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Banking on the Future: How Saving Seed can Save us All

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Abstract

India boosts a diverse and abundant Biodiversity and legacy that stands a broad range of Environments including Alpine vegetation, Tropical rain forest, Temperate forests and Coastal areas explore the inner workings of Seed banks across the world and the impressive Diversity of the seed. Seed Scientists are saving the world by saving the seed and how seed dormancy can lock seeds in time and the many ways Seed bank capitalizes off-seed dormancy to solve problems around the world. It all Starts with a Knowledge of the many complex ways of how Seed work.

Introduction

The loss of Genetic diversity which in the is commonly referred to as the reduction in the quantities of specimens of a species the loss of the genetic variation among the plants or loss of the some of the various forms of the Genes. So to protect and preservation of natural and existing crop diversity to ensure future food security and how seed dormancy play major role in seed loss.

Key Factors that Influence loss of Genetic Material

1. Environmental degradations, pollution and other negative environmental impacts further stress plant populations contributing to the loss of genetic variation
2. Deforestation urbanization and other alterations to natural habitats destroy wild species that are crucial Reservoirs of genetic diversity.
3. A lack of genetic variation makes crops more vulnerable to new threats, such at novel diseases, pest and climate related Stresses.
4. A narrows genetic base for the global food supply increases the risk of wide spread crop failures and the potential famine.

The Role of Seed Dormancy in affecting Genetic Loss

Seed Dormancy

Definition

According to Lang (1987), dormancy is a temporary suspension of growth of an organ or tissue having meristematic activity. It describes a condition in which seeds are unable to germinate even under favorable environmental conditions. This differs from *quiescence*, where seeds fail to germinate solely due to unfavorable external factors such as moisture, temperature, or aeration.

Types of Dormancy

1. Exogenous Dormancy

   Imposed by factors external to the embryo.

   a) Physical Dormancy (Seed Coat Dormancy)

   - Seed coat becomes hard under environmental influence, rendering it impermeable to water and gases and preventing physiological processes.

   b) Mechanical Dormancy

   - Structures covering the seed physically restrict radicle extension, inhibiting germination.

   c) Chemical Dormancy

   - Presence of inhibitory compounds (e.g., phenols, tannins, abscisic acid) in seed coverings prevents germination.

2. Endogenous Dormancy

   Induced by the embryo itself, often due to immaturity or underdevelopment at the time of seed maturation or ripening.

3. Physiological Dormancy

   Involves internal physiological factors within the seed. Subtypes include:

   - Non-deep physiological dormancy
   - Photo-dormancy
   - Thermo-dormancy
   - Intermediate physiological dormancy
   - Deep physiological dormancy
   - Epicotyl dormancy
   - Double dormancy

Methods to Break Dormancy

1. Scarification

   Alters the seed coat to make it permeable to water and gases by mechanical or chemical means, including:

   - Mechanical scarification
   - Acid scarification
   - Hot water scarification
   - Warm moist scarification

2. Stratification

   Subjects imbibed seeds to a period of chilling to stimulate embryo maturation and germination.

3. Other Treatments

   - Leaching of chemical inhibitors
   - Pre-chilling
   - Pre-drying
   - Seed priming
   - Application of chemicals and hormones

Hormonal Control of Dormancy

Seed dormancy and germination are regulated by endogenous hormones:

- Growth-promoting hormones: gibberellins, cytokinins, ethylene
- Inhibitory hormone: abscisic acid, which plays a key role in maintaining dormancy and whose removal or breakdown is essential for germination.

The Storage of Seed

We need to Stop Seed from using this finite resources. Each seed contains a finite amount of food in the form of Carbohydrates, fats or proteins and when a Seed a fully Seed is out of this food if they haven't grown into a fully Self-Sufficient plant they die. We usually stop seed from using their resources in two ways by drying them down to a low moisture content and keeping them down at very cold temperatures seed banks dry seed to appropriate moisture levels and then store Seed at -20 degree Celsius or so we can talk about why these Seed are able to grow once we pull them out of their deep sleep this is very difficult to do because typically plants have a lot of ways to ensure they are over coming Seed dormancy.

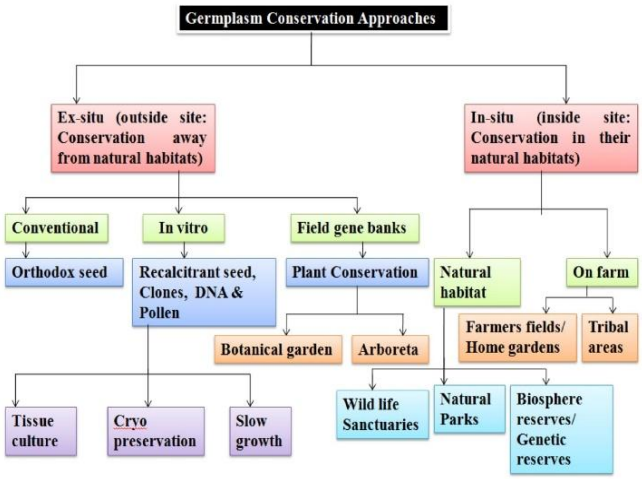
Loss of Genetic Erosion of Biodiversity in India

In India a large number of genetically rich rice varieties in Jeypore tract of Odisha state. Rice varieties with medicinal properties popularly called Njavara in Kerala state and a wide range of millet Species like Little millet(*Panicum sumaterense*) Italian millet(*setaria italica*), Kodo millet (*Paspalum scrobicuiatum*) Common millet(*Panicum milaceum*), Barnyard millet (*Echinochioa colona*) and Finger millet(*Eleusine coracana*) in Tamil Nadu have faded out of cultivation in their native habitats. Five decades ago each region in the state of Chhattisgarh (then part Madhyapradesh cultivated 19000 Rice varieties those were suitable to the soil, climate and other variations. But in the 1960's almost all the local varieties replaced by high yielding varieties of rice.

Key developments from the Recent Time

1. India's 2nd National Gene Bank announced in the 2025-2026 Union budget, this new facility will store 1 million germplasm lines to bolster food security. It is intended to support both public and private sectors and address climate change impact on genetic diversity.
2. **International Olive council (IOC):** the LOC is working with FAO and the Crop Trust to safe guard Olive genetic resources a late 2024 workshop focused on Securing Sustainable funding for International Gene Banks, highlighting the importance of living collections like those for Olives.
3. **World Coffee Research:** The organization is actively involved in Coffee Germplasm conservation to protect against potential catastrophic losses from drought, pests and diseases. This includes serving on the USDA coffee and Cocoa Germplasm committee to advice on priorities.

Germplasm Conservation Approaches



Conclusion

Preserving the world's genetic heritage depends on understanding both the vulnerabilities and strengths inherent in seeds. By harnessing seed dormancy, employing advanced storage techniques, and establishing community and national seed banks, scientists and citizens can safeguard crop diversity against emerging threats such as climate change, pests, and diseases. Local initiatives—whether a school garden project or a backyard seed-saving circle—complement large-scale gene bank efforts by maintaining living repositories of traditional varieties. Collaborative networks that connect farmers, researchers, and policy makers will ensure continuous exchange, backup, and revitalization of genetic resources. Ultimately, every individual can contribute to a global mosaic of seed security: small actions—saving a handful of seeds, sharing them with neighbors, or supporting conservation programs—aggregate into powerful defenses for future food systems. Seed banks are not merely archives but dynamic engines of resilience, powering solutions for both present challenges and generations to come.

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