Desiccation Tolerance and Seed Storage Behaviour Studies in Himalayan Rhubarb

Veena Gupta, Anjali Kak and Chitra Pandey
Germplasm Conservation Division, National Bureau of Plant Genetic Resources, Pusa Campus New Delhi-110012

Seed storage studies were initiated on three species of *Rheum*. In all three species, seeds showed good germination when dried upto 5.6% moisture content. Irrespective of the temperature and storage conditions, all three species showed marginal decline in germination percentage (up to 12 %) when stored for twelve months. Based on present studies it seems that *Rheum* exhibit the orthodox type of seed.

Key Words: Desiccation tolerance, Seed storage behaviour, Himalayan Rhubarb, *Rheum*

Introduction

Roberts (1973) categorized the storage behaviour of seeds into recalcitrant and orthodox based on the desiccation sensitivity and desiccation tolerance, respectively. Of the 250,000 known species, the information on seed storage behaviour is known for about 7000 species from 251 families of plants (Hong and Ellis, 1996), which is also not complete. This is true for indigenous medicinal plant species where the information is meagre. The seed storage behaviour determines the survival and longevity of seed under various storage conditions. Therefore, investigating seed storage behaviour is essentially quantifying optimum storage conditions in order to preserve the seed under the best possible conditions while keeping the costs to be minimum. To determine the strategies for germplasm conservation seeds should be first classified according to their storage behaviour.

Although there are some references on seed germination and propagation of endangered medicinal plants, but the seed storage behaviour is still an untouched aspect. Therefore, experiments were conducted to investigate seed storage regimes and storage behaviour in three species of endangered but highly demanded medicinal plant–*Rheum viz., R. emodi, R. moorcroftianum* and *R. australe.*

Material and Methods

Physiologically mature seeds of three *Rheum* species were procured from NBPGR regional station Bhowali.

1. *R. emodi* (IC211665)
2. *R. moorcroftianum* (IC394048)
3. *R. australe* (IC220416)

Seed Germination

The standard germination was conducted as per International Seed Testing Association rules (ISTA, 1993) using three replicates of twenty-five seeds placed on top of the paper in sterilized petri-plates. Preliminary experiments have shown that the seeds showed good germination at 20°C, therefore rest of the germination studies were conducted on this temperature.

Seed Storage Behaviour Studies

Seed moisture was estimated as per the ISTA Rules (1993) at 130°C for one hr in three replicates. The samples were processed and conserved at the National Gene Bank. The extra seed samples were divided into small seed lots and were conditioned to different moisture levels using desiccators containing water viz., 9.82 and 5.6 per cent. Seeds of each species were packed in tri-layered aluminium foil pouches with two moisture levels 9.82% and 5.6% and were stored at ambient, 5°C (MTS) and –20°C (LTS). These are the storage regimes used in gene banks for medium and long term conservation. Samples were drawn after 3, 6, 9 and 12 month from each storage regime and were subjected to seed viability studies.

Desiccation Tolerances

Seeds were kept in desiccators containing freshly charged silica gel and two replicates of 10 seeds each were removed every alternate day for testing moisture content and seed viability.

Result and Discussion

According to the storage physiology, two distinct types of seed have been identified. Those undergo desiccation during the final stage of development, and of low moisture content can be stored successfully at low temperature, have been described as orthodox seeds, while those do not undergo maturation drying upon the parent plant and lose viability at relatively high moisture content upon dehydration after shedding, have been termed as recalcitrant. The extent to which dehydration can be

tolerated varies from species to species (Chin and Roberts, 1980). The widely accepted method to test the recalcitrant nature of seeds is to uniformly desiccate them and withdraw periodically for moisture testing and germination study. In the present study (Table 1) it is observed that freshly harvested seeds showed 15.49% moisture content with 90 percent germination and subsequent drying up to 5.67% showed 86% germination. This indicates that the seeds are desiccation tolerant and seems to be of orthodox nature.

Seeds of all the three species showed negligible decline in germination at low moisture content (5.6%) under all the three storage conditions (Table 2). Seeds with lower moisture contents when stored at lower temperatures of 5°C and –20°C showed insignificant decrease in viability as compared to those with higher moisture content of 9.82 under ambient conditions. When compared to fresh seeds stored for 3, 9 and 12 months showed loss in germination to the extent of 4, 8 and 24 per cent. Irrespective of the temperature and storage conditions, all three species showed marginal decline in germination percentage (up to 12%) in the present investigation. Seeds of all the three species with varying moisture content stored under –20°C showed insignificant difference in germination percentage when compared to control indicating thereby that the seeds of *Rheum* are tolerant to chilling.

Seed storage behaviour is also associated with plant ecology (King and Roberts, 1979) as most of the orthodox species originate from environments subjects to occasional or seasonal drought in which desiccation tolerance of seeds is integrated with seed survival and continued regeneration of the species. On the other hand, recalcitrant species tend to originate from ecosystem in which seeds are subjected to high humidity during seed development, maturation and after shedding. For example, *Coffee arabica*, which is native to the dry and cool region of Ethiopia and showed intermediate seed storage behaviour, whereas *Coffee liberica*, which is native to hotter and humid region of Liberia showed recalcitrant seed storage behaviour (Hong and Ellis, 1996). The same has been observed in the family Palmae, where the species native to dry habitats were orthodox in nature and the species native to relatively moist habitats were recalcitrant in nature whereas in arid habitats, deserts and Savannas environment, the majority of plant species show orthodox seed storage behaviour while a few shows intermediate seed storage behaviour. In the present investigations, all the species were from the sub temperate region which faces a span of at least 2 months dry climate. Further the seed with 9.82% moisture as well as 5.6% moisture content showed 80 to 88% germination under all the conditions of storage. When stored for 12 months, the viability declined by approximately 24% at all storage temperatures. Therefore, it is suggested that all the three

Table 1. Desiccation Tolerance studies in *Rheum* Spp.

S. No	Moisture %	Germination %
1	15.49	90
2	12.58	86
3	11.63	86
4	10.84	82
5	9.32	80
6	9.12	84
7	6.43	84
8	5.67	86

Table 2. Seed germination in different storage conditions in three *Rheum* species.

Storage conditions	Initial		After 3 month of storage		After 6 month of storage		After 9 month of storage		After 12 month of storage	
Moisture content	9.82	5.6	9.82	5.6	9.82	5.6	9.82	5.6	9.82	5.6
R. moorcroftianum (IC394048)										
Ambient	88	80	84	80	72	80	72	80	64	72
MTS	84	84	84	80	80	84	74	78	68	72
LTS	84	84	80	82	80	84	80	80	72	76
R. australe (IC220416)										
Ambient	84	88	84	82	72	88	68	78	68	76
MTS	80	80	84	80	72	80	72	72	68	72
LTS	84	80	80	88	72	72	76	78	68	72
R. emodi (IC211665)										
Ambient	88	84	72	82	72	80	76	88	72	70
MTS	80	72	72	82	76	80	72	80	64	72
LTS	80	92	84	84	68	72	72	76	60	78

species of *Rheum* under investigation tends to exhibit orthodox type of seed storage behaviour and can be stored at ambient conditions by reducing the moisture content up to 5%.

Acknowledgements

The authors gratefully acknowledge the facilities provided by Director, NBPGR, New Delhi.

References

Chin HF and EH Roberts (1980) *Recalcitrant crop seeds*, Kuala Lumpur, Tropical Press Sdn. Bhd. 71 p.

Hong TD and RH Ellis (1996) A protocol to determine seed storage behaviour. *Technical Bulletin on International Board for Plant Genetic Resources, Rome.*

ISTA (1993) International rules for seed testing. *Seed Sci. Technol.* **21:** 288.

King MW and EH Roberts (1979) *The Storage of Recalcitrant Seeds. Achievements and Possible Approaches.* International Board for Plant Genetic Resources.pp 96. Rome.

Roberts EH (1973) Predicting storage life of seeds. *Seed Sci. Technol.* **1:** 499-514.