Multiple Allelism

- A given phenotypic trait of an individual depends on a single pair of genes, each of which occupies a specific position called the locus on homologous chromosome. When any of the three or more allelic forms of a gene occupy the same locus in a given pair of homologous chromosomes, they are said to be called **multiple alleles**.

Characteristics of multiple alleles

Multiple alleles of a series always occupy the same locus in the homologous chromosome. Therefore, no crossing over occurs within the alleles of a series.

Multiple alleles are always responsible for the same character.

The wild type alleles of a series exhibit dominant character whereas mutant type will influence dominance or an intermediate phenotypic effect.

When any two of the mutant multiple alleles are crossed the phenotype is always mutant type and not the wild type

- Wild type
- Mutant type
- Amorphs
- Hypomorphs
- Neomorphs
- Isoalleles
- Unstable alleles

Self-sterility in *Nicotiana*

- In plants, multiple alleles have been reported in association with self-sterility or self-incompatibility. Self-sterility means that the pollen from a plant is unable to germinate on its own stigma and will not be able to bring about fertilization in the ovules of the same plant. **East (1925)** observed multiple alleles in ***Nicotiana*** which are responsible for self-incompatibility or self-sterility. The gene for self-incompatibility can be designated as S, which has allelic series S_1, S_2, S_3, S_4 and S_5

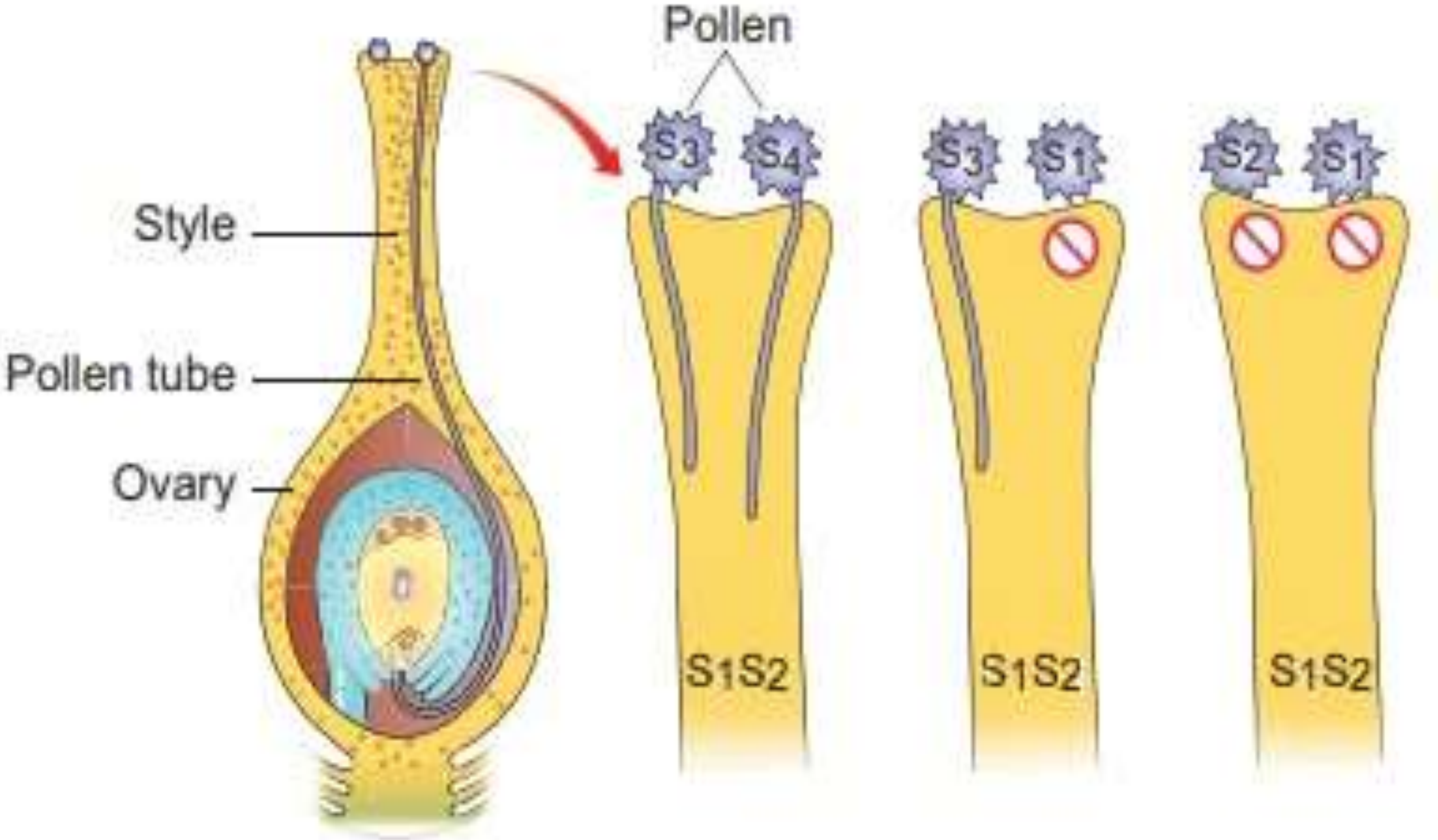


Figure: 3.17 The self-incompatibility in relation to its genotype in tobacco

- The cross-fertilizing tobacco plants were not always homozygous as S_1S_1 or S_2S_2, but all plants were heterozygous as S_1S_2, S_3S_4, S_5S_6. When crosses were made between different S_1S_2 plants, the pollen tube did not develop normally. But effective pollen tube development was observed when crossing was made with other than S_1S_2 for example S_3S_4.

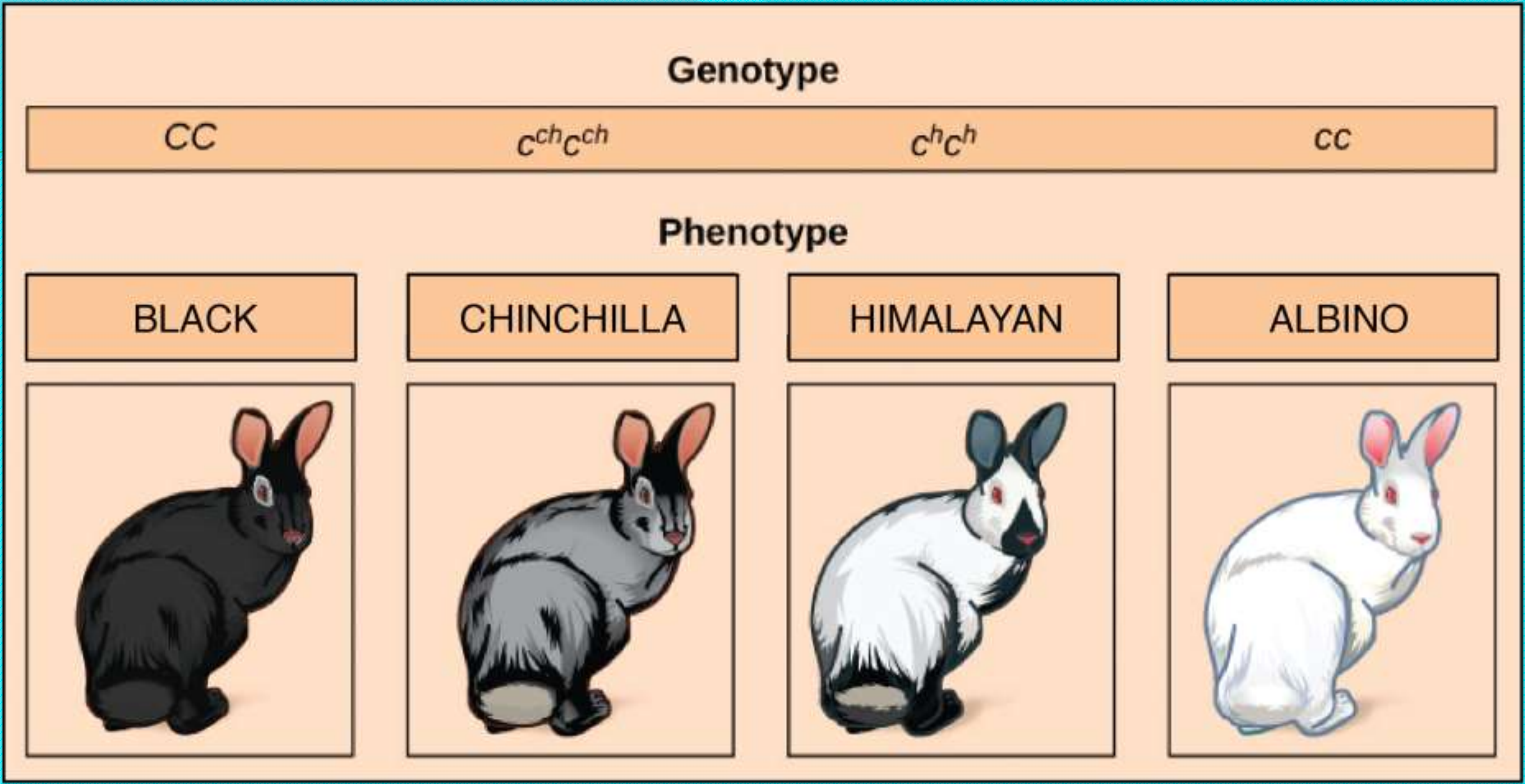
Female parent (Stigma spot)	**Male parent (Pollen source)**		
	S_1S_2	S_2S_3	S_3S_4
S_1S_2	Self Sterile	S_3S_2 S_3S_1	S_3S_1 S_3S_2 S_4S_1 S_4S_2
S_2S_3	S_1S_2 S_1S_3	Self Sterile	S_4S_2 S_4S_3
S_3S_4	S_1S_3 S_1S_4 S_2S_3 S_2S_4	S_2S_3 S_2S_4	Self Sterile

Table: 3.5. Different combinations of progeny in self-incompatibility

- When crosses were made between seed parents with S_1S_2 and pollen parents with S_2S_3, two kinds of pollen tubes were distinguished. Pollen grains carrying S_2 were not effective, but the pollen grains carrying S_3 were capable of fertilization. Thus, from the cross $S_1S_2XS_3S_4$, all the pollens were effective and four kinds of progeny resulted: S_1S_3, S_1S_4, S_2S_3 and S_2S_4.

Coat colour in rabbit

- As an example, let's consider a gene that specifies coat color in rabbits, called the C gene. The C gene comes in four common alleles: C, c^{ch}, c^{h} and c:
- A CC, rabbit has black or brown fur
- A $c^{ch}c^{ch}$, rabbit has chinchilla coloration (grayish fur).
- A $c^{h}c^{h}$ rabbit has Himalayan (color-point) patterning, with a white body and dark ears, face, feet, and tail
- A cc rabbit is albino, with a pure white coat.



- Multiple alleles makes for many possible dominance relationships. In this case, the black C allele is completely dominant to all the others; the chinchilla c^{ch}*cch*c, start superscript, c, h, end superscript allele is incompletely dominant to the Himalayan c^h*ch*c, start superscript, h, end superscript and albino c*c*c alleles; and the Himalayan c^h*ch*c, start superscript, h, end superscript allele is completely dominant to the albino c*c*c allele.
- Rabbit breeders figured out these relationships by crossing different rabbits of different genotypes and observing the phenotypes of the heterozygous kits (baby bunnies).

Human Blood Type

- An excellent example of multiple allele inheritance is human blood type. Blood type exists as four possible phenotypes: A, B, AB, & O.There are 3 alleles for the gene that determines blood type.
- The alleles are as follows:

ALLELE	CODES FOR
I^A	Type "A" Blood
I^B	Type "B" Blood
I	Type "O" Blood

- Notice that, according to the symbols used in the table above, that the allele for "O" (i) is recessive to the alleles for "A" & "B".
- With three alleles we have a higher number of possible combinations in creating a genotype.

GENOTYPES	RESULTING PHENOTYPES
I^AI^A	Type A
I^ai	Type A
I^BI^B	Type B
I^bi	Type B
I^AI^B	Type AB
ii	Type O

- Thank You