THE HINDU

Focus on plant proteins to feed billions

Innovations to boost production on land used for agriculture are needed

Superior variety:Barley, growing at The John Innes Centre, engineered for enhanced zinc content in the endosperm.— photo: The John Innes Centre

Growing food sustainably to feed a growing global population will require improving the way staple crops take in and transport substances, says a group of a dozen scientists from six countries. As it was, some two billion people in the world were suffering dietary deficiencies that had an enormous impact on their health, noted Julian Schroeder of the University of California at San Diego in the U.S. and his colleagues in a Perspective article appearing today (May 2) in *Nature* . During the next four decades, an expected additional two billion humans would require nutritious food.

“Global demand for food is predicted to increase by 40 per cent by 2030. Innovative solutions are required to increase production on the land currently used for agriculture, because we are already close to the sustainable limit of 15 per cent of the Earth’s surface that can be exploited for crop production.” Utilising the biology of a class of plant proteins known as ‘membrane transporters’ could be a “key contributor to the goal of global food security,” they said. These proteins, embedded within membranes of cells, could improve the efficiency with which plants took up and used water and nutrients. The transporters were also central to mechanisms for drought tolerance in plants as well as their ability to grow in other adverse conditions, such as in saline or acidic soils.

Salt tolerance

The ‘HKT’ family of transporters, for instance, moves sodium and potassium, and plays an essential part in salt tolerance. In the course of fundamental research using the plant *Arabidopsis thaliana* , Prof. Schroeder's lab discovered the genes for these proteins and their mechanism for improving salt resistance.
Recently, agricultural scientists in Australia, led by co-author Rana Munns, used marker-assisted breeding to move members of this gene family from a wild, salt-tolerant wheat species to a commercial variety, boosting the latter’s yield by 25 per cent in field trials.

“Aluminium tolerance genes are also very promising for enhancing yields in acidic soils,” said Prof. Schroeder in an email. Such soils, with low crop yields, were widely distributed in sub-tropical and tropical regions of the world where developing nations are located.

Many millions of people in the world suffered from iron and zinc deficiencies “because their plant-based diets are not a sufficiently rich source of these essential elements,” the scientists observed in their paper.

Boosting iron content

To fortify rice with more iron, scientists had turned on key transporter genes in the plant’s seeds. These genes are usually expressed in the root so that the plant could take in nutrients from the soil. The result was a greenhouse-grown rice with three- to four-fold higher levels of iron in polished grain.

In a similar fashion, zinc content of cereal grains could be increased, according to Dale Sanders, director of the John Innes Centre in the U.K. and another co-author. His team had demonstrated this with barley. “We are also in the early stages of research to increase iron and zinc content in wheat,” he added in an email.

Fertiliser reduction

Targeting appropriate membrane transporters could increase the efficiency with which plants took up phosphorus and nitrogen. The amount of phosphate and nitrate fertilisers used for cultivation could then be substantially reduced.

“This is an important goal for sustainable high-yielding agriculture,” remarked Prof. Schroeder in his email. However, more basic research was needed into the fundamental mechanisms operating in plants.