Black eyed peas could help eliminate need for fertilizer

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Joel Sachs, UC Riverside professor of evolution and ecology, in a field of black eyed peas. Credit: Joel Sachs/UCR

Black eyed peas' ability to attract beneficial bacteria isn't diminished by modern farming practices, new UC Riverside research shows. Planting it in rotation with other crops could help growers avoid the need for costly, environmentally damaging fertilizers.

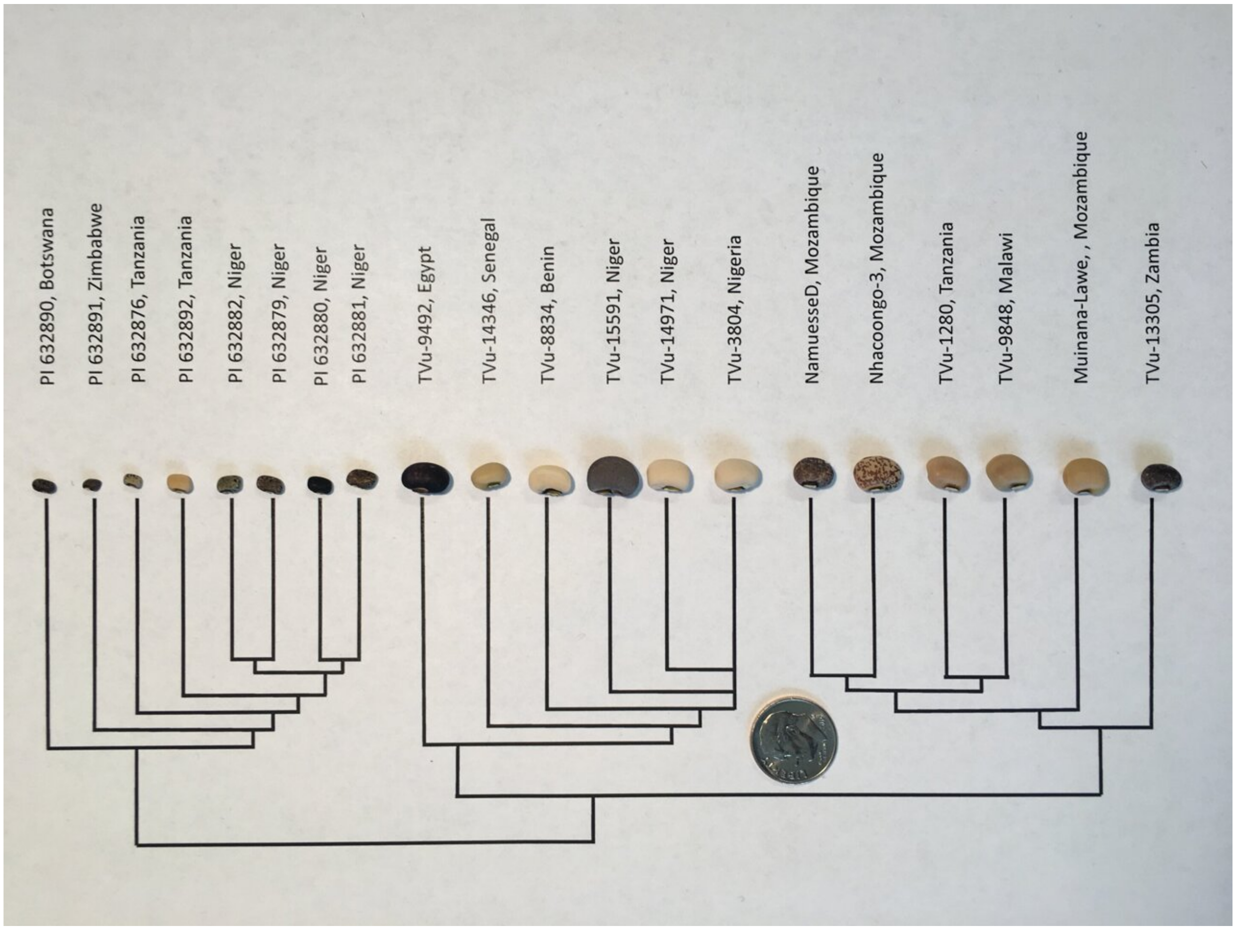
Without enough nitrogen, plants won't grow. The plant family that black eyed peas belong to, legumes, are unique in their ability to obtain substantial amounts of it by enticing and protecting nitrogen-fixing bacteria.

"The ability of legumes to do this caused them immense success as the third biggest plant family on the planet," said Joel Sachs, UCR professor of evolution and ecology.

Often times, when people grow crops, they focus on above-ground traits like disease resistance, yield, and protein content. Only recently have growers begun to pay closer attention to below-ground traits, like plants' ability to attract soil-enhancing microbes.

UCR plant pathologist Gabriel Ortiz wanted to understand whether black eyed peas—a hugely popular food in many parts of the world—maintain their ability to attract good bacteria even after being subjected to modern farming practices. In many cases, plants heavily impacted by humans do not benefit as much from relationships with bacteria compared to their wild relatives.

However, Ortiz and his team found that the peas maintained their natural ability to form beneficial relationships with nitrogen-fixing bacteria. "In fact, some of the strains in the experiment appear to have gained more benefit from bacteria than their wild ancestors," Sachs said.



This image shows how the black eyed pea plant lines used in the study are related to each other, and it also shows how different the wild seeds are from the early land races. Credit: Joel Sachs/UCR

Results from this research have just been published in the journal *Evolution*. The experiments involved 20 different types of black-eyed peas, and point toward a genetic basis for their symbiotic abilities.

"We can use this information in the future to design better performing plants," Ortiz said. He and his team focused on black-eyed peas because they are also drought tolerant, another important trait for Southern California growers.

To attract the bacteria that fixes nitrogen, rhizobia, black-eyed peas emit chemicals through their roots. Eventually, the roots form tumor-like nodules that protect the rhizobia and supply them with carbon. In return, the black eyes peas receive a useful, fixed form of nitrogen.

"When the plant senses it is going to die, it releases the bacteria into the soil, replenishing it," Ortiz explained. "Growers could alternate seasons of legumes with other crops, leaving the soil full of nitrogen-fixing bacteria that reduce the need for fertilizer."

When nitrogen fertilizer is applied faster than plants can use it, the excess can end up in the atmosphere as a greenhouse gas or washed out into lakes, rivers and oceans. In waterways, the nitrogen feeds harmful algae blooms that use up all the oxygen and kill fish.

"To make agriculture more sustainable, one of the things we need to do is focus on the plant's ability to get services from microbes already in the soil, rather than trying to get those services by dumping chemicals," Sachs said.

More information: Gabriel S. Ortiz-Barbosa et al, No disruption of rhizobial symbiosis during early stages of cowpea domestication, *Evolution* (2022). DOI: 10.1111/evo.14424

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