Plant scientists use new tools for better food crops

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With millions facing hunger around the world, Flinders University researchers are looking into novel properties of edible plants which could enhance future food crop production.

The new studies, with Australian and international partners, separately examine how legumes use an alternative "respiration" as a stress response—and how a popular pulse crop finds strength in a "ménage à trois" three-way relationship with soil and root systems.

The UN's Food and Agricultural Organization's forecasts for 2030

includes worsening food security and nutrition for people in Asia, Africa and other countries with the pandemic, conflict and economic downturns exacerbating supply issues caused by climate change.

The latest Flinders University investigations open promising new pathways to develop faster-growing crops with more resistance to stresses such as drought, heat and salinity at a time when climate variability and extremes are putting pressure on vital food production.

In the first study, published in *Frontiers in Plant Science*, Flinders University experts focused on the complex processes legumes go through to have a backup or alternative respiration. This can act in a similar way to an antioxidant, preventing damage during stress or difficult conditions, says first author Dr. Crystal Sweetman.

"Alternative respiration is quite different between crops such as legumes and cereals, because different plants contain different versions of alternative respiration genes and proteins," she says. "This means that some plants can fine tune their stress response more efficiently than others.

"There can also be variation within populations of the same species, making this an interesting candidate for breeding new varieties of crops with improved tolerance to heat, drought, salinity and other stresses. And that is our ultimate goal with this research."

In another article, published last week in *Plant and Soil,* Flinders researchers focused on how legume plants enlist help from favorable micro-organisms in the soil to improve growth and stress tolerance. The latest study of the "tripartite" symbiosis in chickpea plants follows long-running research into actinobacteria that increase rhizobial root N-fixing abilities in chickpea growth and grain yield.

Senior researcher Professor Chris Franco says the research is vital to seek insights into better management of chickpea production when variable soil pH, nutrients and moisture and hotter weather are increasingly more common in Australia, the world's second largest chickpea producing country behind India.

"Along with nitrogen-fixing rhizobia, legume roots can also be supported by common soil microbes or actinobacteria, which occur in different measures in soils and also within the plant," Professor Franco says.

"In fact, our research confirms that this vital symbiosis between legume and rhizobium is actually a ménage à trois with these actinobacteria which paves the way for development of more effective inoculants to maximize growth.

"This is important to developing better soil and growing conditions for premium chickpea production in a very sustainable manner," he says.

More information: Crystal Sweetman et al, Legume Alternative Oxidase Isoforms Show Differential Sensitivity to Pyruvate Activation, *Frontiers in Plant Science* (2022). DOI: 10.3389/fpls.2021.813691

Ting Xu et al, Revealing the underlying mechanisms mediated by endophytic actinobacteria to enhance the rhizobia - chickpea (Cicer arietinum L.) symbiosis, *Plant and Soil* (2022). DOI: 10.1007/s11104-022-05335-2

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