JUST AGRICULTURE
multidisciplinary e-Newsletter

Conservation of Orthodox and Recalcitrant Seeds

Pradip Kumar*,Upasna Choudhary, Suraj Soni and Anand Sahil
Ph.D. Research Scholar, Dr. Rajendra Prasad Central Agricultural UniversityPusa Samastipur Bihar-848125

ARTICLE ID: 17

Introduction

The terms orthodox and recalcitrant seed came into usage in 1973. Seeds are the most convenient form to store and distribute plant germplasm. Classified these seed according to their physiological behavior.

Gene banks in which dried seed is stored at low temperature are the most wide spread form of *ex-situ* conservation. Seed stored this manner are referred to as "orthodox seeds." Techniques for conserving orthodox seeds involve drying seed to low moisture content and storing them , in hermetically-sealed containers, at low temperature, preferably at-18°Corcooler. These procedures have been widely adopted by seed banks worldwide. Many species of tropical or subtropical origin have seeds which are sensitive to drying and chilling and cannot best ored in conventional gene banks. Seeds of this type are termed "recalcitrant" and even when stored under optimal conditions, their span is limited to a few weeks, occasionally months. Recent investigations have identified species exhibiting an" intermediate "storage behavior. Such seeds can tolerate desiccation to low moisture content, once dried, they become particularly susceptible to injury caused by low temperature. In comparison with truly recalcitrant seeds, the storage life of these intermediate seeds can be prolonged by some drying, but it remains impossible to achieve the long-term conservation which can be realized for orthodox seeds.

Types of Seed

A. Orthodox seed

B. Recalcitrant seed

C. Intermediate seed

Orthodox Seed

- Orthodox seeds were those seeds that could be dried to low moisture content and tolerated freezing temperatures.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Orthodox seeds are long-lived seeds and can be successfully dried to moisture contents as low as 5% without injury and are able to tolerate freezing.
- Orthodox seeds are therefore, also termed as desiccation tolerant seeds.
- In fact, the life span of orthodox seeds can be prolonged with low moisture content and freezing temperatures.
- Ex-situ conservation of orthodox seeds is therefore, not problematic.
- Orthodox seeds are exemplified by most annual and biennial crops and Agro -forestry species which are relatively small-seeded (in comparison to unorthodox seeds).

- Orthodox seeds include for example, cowpea, *Citrus aurantifolia,Capsicum annum,Hamelia patens, Lantana camara*, guava (*Psidium guajava*), Cashew (*Anacardium occidentale*)and most grains and legume types.
- **B. Recalcitrant Seeds (Unorthodox Seeds)**
- Recalcitrant seeds could not be dried below a relatively critical moisture content and could not tolerate freezing temperatures.
- Recalcitrant seeds lose viability once they are dried to a moisture content below a relatively high critical value.
- Recalcitrant seeds are remarkably short-lived which cannot be dried to moisture content below 20-30% without injury and are unable to tolerate freezing.

JUST AGRICULTURE
multidisciplinary e-Newsletter

- Recalcitrant seeds are therefore, also termed as desiccation sensitive seeds.
- These are difficult to be successfully stored and their ex-situ conservation is problematic**.**
- It is because of their high moisture content that encourages microbial contamination and results in more rapid seed deterioration.
- Storage of recalcitrant seeds at freezing temperatures causes the formation of ice-crystals which disrupt cell membranes and causes freezing injury.
- The plants that produce recalcitrant seeds must best or ending rowing phase (i.e., as growing plants) rather than as seeds and propagated vegetative.
- Recalcitrant species belong to trees and shrubs of mostly tropics and of temperate are as which are moist and some plants which grow in aquatic environment.
- Some common examples of plants that produce recalcitrant seeds (which are generally larger than orthodox seeds) include, pointed gourd, chow-chow, avocado, cocoa, coconut, jackfruit, litchi, mango, rubber, tea, some horticultural trees, and several plants used in traditional medicine.+6555

C. Intermediate Seed

- Intermediate seeds are more tolerant of desiccation than recalcitrant, though tolerance is much more limited than orthodox seeds, and they generally lose viability more rapidly at low temperature.
- They do not con form to all the criteria defining orthodox seeds, especially in respect of the quantification and predictability of the relations between longevity and both drying and cooling.

Classification of Seed Based on Storage Behavior

Seeds divided into three biological classes according to their life span under ordinary storage conditions:

A. **Microbiotic**- seeds with life spans not exceeding 3 years.
B. **B.Mesobiotic**- seeds with life spans from 3 to 15 years.
C. **Macrobiotic**- seeds with life spans from 15 to 100 or more years.

JUST AGRICULTURE
multidisciplinary e-Newsletter

The Importance and Problems of Seed Moisture in Recalcitrant Seeds

- High moisture contents of recalcitrant seeds make them sensitive to desiccation and chilling injury. For example, cocoa (*Theobroma cocoa*) and Hevea seeds rapidly lose germination when they are dried to 0.26 and 0.20g H20g'fw, respectively.
- The recommended a low-temperature drying protocol using a desiccant to minimize deterioration of stored recalcitrant seeds.
- High seed moisture content is associated with freezing injury through ice crystal formation that disrupts cells when subjected to subzero temperatures.
- The deleterious effects of temperature below 16 to 18°C (chilling injury) on several number of recalcitrant seeds has been observed and is difficult to explain in terms of freezing damage. Species susceptible to this temperature are cocoa, (*Shorea ovalis*) and Dry (*Balanopsaromatica)*
- Imbibition is a prerequisite for germination for both orthodox and recalcitrant seeds. The only difference with recalcitrant seed is that they tend to be fully imbibed in the fruit resulting in a several number of seeds germinating within the fruit.
- In the case of jackfruit (*Artocarpus heterophyllus* Lam.), 80% of the seeds can germinate insidetheripefruit.
- High moisture in recalcitrant and orthodox seeds is a problem for successful seed storage due to its association with microbial contamination.
- Microbial contamination is a serious problem with the storage of recalcitrant seeds.
- Partial drying of cocoa seeds followed by a fungicide treatment of thiram mixture and storing in air-conditioned rooms at 20° C has prolonged the storage life of these seeds for 24wk.

Conservation of Orthodox and Recalcitrant Seed

- Hot and humid climate
- Appropriate moisture content
- Favorable weather
- Suitable temperature
- Proper handling of seeds

JUST AGRICULTURE
multidisciplinary e-Newsletter

Cryopreservation: A Potential Alternative for Conserving Seeds

In the case of recalcitrant and intermediate seed types, research should be aimed at developing ways for manipulating or treating seeds or embryos in order to induce desiccation and chilling tolerance. Development of such methods could enable storage of recalcitrant and intermediate seed following conventional procedures used for orthodox seed. They could also aid efforts to improve the survival of excised embryos after cryopreservation. Optimizing seed drying methods, with respect to the rate of seed desiccation is one important aspect requiring investigation.

Approaches To Predict Seed Storage Behaviour

Certain approaches to predict seed storage behaviour in species for which experimental results are not available are as follows:-

- Association between plant ecology and seed storage behavior.
- Association between taxonomic classification and seed storage behavior.
- Association between plant, fruit, or seed characters and seed storage behavior.
- Association between seed size and storage behavior.
- Association between seed moisture content at maturity or shedding (wild species) and seed storage behavior.
- The use of several criteria combined to indicate likely seed storage behavior.

Conclusion

Seeds are the most convenient form in which to store and distribute plant germplasm. Orthodox seeds are long-lived seeds and can be successfully dried to moisture contents as low as 5% without injury and are able to tolerate freezing.

Intermediate seeds are more tolerant of desiccation than recalcitrant, though that tolerance is much more limited than is the case with orthodox seeds, and they generally lose viability more rapidly at low temperature.

Recalcitrant seeds are remarkably short-lived which cannot be dried to moisture content below 20-30% without injury and are unable to tolerate freezing. Recalcitrant seeds are therefore, also termed as desiccation sensitive seeds. Recalcitrant seeds can be conserved in proper hot and humid climate, appropriate moisture content, favorable weather, suitable temperature, proper handling of seeds etc. Moisture is a critical factor determining the viability and longevity of both recalcitrant and orthodox seeds.