

Pollen Grain Storage

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Pollen grain storage refers to the preservation or conservation of pollen grains, typically for use in plant breeding, research, or agricultural practices. This storage may involve techniques such as drying, freezing, or storing in a desiccated environment to maintain the viability of the pollen grains over an extended period. Proper storage conditions are crucial to ensure the longevity and viability of pollen grains for future use in pollination and hybridization experiments.

Importance

The importance of pollen grain storage lies in its pivotal role in various aspects of plant biology, agriculture, and research.

1. Genetic preservation: Pollen grain storage allows for the preservation of genetic diversity within plant species. By storing pollen from different varieties or wild relatives, genetic resources can be conserved for future breeding programs, ensuring the availability of diverse genetic material for crop improvement.

2. Plant breeding: Stored pollen serves as a valuable resource for plant breeders and researchers engaged in hybridization programs. It enables controlled pollination between different cultivars or species, facilitating the development of new varieties with desired traits such as disease resistance, improved yield, or environmental adaptability.

3. Research purposes: Pollen storage supports scientific studies on various aspects of plant reproduction, genetics, and evolutionary biology. Researchers can access stored pollen for investigations into pollen viability, pollen tube growth, fertilization mechanisms, and the genetic basis of traits.

4. Crop production: In agriculture, stored pollen can be used to ensure pollination in crops where natural pollination may be insufficient or unreliable. This is particularly important for crops with specialized pollination requirements, such as hybrid seed production in crops like corn or sorghum.

5. Conservation efforts: Pollen storage contributes to the conservation of endangered plant species by preserving their genetic material for potential future restoration efforts. It offers a means to safeguard genetic diversity and prevent the loss of valuable plant species due to habitat destruction, climate change, or other threats.

6. Time and resource efficiency: By storing pollen, researchers and breeders can reduce the need for continuous field collections and expedite breeding programs. This saves time, labor, and resources involved in maintaining live plant populations solely for pollen collection purposes.

Pollen viability and the factors affecting pollen viability

The viability of pollen grains refers to their ability to germinate and fertilize ovules, thereby contributing to successful pollination and seed development. Several factors influence pollen viability, including genetic factors, environmental conditions, and storage methods.

1. Genetic factors: The genetic makeup of a plant species or cultivar can significantly affect pollen viability. Some plants naturally produce pollen with higher viability, while others may have lower viability due to genetic factors. Breeding programs often aim to select for traits associated with high pollen viability to improve reproductive success.

2. Environmental conditions: Environmental factors play a crucial role in determining pollen viability. Temperature, humidity, light intensity, and air quality can all impact pollen development and germination. Optimal environmental conditions vary among plant species but generally involve moderate temperatures, adequate moisture, and sufficient sunlight.

3. Pollen age: The age of pollen grains can affect their viability. Pollen is most viable when freshly produced, but viability gradually declines over time due to metabolic processes and dehydration. Proper storage

methods can help prolong pollen viability, but aging can still occur over extended periods.

4. Storage methods: The method used to store pollen grains can influence their viability. Techniques such as desiccation, freezing, or cryopreservation can help maintain pollen viability for extended periods. However, improper storage conditions or exposure to harsh environments can lead to a loss of viability.

5. Pollination timing: Pollen must be released and available for pollination at the same time as the stigma of the flower is receptive to ensure successful fertilization. In some cases, pollen may be viable, but if it is not released or available during the receptive period of the stigma, pollination may not occur.

6. Pollination mechanisms: Different plant species have varied pollination mechanisms, which can affect pollen viability. Some plants rely on wind or water to transport pollen, while others depend on animals such as insects or birds. The efficiency of these pollination mechanisms can impact pollen transfer and subsequent fertilization.

Methods

I. Short-term storage

1. Refrigeration: Pollen grains can be stored in refrigerators at temperatures around 4°C. This method is suitable for short-term storage lasting from a few days to a few weeks.

2. Desiccation: Pollen grains are dried using desiccants like silica gel or in a low-humidity environment. Desiccation inhibits metabolic processes, extending viability for short periods, typically up to several months.

3. Vacuum sealing: Pollen samples are stored under vacuum conditions to remove oxygen and moisture, inhibiting degradation. Vacuum-sealed storage is effective for short-term preservation, usually up to a few months.

4. Storage in organic solvents: Organic solvent storage of pollen grains involves preserving pollen samples by immersing them in a solution of organic solvents. This method is commonly used for short-term storage and is particularly effective for

preserving pollen for genetic analysis, microscopy, or biochemical studies.

II. Long-term Storage:

1. Freezing: Pollen grains are preserved at ultra-low temperatures, typically below -20°C. Freezing halts metabolic activity, maintaining viability for extended periods ranging from several months to decades.

2. Cryopreservation: Pollen grains are frozen in liquid nitrogen after being treated with cryoprotectants to protect against ice crystal formation. Cryopreservation enables long-term storage of pollen with minimal loss of viability, suitable for maintaining genetic resources over many years.

3. Deep-freezing: Pollen samples are stored at temperatures below -80°C in specialized laboratory freezers. Deep-freezing offers long-term preservation, ensuring pollen viability for several years to decades, especially when combined with cryoprotectants.

4. In vitro culture: Pollen grains can be cultured in vitro on nutrient media supplemented with growth regulators and sugars. In vitro culture allows for long-term storage and propagation of pollen under controlled conditions, maintaining viability and genetic integrity over extended periods.

Conclusion

Pollen viability is a critical factor in plant reproduction and crop yield. Understanding the factors that influence pollen viability can help improve breeding programs, optimize pollination practices, and enhance overall reproductive success in plants. Pollen grain storage plays a crucial role in advancing agricultural practices, sustaining biodiversity, and supporting scientific research aimed at understanding and improving plant reproduction and crop production. Selecting the appropriate storage method depends on factors such as the species being stored, available resources, intended duration of storage, and future use of the pollen. Short-term storage methods are suitable for immediate use or short-term experiments, while long-term storage methods are preferred for preserving genetic resources and maintaining viability over many years.
