# Roots breakthrough for drought-resistant rice

August 5 2013

Japanese biotechnologists on Sunday said they had developed a rice plant with deeper roots that can sustain high yields in droughts that wipe out conventional rice crops.

It is the third breakthrough in new cereal strains in less than two years, boosting the quest to feed the world's spiralling population at a time of worsening climate change.

Writing in the journal *Nature Genetics*, a team led by Yusaku Uga of the National Institute of Agrobiological Sciences in Tsukuba describe how they found a remarkable gene in a rice plant cultivated in the dry uplands of the Philippines.

This rice strain, also called cultivar, is called Kinandang Patong. Its big characteristic is roots that are deep and grow straight downwards, delving into parched soil for water, as opposed to root systems that are shallow and grow out sideways in typical water-rich paddy fields.

The gene for this, called Deep Rooting—dubbed DRO1—was spliced into a cultivar called IR64, a paddy rice plant that is grown around Asia.

The team then put the new plant through its paces, planting it and standard IR64 in upland fields in three kinds of conditions—no drought, moderate drought and severe drought.

Moderate drought reduced yield from IR64 to just 42 percent of no-

drought conditions. Severe drought destroyed it totally.

But IR64 with the DRO1 gene was almost unaffected by moderate drought. In severe drought, yield fell—but not catastrophically—by around 30 percent.

"Based on our results, this variety can be adapted to upland (agriculture) without irrigation," Uga said in an email exchange with AFP.

"We are also evaluating the DRO1 performance under rain-fed lowland with the International Rice Research Institute," he said. "If we can get positive results in farmer's fields, we hope to release the variety for Asian countries. We are also going to introduce the DRO1 into leading varieties in Latin America with CIAT," the International Centre for Tropical Agriculture, he said.

Without genetic technology, it would have been extraordinarily hard to have pinpointed, and then inserted, the right gene, said Uga.

"Development of GM rice plants is... one of (the) useful strategies to improve drought resistance," he said.

In January 2012, scientists in Britain and Japan said they had developed a fast-track technique, called MutMat, that identifies useful genetic variants, or mutations, in rice plants. They used it to derive a strain from Japan's Hitomebore wild rice that is resistant to salinity—a boon for farmers whose fields have high salt content through irrigation.

In March 2012, researchers in Australia said they had bred durum wheat with a salt-loving gene whose yields were up to 25 percent greater than ordinary counterparts when grown on saline fields.

The world's population is expected to reach 9.6 billion by mid-century,

from 7.2 billion today, according to UN estimates. By 2100, the tally could be 10.9 billion.

To feed this rising number at a time of worsening drought and flood will require a campaign against food waste, smarter use of land, water, fertiliser and pesticides and agricultural innovation to select higher-yield or climate-resistant strains of cereals, according to the UN's Food and Agricultural Organisation (FAO) and France's National Institute for Agricultural Research (INRA).

Improvements in rice strains—leading to a short, stubby "semi-dwarf" plant with a full head of grain—unleashed the Green Revolution of the 1960s, boosting harvests in China and other rice-dependent countries that used to teeter perpetually on the brink of famine.

**More information:** *Nature Genetics* DOI: 10.1038/ng.2725