SELF-INCOMPATIBILITY IN FLOWERING PLANTS

Summary

Many hermaphrodite flowering plants possess the mechanisms called self-incompatibility (SI), which prevent self-fertilization and promote out-crossing. SI enables the pistil to distinguish between self (genetically related) and non-self (genetically unrelated) pollen. Self pollen is rejected either at the stigma surface or in the style. Non-self pollen is accepted and its tube grows down through the style to reach the ovary where fertilization takes place. In most species the self/non-self recognitin in SI is controlled by a single S-locus containing two or more separate polymorphic genes, one determining the female and the other the male S-haplotype specificity. Because the S-locus is a multigene complex, the term haplotype is used to denote variants of the locus, and the term allele to denote variants of each gene in the S-locus.

There are two major types of SI systems, gamatophytic and sporophytic. In gametophytic SI, the phnotype of pollen is determined by its own S-haplotype and pollen is recognized by pistil as self when the haploid pollen matches either of the two S-haplotypes of the diploid pistil. In sporophytic SI, the phenotype of pollen is determined by the S-haplotype of its diploid parent. The pollen is recognized by the pistil as self if either of the two S-haplotypes carried by its parent matches one of the two S-haplotypes carried by the pistil.

Although SI is controlled by a single S-locus, in the various plants the mechanisms employed are different. So far, three distinct systems have been characterized in some detail at the molecular level in widely divergent plant families. This article describes molecular SI mechanisms in Solanaceae and Papaveraceae that possess gamatophytic self-incompatibility (GSI), and in Brassicaceae that possess sporophytic self-incompatibility (SSI).

Self-incompatible members of the Solanaceae species reject pollen via the action of a style S-locus-encoded ribonuclease (S-RNase). This S-RNase is held to degrade RNA molecules present in incompatible pollen tubes, which leads to an arrest of pollen tube in the style. In Papaveraceae, SI operates through a calcium-dependent signal transduction pathway located in the pollen that involves also phosphorylation of downstream proteins. Activation of this signalling cascade leads to the arrest of pollen tube growth on the stigma. The SI system in members of the Brassicaceae is based on the interaction between stigmatic plasma-membrane receptor (SRK) and pollen ligand (SCR). The signalling process downstream in the pistil causes pollen rejection on the stigma surface.