Chapter 9
Molecular Biology of S-RNase-Based Self-Incompatibility

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Abstract Many flowering plants have developed self-incompatibility (SI) systems to avoid inbreeding and to promote out-crossing. Among the various SI systems, gametophytic SI (GSI) in the Solanaceae, Plantaginaceae and Rosaceae is believed to be the most common type, in which the specificity of SI response is controlled by a single polymorphic locus, termed the self-incompatibility *S*-locus. It has been shown that this locus is organised in a haplotype fashion carrying at least two genes determining the self and non-self pollen recognition specificity: *S-RNase* (*S-Ribonucleases*) expressed in pistil (pistil *S*) and *SLF* (*S*-Locus F-box)/*SFB*(*S*-haplotype-specific F-box) genes in pollen (pollen *S*). In this chapter, we present and discuss the current knowledge about molecular biology of S-RNase-based self-incompatibility.

Abbreviations

120K	120 kDa glycoprotein
AhSLF	*Antirrhinum hispanicum SLF*
C1 to C5	Conserved regions in the S-RNase sequence
CUL	Cullin
ECM	Extracellular Matrix
F-box	A protein motif; often components of SCF ubiquitin–ligase complexes
GSI	Gametophytic self-incompatibility
HT-B	H-Top Band; a small, novel asparagine-rich protein
HVa and HVb	Hypervariable regions in the S-RNase sequence

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PhSBP1	*Petunia hybrida S-RNase binding protein1*
PiSLF	*Petunia inflata SLF*
PPMs	Pollen-part mutants
RNAi	RNA interference
rRNA	Ribosomal ribonucleic acid
SC	Self-compatible
SCF	Skp1-cullin-F-box complex
SFB/SLF	*S-Locus F-box*/*S-haplotype-specific F-box* (the pollen *S*-determinant in many GSI systems; *SLF* in *Antirrhinum* and *Petunia*; *SFB* in *Prunus*)
SI	Self-incompatibility
S-locus	Self-incompatibility locus
S-RNase	*S*-locus ribonuclease (the pistil *S*-determinant in many GSI systems)
SSK	SLF-*interacting SKP1-like*
TAC	Transformation-competent artificial chromosome

9.1 Introduction

Self-incompatibility (SI) is one of the most important systems adopted by many flowering plants to prevent self-fertilisation and thereby to generate and maintain genetic diversity within a species. Classic genetic studies established that SI in most species is controlled by a single polymorphic locus, the self-incompatibility *S*-locus. It is now aware that this locus contains at least two separate genes: one controlling the self and non-self pollen recognition specificity on the pistil side (pistil *S*), and the other on the pollen side (pollen *S*), thus the term *haplotype* is used to describe variants of the *S*-locus. Pollen inhibition occurs when the same *S*-haplotype is expressed by both pollen and pistil (de Nettancourt 2001).

The molecular nature of the *S*-locus has been extensively studied in several species with different genetic features, and accordingly, the SI systems have been classified into several types. Generally, we can define these types of SI as the Brassicaceae-type, Solanaceae-type and Papaveraceae-type SI, because the species from the three families were used first for molecular studies and subsequent findings revealed that they represent three different molecular types of the *S*-locus (McCubbin and Kao 2000; Sims 2005; Takayama and Isogai 2005). The Solanaceae-type SI appears to be the most phylogenetically widespread form of SI found in angiosperms and is shared by two more families, the Plantaginaceae (formerly placed in the Scrophulariaceae) (Xue et al. 1996; Olmstead et al. 2001) and Rosaceae (Sassa et al. 1996; Ishimizu et al. 1998). This type of SI is genetically determined as a single-locus gametophytic SI (GSI) system, of which the recognition specificity is determined by the haplotypes of the polymorphic *S*-locus: pollen tube growth is