RICE BREEDING

The hybrid vigour of sexless rice

Researchers mount an ambitious project to create one-line hybrid rice varieties, reports Gio Braidotti

PARTNER COUNTRIES: Global PROJECTS: CIM/2002/106: Fertilisation-independent formation of embryo, endosperm and pericarp for apomictic hybrid rice; and CS1/1995/125: Molecular tools for achieving Apomixis in rice

DESCRIPTION: IRRI and Australian researchers aim to create one-line hybrid rice varieties to help boost rice yields

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The experts agree that what growers need is a hybrid line whose seed – besides providing a food crop – can produce an embryo that is a clone of the first-generation hybrid plant. Being a clone it can maintain the hybrid vigour of its mother, delivering to the farmer the yield advantage minus the need to buy seed.

"Apomixis is found in some 300 species of plants, including many that are close relatives of cereals, but there is no known relative of rice that is apomictic," Dr Bennett says. "That means the project involves building a synthetic version of apomixis using genetic engineering. If that can be achieved, then there is an outside chance that we can repeat the process through mutagenesis to produce a non-genetically modified (GM) variety."

Dr Bennett explains that normally in rice there are two fertilisation events, both of which need to be modified. One generates the embryo via fertilisation of the egg. The other involves fertilisation of a cell that produces the edible endosperm.

"The CSIRO team has made significant headway solving the problem of endosperm production in the absence of fertilisation," Dr Bennett says.

From work done with Arabidopsis (the model plant system for experimental genetics), the CSIRO team was able to identify – for the first time – the genes that control partial apomictic development, the so-called FIS (fertilisation-independent seed) genes.

"Because the FIS genes are present in rice and the rice genome has been sequenced, we could readily isolate FIS-class genes in rice," Dr Chaudhury says. "Since the genes function as suppressors of partial apomictic development in Arabidopsis, what we needed to do was switch these genes off in rice."

To achieve that goal, ACIAR-funded post-doctoral fellow Dr Ming Luo generated transgenic rice lines using a gene-silencing technique developed by CSIRO called RNAi (RNA interference).

"When you silence FIS-class genes, you remove the suppressors and then you observe both autonomous apomictic development and partial embryo development," Dr Chaudhury says.

The next frontier, according to Dr Bennett and Dr Chaudhury, is achieving full embryo production in the absence of fertilisation. "We have a lot of ideas about how to achieve it which we are testing at the moment," says Dr Chaudhury.

He remains optimistic that the ultimate target can be achieved and an increased rice production system can be made available to poor farmers.

"This is one of the most ambitious projects in plant biology," says Dr Chaudhury. "But the international community is once again becoming excited about the possibilities of apomixis and its ability to make seed production so much easier. Of course, once we can do it in rice, it opens the way for apomictic varieties of other cereals."