Development of Transgenic Rice with High Insect-resistance

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Rice is one of the most important food crops in the world, but it is susceptible to be attacked by wide range of herbivorous insects. Since there are no known germplasm resources with natural sufficient level of resistance to *lepidopteran* pests in rice cultivars and related species, transgenic breeding technology has been considered to be a new environmentally sustainable approach to control of rice insect pests.

We initiated the development of insect-resistant GM rice since 1996 and have successfully developed three versions of GM rice lines with highly resistance to *lepidopteran* pests. In the first version, we increased insect-resistance by subcellular targeting of foreign insecticidal protein; in the second version, we established multi insect resistant mechanism by using two different insect-resistant genes; recently, we have got the third version, marker-free GM rice with stable and high level expression of foreign gene. We have gotten the productive trail permission of the GM rice MH86, the restorer line of Two-line Hybrid Rice and Three-line Hybrid Rice, and its combination in 2002 with these two versions.

In these studies, to enhance the insect-resistant efficiency and improve the biosafety of the GM rice, we carried out the researches with Multi insect-resistant mechanism, including 4 aspects: (1) subcellular targeting of the Cowpea Trypsin Inhibitor (CpTI) to endoplasmic reticulum to increase the CpTI accumulation level and enhance the insect-resistance of transgenic plants.(2) utilizing genes, *sck* (the modified *cpti* gene) and *cry1Ac* (the *Bacillus thuringiensis* -endotoxin gene) with different insect-resistant mechanism to enhance insect-resistance and broadening resistance range against different pests and delaying the tolerance. (3) Achieving efficient and stable expression of insect-resistant genes by using MAR (Matrix Attachment Regions) sequence, and (4) removing the selectable marker gene from the GM rice plants by using a double T-DNA vector system, one independent T-DNA region containing a selectable marker gene and the other interest genes. The integration of these approaches enhanced the insect-resistant level of the GM rice significantly.

In addition to the breeding of elite insect-resistant hybrid rice, the environment and food safety assessments were also carried out since 2000. (1)The environment assessments results showed there were no significant differences of the number of orders, number of families, and number of species for the insect pests, natural enemies and neutral insects between fields of GM rice and fields of non-transgenic controls rice. (2)Based on the principle of Substantial Equivalence, we evaluated the nutrition content and the food safety of GM rice cooperated with Chinese Center for Disease Control & Prevention and Peking University. Up to now, all the measured variables were similar for animals fed with GM rice and the parental line, indicating that the GM rice is the substantial equivalent of their conventional parental line.