

MSC BOTANY
EMBRYOLOGY
FERTILISATION-II
POLLEN GERMINATION AND
POLLEN TUBE GROWTH

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Pollination → Pollen adhesion → Pollen hydration
→ Pollen germination → Pollen tube entry into
stigma → Pollen tube growth through the style →
Pollen tube entry into the ovule and embryo sac
→ Double fertilization

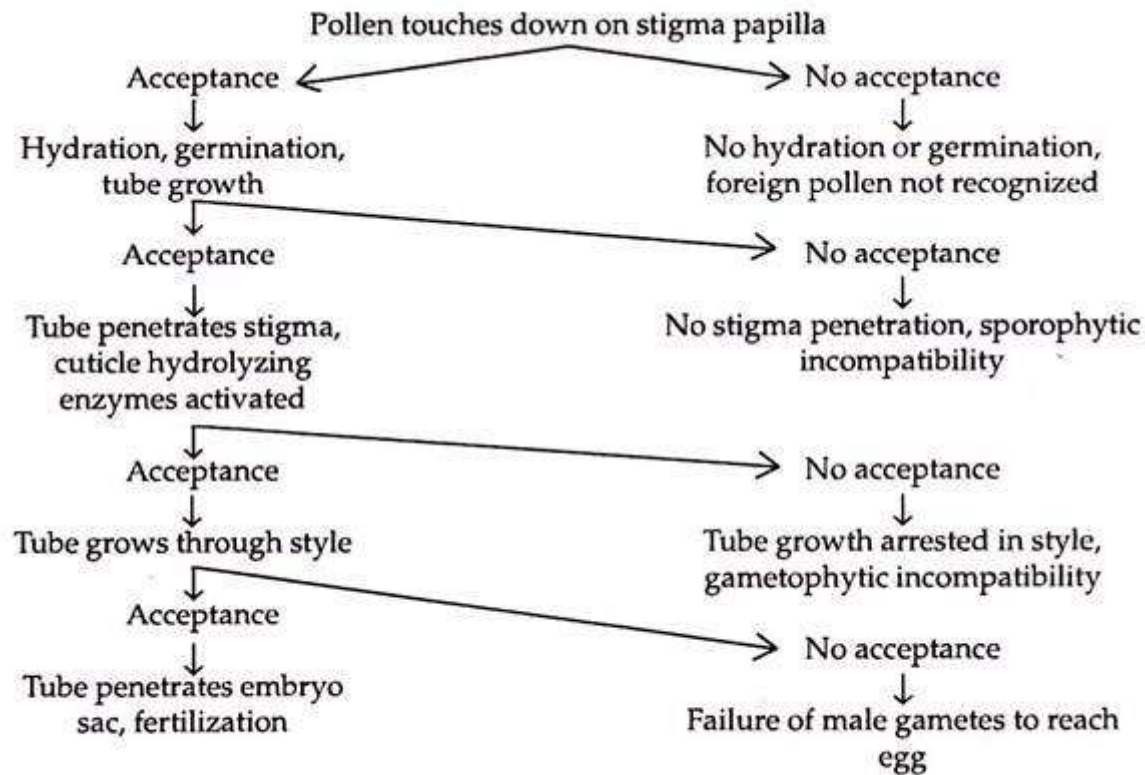


Fig. 6.8 : Behaviour of compatible and incompatible pollination (*after* Knox, 1979)

POLLEN GERMINATION AND POLLEN TUBE GROWTH

- ❖ The first requirements for pollen germination are their adhesion on the stigma and hydration ,which take a few seconds to a few minutes

Adhesion and hydration of pollen :

- ❖ Adhesion : the first key step after pollination,especially in plants with dry stigma, is the adhesion of pollen on the stigma surface. Pollen stigma adhesion is strong, highly selective and established.

Immediately after pollination the stigma surface becomes altered at the interface,acquiring a pattern that interlocks with the exine to firmly fix the pollen on the stigma . Pollen cell surface and extracellular matrix of the stigma plays an important role in mediating pollen adhesion

- ❑ In species with wet stigma the stigmatic exudate ,which contains a wide range of proteins and enzymes,is responsible for pollen adhesion. In plants with dry stigma this role is performed by the pollen coat.
- ❑ Luu et al(1999) have suggested- involvement of SLR(S locus related protein) and SLG (an extracellular glycoprotein) in pollen stigma adhesion.
- ❑ Pollen stigma adhesion may trigger cytoplasmic recognition and initiate signalling that regulates pollen hydration and germination

Hydration :

hydration of pollen ,which is prerequisite for pollen activation and germination is a highly regulated process. In plants with wet stigma the exudates released by the secretory zone of the stigma promote pollen hydration and germination.

It has been shown that lipids in wet stigma exudates are essential for pollen tubes to penetrate the stigma . In plants with dry stigma the pollen coat fulfills the role of exudates in wet stigma. Similar to wet stigma in dry stigma the lipids in the pollen coat are required for pollen germination

Hydration of pollen triggers physiological activation of pollen cytoplasm, leading to pollen germination. The pollinated stigmatic papillae also show subsequent increase in the level of calcium ions in 3 successive stages:

1. Soon after pollen hydration
2. At pollen tube protusion
3. When pollen tube penetrates the papillae

Pollen germination:

Factors influencing pollen germination and pollen tube growth has been collected through the culture of pollen grains on nutrient medium

In vitro germination: uptake of water leads to swelling of the grains and their activation .

Therefore ,high relative humidity (RH) is the first essential requirement for pollen germination whether in vivo or invitro

Other factors are:

1. Carbohydrates : for the germination of pollen in nutrient medium a sugar is always necessary. Two roles has of sugar are-
 1. control of osmotic pressure
 2. to serve as respiratory substrate

Pollen of many species would burst when placed in water. Addition of definite amount of sugar limits the diffusion rate of water into pollen and thus prevents bursting of pollen tube.

Of the many sugars tested for their ability to promote germination and pollen tube growth, sucrose is the most effective . The amount of sucrose required for germination of 3 celled pollen is generally much higher than 2 celled pollen

2. boron: among inorganic substances ,boron in the form boric acid or borate has a imp. Effect on pollen germination and pollen tube growth.

Pollen of most species are deficient in boron content . In nature this deficiency is made up by comparatively high levels of boron in the stigma and style. When such pollen are grown in vitro high amounts of boron are supplied

Boron reduces bursting of pollen tubes as well as enhances percentage germination and pollen tube growth .

some of the roles attributed to boron are

1. Effect on water relationship and thus preventing pollen and pollen tube bursting
2. Translocation of sugars
3. Direct or indirect influence on enzymatic steps in biosynthesis of carbohydrates

3. Calcium:

There is sufficient evidence to suggest calcium plays an imp role in pollen germination and tube growth

Lack of calcium ions in the culture medium results in morphological abnormalities such as coiling and tip swelling.

The percentage of pollen germination and pollen tube growth are far better when a large population of pollen grains is grown compared to when they are placed seperately on the culture medium . This observation led to the recognition of “ population effect “ or crowding effect” or “mentor effect”

Pollen grains contain a very small amount of calcium . In aqueous medium calcium diffuses out rapidly leaving a low endogenous level which is insufficient for pollen germination . When pollen are present in large numbers on the surface of the semisolid medium the diffused calcium may be trapped between the pollen grains and then bring about the population effect

4. flavonols:

All pollen grains accumulate flavonols often to very high levels . These are aromatic compounds which are derived from the anther tapetum , plays an important role in pollen germination and pollen tube growth . Flavanol deficient pollen are self sterile because their pollen are unable to germinate or produce functional tube

5. Physical factors :

among the physical factors affecting pollen germination and tube growth temperature is the most important . The growth rate is enhanced with an increase in temperature optimum temp-20-30C

In vivo germination :

- ❑ pollen germination on stigma and pollen tube growth in pistils are much faster than in vitro
- ❑ In Arabidopsis , pollen germination occurs within 30 seconds of their landing on the stigma .
- ❑ Pistil provides factors that promote pollen germination . The chemical nature of the factors that promote pollen germination and tube growth vary with species

THANK YOU