



# Development of Genetic and Molecular Tool Boxes to Control Rice Blast Disease

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The use of resistance genes is one of the best methods to prevent blast disease because resistance genes have evolved over time to prevent the infections by pathogens using novel strategies. In order to facilitate commercial deployment of resistance genes in the US, we have been investigating map position, introgression, resistant spectrum, expression and stability of resistance and co-evolution with the blast fungus of the five major blast resistance genes *Pi-ta/Pi-ta2*, *Pi-ks*, *Pi-kh(m)*, *Pi42(t)*, *Pi43(t)*. Our research provides a solid foundation for effective blast management in years to come in the USA.

## Use Resistance Genes To Control Rice Blast Disease

Rice blast disease is one of the major threats to stable rice production in the USA. Farmers often grow cultivars with the highest yield potentials, some of these cultivars are often susceptible to blast. In addition, excessive accumulation of nitrogen has been often observed under high intensified rice production systems. These farming practices plus conducive environmental conditions have been the major reasons for significant losses caused by blast in 1980s, 1999 and this crop year. The most environmentally benign method to prevent blast disease is the use of resistance genes. In order to facilitate commercial deployment of resistance genes in the US, we have been investigating map position, introgression, resistant spectrum, expression and stability of resistance and co-evolution with the blast fungus of the five major blast resistance genes *Pi-ta/Pi-ta2*, *Pi-ks*, *Pi-kh(m)*, *Pi42(t)*, and *Pi43(t)*.

## Recent Accomplishments

- ✓The spectra of resistance mediated by the *Pi-ta* and *Pi-ks(h/m)* genes in the USA were determined (Jia et al., Plant Disease 93: 639-644, 2009).
- ✓*Pi-ta* was found to produce 12 proteins, each can be a resistance gene (Costanzo and Jia, Plant Science 177: 469-478, 2009).
- ✓A large linkage block at the *Pi-ta* locus was found in resistant germplasm worldwide suggesting that rice genes required for *Pi-ta* resistance is clustered (Jia, Heredity 103: 333-339).
- ✓Evolutionary dynamics of rice blast resistance gene *Pi-ta* has been better understood (Lee et al., Genetics 183: 1315-1325, 2009).
- ✓*Pi-ta* was identified in 89 rice germplasm collections (Wang et al., Plant Breeding, 2010 in press).
- ✓Two novel resistance genes are tagged from a Chinese indica cultivar Zhe733 (Molecular Breeding 24:127-134, 2009).
- ✓A total of 182 mono - and digenic rice with *Pi-ta*, *Pi-ks(h/m)* were developed to study epistatic interaction of blast resistance and yield components (Jia and Moldenhauer, J. of Plant Registration 4: 163-166, 2010, cover).
- ✓Race specific DNA makers were developed from the *Pi-k* locus (Costanzo and Jia, Plant Science 178: 523-530, 2010).
- ✓A total of 27 haplotypes of AVR-Pita1 based on amino acids were identified in field isolates. Point mutation, deletions, transposon insertions in the AVR-Pita1 (Dai et al, under revision, 2010).
- ✓A total of 8 quantitative resistant loci to blast were identified (Jia and Liu et al. 2010, under revision).



Panicle blast of a susceptible medium grain "Bengal" in an Arkansas Farm, 2009



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