

# MANAGING SOIL MICROBES

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Plants depend on microorganisms in the soil for growth and reproduction, but some microbes damage plants. Each year, 7% to 15% of the world's major crops are lost to soilborne fungi, bacteria, and nematodes. In the U.S. alone, yearly losses are estimated at over \$10 billion.

To manage soilborne pathogens, farmers have mostly relied on chemical pesticides, but these products are often costly and can pose risks to human and environmental health—and they can't be used on organic farms.

To control plant disease without the risks associated with some chemical pesticides, researchers from 20+ land-grant universities are finding alternative ways—such as biopesticides, soil additives, farming practices, and resistant crop varieties — to suppress soilborne pathogens. Working together, researchers in different states can share resources and expertise, test strategies and products in a wide range of crops and conditions, extend findings to more people, and provide more cost-effective control of widespread soilborne diseases.

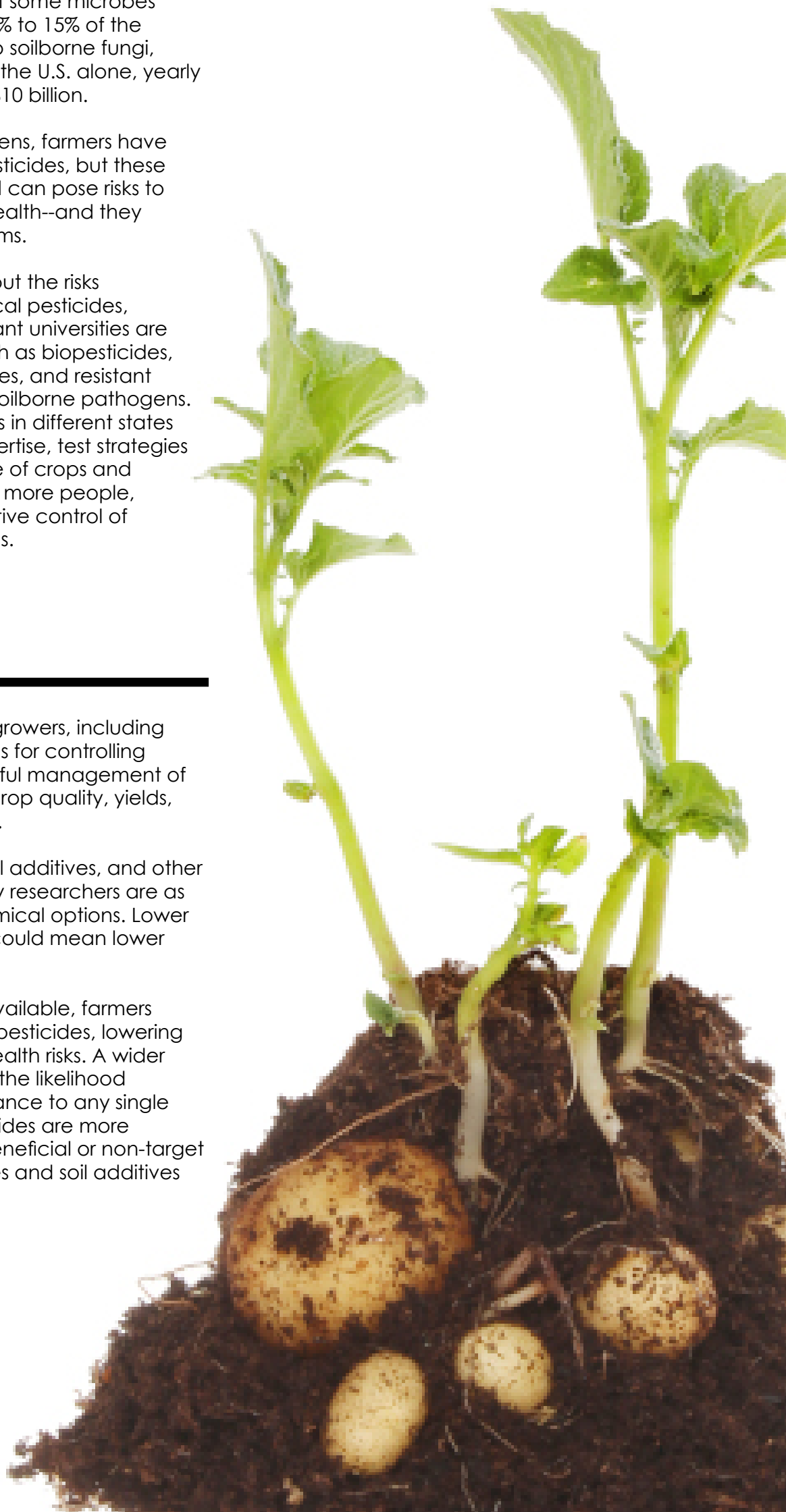
## IMPACTS

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New discoveries have given growers, including organic growers, more options for controlling soilborne pathogens. Successful management of soilborne diseases increases crop quality, yields, profitability, and sustainability.

Many of the biopesticides, soil additives, and other methods being developed by researchers are as or more affordable than chemical options. Lower production costs for farmers could mean lower costs for consumers.

With biological alternatives available, farmers can reduce use of chemical pesticides, lowering human and environmental health risks. A wider array of options also reduces the likelihood pathogens will develop resistance to any single product or method. Biopesticides are more selective and do not harm beneficial or non-target organisms. Some biopesticides and soil additives even improve soil quality.



# RESEARCH HIGHLIGHTS

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## STUDYING SOIL PATHOGENS

- Researchers are using next-generation DNA sequencing to quickly identify the entire bacterial or fungal community in a soil sample, which is critical for understanding soil health.
- Scientists identified DNA markers that can be used to count and track specific kinds of fungi and bacteria even when thousands of other microbes are present. This offers a closer look at how "bad" microbes can affect plants and how they can be controlled by "good" organisms.

## MAKING BIOPESTICIDES

- Researchers identified bacteria, algae, fungi, and other microorganisms that suppress disease-causing pathogens.
- Scientists developed standardized procedures that ensure biopesticide product quality.
- New information shows farmers exactly when and how to apply biopesticides.

## RESISTANT CROP VARIETIES

- Researchers identified wheat and peanut varieties that are resistant to common soilborne diseases. Using these varieties is a sustainable way to reduce the spread and impact of soilborne pathogens.

## GROWING PRACTICES & SOIL ADDITIVES

- Planting new spinach seed crops too soon after the previous harvest can lead to Fusarium wilt outbreaks, but by screening fields and adding limestone to soil, growers have been able to plant new crops sooner without major losses. This has the potential to double spinach seed production in the U.S.
- Sugar beet growers in southern California have eliminated nematicide use and increased yields and profits by monitoring cyst nematode levels at harvest and growing non-host crops in between plantings.
- Growers have adopted cover crops to suppress soilborne diseases in watermelon, corn-soybean, and onion fields.
- Researchers created a specific blend of mustard seed meal (ground up seeds) that can be added to soils to suppress diseases.
- Studies showed that biofumigation (adding plant matter that is toxic to pathogens in the soil) can be as effective as chemical fumigation
- Anaerobic soil disinfestation (using soil amendments, covering the soil with plastic mulch, and irrigating for multiple weeks) is an effective non-chemical way to reduce soil pathogens.
- Soil solarization (covering the ground with clear plastic mulch so that the soil temperature rises high enough to kill pathogens) is an affordable way to prevent disease outbreaks in nurseries. A new online tool shows farmers how long the soil must be covered to kill certain species.

## SMARTER CHEMICAL USE

- Researchers found safer, more effective ways to use chemical pesticides. For example, adding a surfactant and fungicide to irrigation water, but reducing irrigation frequency and duration, helps manage soilborne diseases and speeds up recovery of severely infected fields.

## IMPROVING KNOWLEDGE

- This group provided critical training to the next generation of plant scientists, agriculturalists, and pest control advisors
- Researchers in the Pacific Northwest diagnosed diseases in hundreds of plant samples and provided relevant management recommendations.
- Hundreds of workshops, field days, Extension presentations, webinars, and other outreach shared research findings with a wide audience.

## PROJECT FUNDING & PARTICIPATION

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