomus aggregatum</i>	<i>Chaetomium brasiliense</i>
<i>Glomus claroideum</i>	<i>Chaetomium elatum</i>
<i>Glomus clarum</i>	<i>Chaetomium murorum</i>
<i>Glomus constrictum</i>	Genus Clonostachys
<i>Glomus deserticola</i>	<i>Clonostachys rosea</i>
<i>Glomus etunicatum</i>	Genus Hirsutella
<i>Glomus fasciculatum</i>	<i>Hirsutella rhossiliensis</i>
<i>Glomus geosporum</i>	Genus Phanerochaete
<i>Glomus intraradices</i>	<i>Phanerochaete chrysosporium</i>
<i>Glomus iranicum</i> var. <i>tenuihypharum</i>	Genus Saccharomyces
<i>Glomus iranicum</i> var. <i>tenuihypharum</i> var. <i>nov.</i>	<i>Saccharomyces cerevisiae</i>
<i>Glomus microaggregatum</i>	<i>Saccharomyces pastorianus</i>
<i>Glomus monosporum</i>	Genus Trichoderma
<i>Glomus mosseae</i>	<i>Trichoderma atroviride</i>
<i>Glomus tortuosum</i>	<i>Trichoderma hamatum</i>
Genus Laccaria	<i>Trichoderma harzianum</i>
<i>Laccaria bicolor</i>	<i>Trichoderma koningii</i>
<i>Laccaria laccata</i>	<i>Trichoderma longbrachiatum</i>
Genus Paraglomus	<i>Trichoderma polysporum</i>
<i>Paraglomus brasilianum</i>	<i>Trichoderma reesei</i>
Genus Pisolithus	<i>Trichoderma virens</i>
<i>Pisolithus tinctorius</i>	<i>Trichoderma viride</i>
Genus Rhizophagus	
<i>Rhizophagus intraradices</i>	
Genus Rhizopogon	
<i>Rhizopogon amylopogon</i>	
<i>Rhizopogon fulvigleba</i>	
<i>Rhizopogon luteolus</i>	
<i>Rhizopogon roseolus</i>	
<i>Rhizopogon subscaerelescens</i>	
<i>Rhizopogon villosullus</i>	
<i>Rhizopogon vulgaris</i>	
Genus Scleroderma	
<i>Scleroderma cepa</i>	
<i>Scleroderma citrinum</i>	
Genus Septoglomus	
<i>Septoglomus deserticola</i>	

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Microbe name tables prepared by Stephanie Short, Dr. Zheng Wang (Former Post-Doctoral Researcher), Julie Laudick (Former Graduate Fellow), Vegetable Production Systems Lab, The Ohio State University (October 2018)