# Characterization of *Pi33*, a resistance gene in rice interacting with *Magnaporthe grisea* avirulence gene *ACE1*

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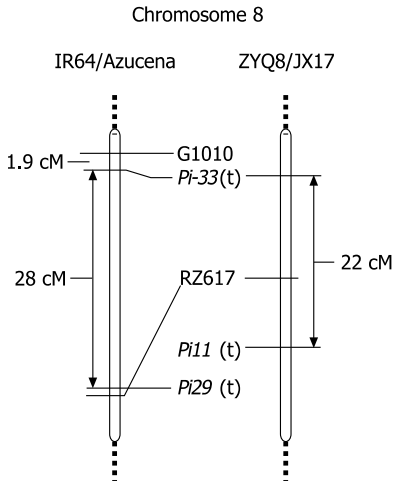
In rice, at least 40 genes conferring resistance to blast (caused by *Magnaporthe grisea*) have been described since 1985 (Sallaud et al, 2002), but only two were cloned (*Pib* [Wang et al 1999] and *Pita* [Jia et al 2000]). These genes belong to the nucleotide-binding site-leucine-rich repeat) (NBS-LRR) family of plant resistance genes. Direct molecular interaction between the protein encoded by *Pita* and the corresponding *M. grisea* avirulence gene product AVR-PITA (a small secreted protein) has been demonstrated (Jia et al 2000). Therefore, the recognition of fungal protein produced during the early stages of the infection process is the initial step in the resistance to blast controlled by *Pita*. Other known *M. grisea* avirulence genes encode for small proteins that are likely to be secreted during infection. They are involved in nonhost resistance either in weeping lovegrass or in rice.

Recently, we have genetically characterized a new *M. grisea* avirulence gene (*AVR1-IRAT7*, Dioh et al 2000) that was isolated by map-based cloning and renamed it *ACE1* (Böhnert et al 2000). *ACE1* was introduced by transformation in several virulent rice blast isolates, producing pairs of isogenic strains that differ only in their avirulence toward rice cultivar IRAT7. These isogenic strains were inoculated on various differential or resistant rice varieties carrying genes with known resistance to blast to identify the resistance gene corresponding to *ACE1* (see table). If a rice variety is susceptible to the virulent strain but resistant to the isogenic avirulent strain carrying *ACE1*, we consider this variety to carry the resistance gene corresponding to *ACE1*. With the exception of C101LAC (carrying the blast resistance gene *Pi1*), none of the rice differentials tested was resistant to an avirulent strain with *ACE1* (see table), suggesting that the corresponding resistance gene could be *Pi1* (located on chromosome 6). The C104LAC line that also carries *Pi1* was susceptible to avirulent *M. grisea* strains carrying *ACE1*, demonstrating that it does carry the resistance gene corresponding to *ACE1*.




**Mapping of a resistance gene corresponding to *ACE1* in IR64/Azucena and JX17/ZYQ8 crosses. Relative positions of RZ617 and *Pi29*(t) are from Sallaud et al (in press). Relative positions of RZ617 and *Pi11*(t) are from Zhu et al 1993.**

The resistance gene corresponding to *ACE1* was detected in several resistant varieties, including IR64 and Bala. The IR64/Azucena and Azucena/Bala crosses were used to map this resistance gene. In both crosses, this gene maps to a single locus on chromosome 8, close to the G1010 RFLP marker. Since the two specific blast resistance genes *Pi11*(t) (=*Pi-zh*; Zhu et al 1993) and *Pi29*(t) (Sallaud et al, 2002) were already mapped on this chromosome, allelism tests were conducted. In both cases, we could identify several recombinants (see figure), showing that the resistance gene corresponding to *ACE1* is neither *Pi11*(t) nor *Pi29*(t), but a new rice resistance gene located on rice chromosome 8. Following the nomenclature in use for blast resistance genes, we named this gene *Pi33*. Fine mapping of this locus is in progress.

## References

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**Detection of a major resistance gene corresponding to avirulence gene *ACE1* in several rice differentials and resistant cultivars.**

| Rice cultivar | | R genes | Reaction to inoculation with | | | | | | | Specific resistance to *ACE1* |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Guy11 | PH14 | PH14-*ACE1* | PH19 | PH19-*ACE1* | 2/0/3 | 2/0/3-*ACE1* | |
| Maratelli (susceptible control) | | | S | S | S | S | S | S | S | N |
| Resistant controls | IRAT 7 | *Pi33* | R | | | R | R | S | R | **Y** |
| | DJ8-341 | *Pi33* | R | | | R | R | S | R | **Y** |
| Parents of progenies used in this work | IR64 | *Pi29* + others | R | S | R | S | R | R | R | **Y** |
| | Azucena | | S | S | S | S | S | S | S | N |
| | Bala | | R | | | | | | | **Y** |
| | ZYQ8 | *Pi11*(t) | | S | R | S | R | R | R | **Y** |
| | JX17 | | | R | R | R | R | S | S | N |
| Isogenic lines made from CO 39 (Mackill and Bonman 1992) | C101LAC | *Pi1* | R | | | S | R | S | R | **Y** |
| | C104LAC | *Pi1* | S | | | S | S | S | S | N |
| | C103TTP | *Pi1*, *Pi1b* | S | | | S | S | S | S | N |
| | C101A51 | *Pi2* | S | | | | | S | S | N |
| | C102A51 | *Pi2* | S | | | | | S | S | N |
| | C105TT9-4 (L-24) | *Pita* | S | | | | | S | S | N |
| | C101TTP-3 | *Pita* | S | | | | | S | S | N |
| | C105TTP-1 | *Pita* | S | | | | | S | S | N |
| | C105TTP-2 (L-9) | *Pita* | S | | | | | S | S | N |
| | C104PKT | *Pita* | S | | | | | S | S | N |
| | C105TTP-2 (L-23) | *Pi3* *Pita* | S | | | | | S | S | N |
| Japanese differential cultivars (Kiyosawa 1984) | Fukunishiki | *Piz Pish* | S | | | | | S | S | N |
| | K1 | *Pi-a* | R | | | | | R | R | ? |
| | K59 | *Pit* | S | | | | | S | S | N |
| | K60 | *Pikp* | S | | | | | S | S | N |
| | Kanto 51 | *Pik* | S | | | | | S | S | N |
| | Norin 22 | *Pish* | S | | | | | S | S | N |
| | Pi-no. 4 | *Pita*$^2$ | S | | | | | S | S | N |
| | Reïho | *Pita*, *Pita*$^2$ | S | | | | | S | S | N |
| | Shin 2 | *Piks*, *Pish* | S | | | | | S | S | N |
| | St1 | *Pif* | S | | | | | S | S | N |
| | Toride 1 | *Pizt* | S | | | | | S | S | N |
| | Tsuyuake | *Pikm* | S | | | | | S | S | N |
| | Zenith | *Piz Pia* | S | | | | | S | S | N |

R = resistant, S = susceptible, Y = yes, N = no.


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