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Letter

Nature **442**, 705-708 (10 August 2006) | doi:10.1038/nature04920; Received 23 March 2006; Accepted 15 May 2006

Sub1A is an ethylene-response-factor-like gene that confers submergence tolerance to rice

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Most *Oryza sativa* cultivars die within a week of complete submergence—a major constraint to rice production in south and southeast Asia that causes annual losses of over US\$1 billion and affects disproportionately the poorest farmers in the world^{1,2}. A few cultivars, such as the *O. sativa* ssp. *indica* cultivar FR13A, are highly tolerant and survive up to two weeks of complete submergence owing to a major quantitative trait locus designated *Submergence 1 (Sub1)* near the centromere of chromosome 9 (refs 3, 4, 5–6). Here we describe the identification of a cluster of three genes at the *Sub1* locus, encoding putative ethylene response factors. Two of these genes, *Sub1B* and *Sub1C*, are invariably present in the *Sub1* region of all rice accessions analysed. In contrast, the presence of *Sub1A* is variable. A survey identified two alleles within those *indica* varieties that possess this gene: a tolerance-specific allele named *Sub1A-1* and an intolerance-specific allele named *Sub1A-2*. Overexpression of *Sub1A-1* in a submergence-intolerant *O. sativa* ssp. *japonica* conferred enhanced tolerance to the plants, downregulation of *Sub1C* and upregulation of *Alcohol dehydrogenase 1 (Adh1)*, indicating that *Sub1A-1* is a primary determinant of submergence tolerance. The FR13A *Sub1* locus was introgressed into a widely grown Asian rice cultivar using marker-assisted selection. The new variety maintains the high yield and other agronomic properties of the recurrent parent and is tolerant to submergence. Cultivation of this variety is expected to provide protection against damaging floods and increase crop security for farmers.

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