THE HINDU

August 23, 2012

Growing rice in soil poor in phosphorus possible

The rare gene found in the roots can improve yield by 60 per cent

A gene present in a specific (aus-type) rice variety, Kasalath, which has its origin in eastern States of India, holds the key to improving yield across the world. This includes soil deficient in natural phosphorus, a mineral essential for food crops.

Natural reserves of the mineral in the soil are limited in “almost half of world’s soil.” About 60 per cent of rain-fed lowland rice is cultivated in phosphorus-poor soil. The compulsion to use phosphorus fertiliser therefore becomes inevitable. But rock phosphate, which is the source of this precious mineral, is limited in quantity and is a non-renewable source.

But growing rice even in such poor and problematic soil without totally depending on phosphorus fertiliser can soon become a reality. Rico Gamuyao from the International Rice Research Institute, Manila, Philippines and his colleagues have successfully identified the gene that provides phosphorus-deficiency tolerance in rice. The results are published today (August 23) in*Nature*.

Though the locus of phosphorus-deficiency tolerance in the aus-type variety, Kasalath was identified a decade ago, the specific gene (PSTOL1) that provides the tolerance remained elusive.

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The gene encodes for a protein kinase enzyme that vastly improves rice yield even when the crop is grown in soils deficient in phosphorus.

If the expression of PSTOL1 is pronounced in the roots of rice that have the phosphorus uptake (Pup1) genomic region, it becomes all the more enhanced when the rice is grown in phosphorus-deficient soil conditions.

“This gene is absent from the rice reference genome and other phosphorus-starvation-intolerant modern varieties,” they write. “The absence of PSTOL1 from modern rice varieties underlines the importance of conserving and exploring traditional germplasm.”

To understand and quantify the effect of PSTOL1 in rice grown in phosphorus-deficient soil, the scientists inserted the gene into two rice varieties that naturally lack the gene.

The two rice varieties chosen represent two distinctly different types of modern irrigated varieties. The field trials were conducted in soil that was phosphorus deficient.

What they observed was a truly significant effect of the gene — the yield improvement was as high as 60 per cent. They also found that “expression” of PSTOL1 above a “certain threshold” was essential to “confer tolerance to phosphorus deficiency.”

So how does PSTOL1 help the plants to grow in phosphorus-deficient soil? PSTOL1 expresses itself at high levels in the roots of the plants. This results in these plants having a “significantly higher” total root length and root surface area. PSTOL1 expression also leads to increased root growth and root proliferation.

Though much more has to be known, the scientists are already “attempting to translate their discoveries into improved phosphorus efficiency in rice crops by use of targeted inter-variety breeding,” notes a news piece in the same issue of the journal.

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