



UK-China research success: John Innes Centre and Nanjing scientists identify protein which boosts rice yield

Dr Xiaorong Fan and Prof Guohua Xu from Nanjing Agricultural University, in collaboration with Dr Tony Miller from the John Innes Centre, have developed rice crops with an improved ability to manage their own pH levels, enabling them to take up significantly more nitrogen, iron and phosphorous from soil and increase yield of grain in a series of field trials.

Rice is a major crop, feeding almost 50 percent of the world's population and has retained the ability to survive in changing environmental conditions. The crop is able to thrive in flooded paddy fields - where the soggy, anaerobic conditions favour the availability of ammonium - as well as in much drier, drained soil, where increased oxygen means more nitrate is available. Nitrogen fertilizer is a major cost in growing many cereal crops and its overuse has a negative environmental impact.

The nitrogen that all plants need to grow is typically available in the form of nitrate or ammonium ions in the soil, which are taken up by the plant roots. For the plant, getting the right balance of nitrate and ammonium is very important: too much ammonium and plant cells become alkaline; too much nitrate and they become acidic. Either way, upsetting the pH balance means the plant's enzymes do not work as well, affecting plant health and crop yield.

The international team has been working out how rice plants can maintain pH under these changing environments.

Rice contains a gene called *OsNRT2.3*, which creates a protein involved in nitrate transport. This one gene makes two slightly different versions of the protein: *OsNRT2.3a* and *OsNRT2.3b*. Following tests to determine the role of both versions of the protein, the researchers found that *OsNRT2.3b* is able to switch nitrate transport on or off, depending on the internal pH of the plant cell.

When this 'b' protein was overexpressed in rice plants they were better able to buffer themselves against pH changes in their environment. This enabled them to take up much more nitrogen, as well as more iron and phosphorus. These rice plants gave a much higher yield of rice grain (up to 54 percent more yield in some trials), and their nitrogen use efficiency increased by up to 40 percent.

Dr Miller said:

"Now that we know this particular protein found in rice plants can greatly increase nitrogen efficiency and yields, we can begin to produce new varieties of rice and other crops. These findings bring us a significant step closer to being able to produce more of the world's food with a lower environmental impact."

This new technology has been patented by PBL, the John Innes Centre's innovation management company, and has already been licensed to 3 different companies to develop new varieties of 6 different crop species.

This study, which has been published in the *Proceedings of the National Academy of Sciences USA*, was funded by the Biotechnology and Biological Sciences Research Council (BBSRC) and grants from the Chinese Government.

Notes to editors

1. The paper "*Overexpression of a pH-sensitive nitrate transporter in rice increases crop yields*" has been published in the Proceedings of the National Academy of Science
<http://www.pnas.org/content/early/2016/06/01/1525184113.full>

2. If you have any questions or would like to interview Professor Miller, please contact:
 Geraldine Platten, Communications Manager, the John Innes Centre
 T: 01603 450 238
 E: Geraldine.platten@jic.ac.uk

3. About the John Innes Centre

The John Innes Centre is an independent, international centre of excellence in plant science and microbiology. Our mission is to generate knowledge of plants and microbes through innovative research, to train scientists for the future, to apply our knowledge of nature's diversity to benefit agriculture, the environment, human health and wellbeing, and engage with policy makers and the public.

To achieve these goals we establish pioneering long-term research objectives in plant and microbial science, with a focus on genetics. These objectives include promoting the translation of research through partnerships to develop improved crops and to make new products from microbes and plants for human health and other applications. We also create new approaches, technologies and resources that enable research advances and help industry to make new products. The knowledge, resources and trained researchers we generate help global societies address important challenges including providing sufficient and affordable food, making new products for human health and industrial applications, and developing sustainable bio-based manufacturing.

This provides a fertile environment for training the next generation of plant and microbial scientists, many of whom go on to careers in industry and academia, around the world.

The John Innes Centre is strategically funded by the Biotechnology and Biological Sciences Research Council (BBSRC). In 2014-2015 the John Innes Centre received a total of £36.9 million from the BBSRC.

The John Innes Centre is the winner of the [BBSRC's 2013 - 2016 Excellence With Impact award](#).

4. About the BBSRC

The Biotechnology and Biological Sciences Research Council (BBSRC) invests in world-class bioscience research and training on behalf of the UK public. Our aim is to further scientific knowledge, to promote economic growth, wealth and job creation and to improve quality of life in the UK and beyond.

Funded by Government, BBSRC invested over £509M in world-class bioscience in 2014-15. We support research and training in universities and strategically funded institutes. BBSRC research and the people we fund are helping society to meet major challenges, including food security, green energy and healthier, longer lives. Our investments underpin important UK economic sectors, such as farming, food, industrial biotechnology and pharmaceuticals.

For more information about BBSRC, our science and our impact see: <http://www.bbsrc.ac.uk>.

For more information about BBSRC strategically funded institutes see: <http://www.bbsrc.ac.uk/institutes>.

5. About PBL

PBL (Plant Bioscience Limited: www.pbltechnology.com) is an IP management and technology development company, investing in emerging technology across the life sciences. The Company is jointly and equally owned by The John Innes Centre, The Sainsbury Laboratory and the BBSRC. PBL brings together innovative technologies from public research sources worldwide, invests in building intellectual property protection and technology development, and commercialises through licensing and, where appropriate, new venture formation. Contact: info@pbltechnology.com

6. For further information about Nanjing Agricultural University visit: <http://english.njau.edu.cn/>.

Ends.