The quest for the missing proteins in rice

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Researchers have identified over 5,700 new proteins in rice and are calling for a global effort to find the remaining missing proteins, in a new study co-authored by Macquarie University.

The international team of scientists from Australia, Iran and Japan say

there's an estimated 35,000 proteins encoded by the rice genome, and yet we still don't have experimental evidence for 82 per cent of them.

This is important because rice is the major food source for more than half the world's population, and in order for it to grow in warmer climates and with less water we will need to better understand rice at the molecular level.

"The genome of rice was completed and published in 2001," says Professor Paul Haynes from Macquarie University, and a co-author on the study. "So surely we know enough about it now that we should be able to manipulate how it grows to meet our needs? Well, we don't."

"What we have for rice, like most of the well-studied plant and animal species, is a good first approximation of what the gene sequence actually encodes for, but there is still a very large amount of information yet to be confirmed."

Rice is Australia's ninth largest agricultural export and generates approximately $800 million in revenue each year, but this productivity comes at a significant cost.

Australian farmers use large amounts of water to irrigate their crops. The increasing demand for this water is threatening the sustainability of their rice production.

"It is imperative that we find ways to make rice better adapted to environments with warmer climates and less available water," says Paul.

One way to do this would be to give commercial rice varieties some of the characteristics of native Australian varieties of rice, he says.

These plants grow vigorously in many wild areas across Australian

without additional watering, in part because their roots grow longer and penetrate deeper into the soil allowing the plants better access to underground reserves of both water and nutrients.

"If we could somehow transform commercial rice varieties so that they grow deeper roots, thereby increasing water uptake efficiency while still retaining high grain yields, we could produce more sustainable plants that would help to future-proof the Australian rice industry," says Paul.

And that's why finding rice's remaining missing proteins is so critical.

Missing proteins are ones that appear to be encoded in the rice's genes but have not been experimentally confirmed to exist in the rice itself.

The idea of missing proteins originally arose from researchers working on the human genome, says Paul, but it's equally applicable to important cereal crops like rice.

The Human Proteome Project is making a map of all the proteins encoded by the human genome, to advance the diagnosis and treatment of disease.

Paul's team took a similar approach when they looked at rice.

Initially they found that 98.5 per cent of the proteins in rice are considered missing. However by mining publicly available datasets and matching this data with information from the rice genome they were able to reduce this percentage of missing proteins to 82 per cent.

"If we are to continue to feed the ever-increasing number of people on our planet, we really need to produce rice which is more sustainable in terms of better water use and better nutrient uptake, while still maintaining current levels of grain production," says Paul.

"This will require us to understand rice at the molecular level in a way that we have never done previously.

"It is only by understanding in great detail what happens inside a particular cell that we can really understand what goes on at the whole organism level, and how we can potentially change how that particular organism responds to an external set of circumstances or stimuli."

The team hopes this study will form the basis of a large-scale scale international collaborative project aimed at identifying all the remaining missing proteins in rice.

More information: Mohsen Rahiminejad et al. The Quest for Missing Proteins in Rice, *Molecular Plant* (2018). DOI: 10.1016/j.molp.2018.11.009

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