



Centurion
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Self In-compatibility

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self-incompatibility

- ❖ First reported by Koelreuter
- ❖ Can be defined as " the prevention of fusion of fertile (functional) male and female gametes after self-pollination. or
To failure of pollen to fertilize the same flower or other flower of the same plant.
- ❖ Self incompatibility is an important out breeding mechanism, which prevent auto gamy and produce allogamy.
- ❖ It has been reported in more than 300 species belonging to 70 families.

❖ Genetically controlled by one or more multi-allelic loci, and relies on a series of complex cellular interactions between the **self-incompatible** pollen and pistil.

Self incompatibility may occurs due to:

1. Pollen grain **fails to germinate** on the stigma.
2. Pollen grain germinates, but **pollen tube fails to enter** inside the stigma and style.
3. Sometimes pollen tube enters inside the style but **growth is very slow**.
4. Pollen tube enters the ovule but there is **no fertilization** due to degeneration of eggs cells.
5. Sometimes fertilization is effected but **embryo degenerate** at very early stage.

Classification of SI

On the basis of the interaction between pollen grain and pistil

Complementary system of SI
Or
Stimulatory type

E.g..- Dendrobium

Oppositional System of SI
Or
Inhibitory type

Almost all cases of SI are of this type

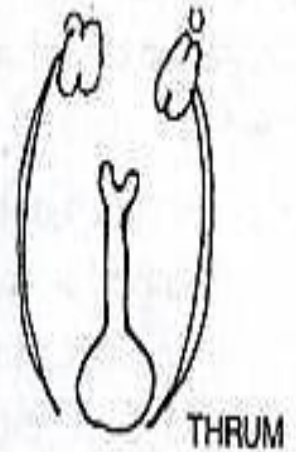
TABLE 9.1**Classification of self incompatibility**

<i>Basis of Classification</i>	<i>Types of self incompatibility</i>	<i>Brief Description</i>
1. Flower Morphology	(a) Heteromorphic	SI is associated with differences in flower morphology.
	(i) Distyly	Styles and stamens are of two types, <i>i.e.</i> short and long.
	(ii) Tristyly	Styles and stamens have three positions, <i>i.e.</i> short, medium and long.
	(b) Homomorphic	The flowers do not differ in Morphology.
	(i) Sporophytic	SI is governed by genotype of pollen producing plant.
	(ii) Gametophytic	SI is governed by the genetic constitution of gametes.
2. Genes Involved	(a) Monoallelic	SI is controlled by single gene.
	(b) Diallelic	SI is governed by two genes.
	(c) Polyallelic	SI is governed by several genes.
3. Site of Expression	(a) Stigmatic	SI genes express on the stigma
	(b) Stylar	SI genes express in the style
	(c) Ovarian	SI genes express in the ovary.
4. Pollen Cytology	(a) Binucleate	The pollen grains have two nuclei.
	(b) Trinucleate	The pollen grains have three nuclei.

SI = Self incompatibility.

Heteromorphic system of SI

- ❖ In this system, flowers of different incompatibility groups are **different in morphology**. E.g In *Primula* there are two types of flowers i.e. **Pin and thrum produced on two different plants**.
- ❖ This situation is referred as **distyly**.
- ❖ **Tristyly** is known in some plant species. E.g *Lythrum salicaria* in such case, the style of a flower may be either short, long or of medium length.
- ❖ In the case of distyly, the only compatible mating between pin and thrum flower.



Heterostyly in *Primula*



Pin (right) and thrum primrose flowers: a visiting insect picks up pollen from the high anthers of the thrum flower, and later may deposit it on the high stigmas of the pin flower.

**Short-styled
Flower (Thrum)**

**Long-styled
Flower (Pin)**

Cross	Result
Ss (thrum) X Ss (thrum)	Incompatible
ss (pin) X ss (pin)	Incompatible
Ss (thrum) X ss (pin)	1 Thrum :1 Pin
ss (pin) X Ss(thrum)	1 Thrum :1 Pin

Homomorphic system of SI

- ❑ Found in majority of Self-incompatible group.
- ❑ In the Homomorphic system incompatibility is not associated with morphological differences among flowers.
- ❑ The incompatibility reaction of pollen may be controlled by the genotype of the plant on which it is produced (**Sporophytic control**) or by its own genotype (**Gametophytic control**).

a) Gametophytic System:

- ❖ Gametophytic incompatibility was first described by East and Mangelsdor in 1925 in *Nicotiana sanderae*.
- ❖ The incompatibility reaction of pollen on which it is produced. Generally, incompatibility reaction is determined by a single gene having multiple alleles. E.g *Trifolium Nicotiana, Solanum, Petunia* etc.
- ❖ Pollen tube grows very slowly in the style containing the same S allele as the pollen and fails to effect fertilization. Therefore all the heterozygous at the S locus.

In a single system there are three types of matings.

- 1) Fully Incompatible E.g $S_1 S_2 \times S_1 S_2$
- 2) Fully Compatible ($S_1 S_2 \times S_3 S_4$)
- 3) Partially Compatible ($S_1 S_2 \times S_2 S_3$)

Sporophytic System:

- ❖ first described by Hughes and Babcock (1950) in *Crepis foetida* & Gerstel (1950) in *Parthenium argentatum*.
- ❖ The incompatibility reaction of pollen is governed by the genotype of the plant (sporophyte) on which it is produced & not by the genotype of the pollen itself.
- ❖ Self - incompatibility is governed by a **single gene 'S'** with multiple alleles (**S1 > S2 > S3 > S4.....**), more than 30 alleles e.g. *Brassica oleracea*.
- ❖ In general, the number of S alleles is considerably larger in Gametophytic than in the Sporophytic system.
- ❖ In the Sporophytic system, the alleles may exhibit dominance, condominance or competition.

Lewis has summarized the following characteristics of this system.

1. There are frequent reciprocal differences.
2. Incompatibility can occur with the female parent.
3. A family can consist of three incompatibility groups.
4. Homozygotes are a normal part of the system.

Now this system has been reported in Radish, Cabbage, Cauliflower, Sunflower, Cosmos and several other crop plant.

TABLE 9.5

Results of gametophytic and sporophytic self incompatibility systems from different crosses

Genotypes crossed		Pollen genotypes		Results		
Female	Male	Compatible	Incompatible	Reaction	Genotypes	
A. Gametophytic System :						
S_1S_2	×	S_1S_2	Nil	S_1, S_2	No Progeny	Nil
S_1S_2	×	S_1S_3	S_3	S_1	Partial fertility	S_1S_3, S_2S_3
S_1S_3	×	S_1S_2	S_2	S_1	Partial Fertility	S_1S_2, S_2S_3
S_1S_2	×	S_3S_4	S_3S_4	Nil	Full fertility	$S_1S_3, S_1S_4, S_2S_3, S_2S_4$
B. Sporophytic System :						
S_1S_2	×	S_1S_2	Nil	S_1, S_2	No Progeny	Nil
S_1S_2	×	S_1S_3	Nil	S_1, S_3 because S_3 also behaves as S_1	No Progeny	Nil
S_1S_3	×	S_3S_4	Nil	S_3, S_4 because S_4 also behaves as S_3	No Progeny	Nil
S_1S_2	×	S_3S_4	S_3, S_4	Nil	Full fertility	$S_1S_3, S_1S_4, S_2S_3, S_2S_4$
S_1S_3	×	S_2S_3	S_2, S_3 because S_3 also behaves as S_2	Nil	Full fertility	$S_1S_2, S_1S_3, S_2S_3, S_3S_3$
S_1S_2	×	S_2S_3	Nil	S_2, S_3	No Progeny	Nil → <i>cross show reciprocal</i>
S_2S_3	×	S_1S_2	S_1, S_2 because S_2 also behaves as S_1	Nil	Full fertility	$S_1S_2, S_2S_2, S_1S_3, S_2S_3$
S_2S_3	×	S_3S_4	Nil	S_2, S_3 because S_4 also behaves as S_3	No Progeny	Nil
S_3S_4	×	S_2S_3	S_2, S_3 because S_3 also Behaves as S_2	Nil	Full fertility	$S_2S_3, S_2S_4, S_3S_3, S_3S_4$

TABLE 9.6

Comparison of gametophytic and sporophytic systems of self-incompatibility.

<i>Sl. No.</i>	<i>Particulars</i>	<i>Gametophytic System</i>	<i>Sporophytic System</i>
1.	SI is controlled by	Genetic constitution of pollen	Genotype of sporophyte
2.	Genes involved	S gene with multiple alleles	S gene with multiple alleles
3.	Site of gene action	Style	Pollen or style
4.	Type of gene action	Individual	Dominance, individual or interaction
5.	Inhibition of pollen tube growth	In the style or ovary	On the stigma
6.	Pollen structure	Binucleate	Trinucleate
7.	Reciprocal differences	Not observed	Observed
8.	Recovery of parents from crosses	Male parent only	Both male and female
9.	Production of homozygotes	Not Possible	Possible
10.	Types of crosses	Sterile, partially fertile and fully fertile	Either fertile or sterile
11.	Effect of polyploidy	Fertility is restored	Fertility is not restored
12.	Production of chemical associated with SI	During pollen formation	Before pollen formation
13.	Examples	Rye, Potato, Tomato, Red clover, White clover, etc.	Radish, Cabbage, Cauliflower, etc.

Mechanism of SI

- A. Pollen-Stigma Interaction
- B. Pollen Tube-Style Interaction
- C. Pollen Tube-Ovule Interaction

Temporary suppression of SI

1. Bud Pollination
2. Surgical Techniques
3. End-of-Season Pollination
4. High Temperature
5. Increase CO₂ Concentration
6. High Humidity
7. Salt (NaCl) Sprays
8. Irradiation
9. Grafting
10. Double Pollination
11. Others techniques: In vitro fertilization