RICE GENETICS

Repelling planthoppers

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Credit: Nigel Cattlin/Alamy Stock Photo

Brown planthoppers (BPH) and white-backed planthoppers (WBPH) are major pests of rice, causing serious damage to global rice production. Although several genes conferring resistance to planthoppers have been reported, broad-spectrum and endurable resistance genes remain scarce. Jianping Guo, from Wuhan University, and colleagues now report an exocyst-localized protein that produces general planthopper resistance.

Using map-based cloning and transgenic experiments, the researchers localized and validated a resistant gene on chromosome 4. This gene, named *Bph6*, encodes a previously unknown protein colocalized with the exocyst complex. The BPH6 protein interacts with an exocyst subunit protein, OsEXO70E1, and promotes the secretion of cytosolic proteins to the cell surface. Knocking down *OsExo70E1* expression in *Bph6*-carrying plants disrupts planthopper resistance, suggesting that *Bph6* confers resistance by affecting exocytosis.

The exocyst-related pathway regulates cell wall development. After BPH feeding, *Bph6*-carrying plants showed higher expression of exocyst-subunit-encoding genes, higher levels of cell wall saccharides and thicker cell walls in leaf sheaths than susceptible plants, indicating that *Bph6* confers protection by maintaining and strengthening cell walls.

During BPH infestation, *Bph6* expression upregulated the expression of genes involved in phytohormone signalling pathways, and induced higher levels of salicylic acid (SA), jasmonic acid (JA) and cytokinin (CK). Exogenous treatment of SA, methyl jasmonate and CK enhanced BPH resistance, suggesting that *Bph6* promotes resistance by altering the action of phytohormones. Phytoalexin is an important chemical used by plants to defend against herbivores. BPH feeding and exogenous treatment of CK both induced expression of genes involved in phytoalexin biosynthesis and caused higher phytoalexin production in *Bph6*-carrying plants, supporting the idea that CK positively regulates production of phytoalexin.

Bph6 confers broad resistance to multiple BPH biotypes as well as WBPH, but caused no yield penalty in the control environment. In fields infested with BPH, *Bph6*-carrying plants maintained about 82% of their yield, whereas wild-type plants lost 90% of their yield. Phylogenetic evidence indicates that the resistant *Bph6* allele probably originated in wild rice.

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