



# Hidden Half of Plants: Developing more robust and sustainable crops

## Active Soil

RHIZOSPHERE, the area surrounding the roots, helps plants extract nutrients from the soil and increases surface area of plant root hairs

THOUSANDS of microbial species such as bacteria, fungi, protozoa, nematodes, earthworms, and arthropods thrive in the rhizosphere

There are more microbes in a teaspoon of soil than there are PEOPLE ON THE EARTH

Deep roots improve plants' ability to ACCESS WATER during drought



## Microbes' Big Benefits

FENDING OFF pests and diseases




Improving access to NUTRIENTS

Protecting against ENVIRONMENTAL stress

REDUCING the need for synthetic nitrogen fertilizer

## Root Interactions

Roots exude chemicals to:

-  Communicate with other roots and microbes
-  Send warning signals to neighboring plants
-  Create symbiotic relationships in the soil

Feed organisms that create and manage other nutrients

Help cycle nutrients in exchange for plant sugar

Respond to light, water, gravity and pressure from soil particles



## Roots as Solutions

Regulate water management, carbohydrate and nitrogen cycling

Help crops be more resilient to unpredictable weather and climate change while increasing or maintaining yield

Sustain and develop biodiversity

Roots with increased nitrogen uptake and foraging reduce nitrogen runoff

