# Legume research uncovers nitrogen uptake genes

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(Phys.org) —Increased nitrogen-use efficiency of plants and an associated reduced need for nitrogen-based fertilisers may be a step closer following University of Adelaide research on legumes.

The research, published in the prestigious journal *Proceedings of the National Academy of Sciences*, has uncovered a unique process by which legumes regulate the transport of nitrogen.

Legumes, which include plants such as beans, peas, soybeans, chickpeas and many pasture species, are known for their "nitrogen-fixing" abilities. They develop a partnership with soil bacteria called rhizobia, which live inside small sac-like structures on their roots called nodules. The bacteria take nitrogen from air and turn it into ammonium - a form of nitrogen the plant can readily use.

"Legumes are highly valued crops for their source of human and animal dietary protein - much of which is made from the ammonium generated inside the nodule," says project leader Associate Professor Brent Kaiser, in the University's School of Agriculture, Food and Wine at the Waite campus. "They are also widely used in agricultural crop rotations so the soil is enriched with nitrogen between seasons of non-legume crops like wheat or barley."

Urea and other nitrogen fertilisers are used in agricultural soils that are often nitrogen poor. This is costly for agriculture in Australia and globally, and nitrogen fertiliser use has become an environmental

problem when used inefficiently.

"There is a strong drive to improve the efficiency of plant nitrogen use so farmers can minimise the amount of agricultural fertiliser used to achieve good yield and qualities. In the context of legumes, enhanced nitrogen-fixation capabilities will improve growth and yield and deliver more nitrogen back to the paddock," says Associate Professor Kaiser.

The researchers identified two genes in soybean - one signalling gene and one transport gene - which are active in root nodules and essential for nitrogen delivery into the plant. The discovery also highlights that the two genes may also have roles in ammonium transport in other plants including non-legumes such as wheat and corn.

"This key stage of getting the nitrogen that is fixed by these bacteria delivered into the plant has been widely investigated but is still very poorly understood at the genetic level," says Associate Professor Kaiser. "Our research sheds light on the complex genetic and biochemical control of this process."

"With this new knowledge, we believe there may be room for improving the collection of nitrogen from the nodule and its delivery to the plant.

"About 40 million tonnes of nitrogen from the atmosphere is fixed every year by nitrogen-fixing crops and much of that eventually becomes human dietary protein.

"That's a massive amount of biological nitrogen provided to the planet. Imagine the potential reductions in fertiliser use if we can improve this process by even only a tiny percentage."

Provided by University of Adelaide