

Effect of Storage Conditions on Germinability of Seeds of some Alpine Medicinal Plant Species

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ABSTRACT Seeds of some important high altitude medicinal plant species viz. *Rheum emodi*, *Aconitum violaceum*, *Nardostachys jatamansi*, *Polygonum rumicifolium* and *Polygonum amplexicaule* were stored in different storage conditions i.e. in polybag at 25°C, desiccator at 25°C and fridge at 4-6°C. Germination percentage of all the species decreased with the increasing storage period. Seeds of all the species stored in polybags at 25°C showed rapid loss of viability with increasing storage period, the seeds stored in desiccator at 25°C, and refrigerator at 4-6°C showed viability for long period. Seeds of *Rheum emodi*, *Aconitum violaceum*, *Nardostachys jatamansi*, *Polygonum rumicifolium* and *Polygonum amplexicaule* stored in fridge and desiccator lost 50% viability after 6, 4, 12, 4 and 6 months of storage respectively. In comparison to initial germination, 50% germinability of seeds was observed after 12, 6, 6 and 8 months of storage in seeds of *Rheum emodi*, *Aconitum violaceum*, *Polygonum rumicifolium* and *Polygonum amplexicaule* respectively at 4-6°C. Moisture content in stored seeds varies with storage condition as it increased in the seeds stored in polythene bag in comparison to the seeds stored in desiccator and fridge.

Keywords: Germination, storage temperature, seed viability and moisture content

Seed storage may influence seed viability and reduces seed vigour. The extent of the change depends on the time span and storage conditions i.e. temperature and humidity [1]. It is well known that storage environment affects seed longevity [2], many studies on accelerated seed viability loss have been reported [3], but less information is available about change caused by long term storage. All the selected species are of high pharmaceutical value and their demand is increasing in national as well as in international market. Thus to meet the ever increasing demand of high altitude medicinal plants as a raw material for herbal drug and cosmetic industries, there is an urgent need to cultivate these plants. Keeping this in view the present study was conducted to see the storage behaviour of seeds of some important high altitude medicinal plants under different storage conditions. This study can be helpful in finding out the appropriate method of seed storage to avoid the loss of seed viability in these species.

MATERIALS AND METHODS

Seeds of *Aconitum violaceum* Stapf, *Rheum emodi* Wall. ex Meissn, *Polygonum rumicifolium* Royle, *Nardostachys jatamansi* DC. and *Polygonum amplexicaule* D. Don were collected from alpine regions of Garhwal Himalaya (30°14'N, 79°13'E and 3600 m altitude) just before the onset of winter in the month of October. Seeds were dried in shade for one week and stored in (a) sealed polythene bag at 25°C (b) desiccator at 25°C and (c) refrigerator at 4-6°C. Seeds from all the storage conditions were tested for their viability at bimonthly interval till the complete loss of viability. Germinability was tested in Petri dishes with 100 seeds in 3 replication by using Whatman No. 1 filter paper at 25±3°C under 16h light 8h dark conditions and seeds were kept under observation for radicle emergence up to the maximum germination percentage. ANOVA was tested to determine the significance in germination percentage during their storage in different storage

conditions. Critical Difference (CD) was analyzed by using following formula

$$CD = SE \times t_{0.05}, SE = SD/\sqrt{n}$$

SE = Standard Error, SD = Standard Deviation

The method described by Moore [4] was used to determine the viability of seeds through tetrazolium staining, for which the seeds were soaked in distilled water for 24h. Then seed coat was removed and seeds were dipped in 0.5% solution of tetrazolium salt followed by incubation for 24h at 37°C in dark. Seeds having pink embryos were counted as viable.

RESULTS AND DISCUSSION

The data on per cent germination and viability of the seeds of the selected species at respective storage conditions are presented in figure 1. Data indicates the pattern of retention of viability and changes in moisture content with storage period in different species under varying storage conditions. It was observed that the percentage of viable seeds was little higher than the per cent germinated seeds and thus the data on germination have been given prominence in discussion below.

Seeds of *Rheum emodi*, which initially had 58% germination, retained more than 30% germination after 12 and 6 months of storage, respectively in frige at 4-6°C and polythene bag at 25°C, while the seeds stored at 25°C in desiccator showed 25% germination even after 12 months of storage. The seeds kept in frige (4-6°C) and desiccator (25°C) enhanced the life span of stored seeds two times than the seeds kept at 25°C in poly bags. Seeds stored in desiccator at 25°C showed nearly similar percentage of germination as observed in seeds stored in frige at 4-6°C.

Initial moisture content was 15% and germination was 86% in *A. violaceum* but after 6 months of storage in frige at 4-6°C and desiccator at 25°C, 43 and 30% germination was recorded respectively, while only 11% germination was observed in seeds stored in polythene bag at 25°C. Complete loss of viability was observed after 8 months in seeds stored in poly bag at 25°C. In this species, seed storage in polythene bag at 25°C is not advisable for more than two months as substantial loss of viability occurred between 2 to 4 months, which decreases from 59 to 15%.

In *N. jatamansi*, nearly 45 to 60% germinability was recorded after one year of storage in all the storage conditions studied, while initial germination was 83%. Seeds stored in frige (4-6°C) and desiccator (25°C) and polybags (25°C) showed 60, 50 and 45%

germination respectively after one year of storage. Moisture content increased by 2% in later conditions with respect to initial moisture content, which was higher enhancement in comparison to seeds stored in desiccator and frige.

Of all the species studied here, rapid loss of viability occurred in *P. rumicifolium*, in which 50% loss of viability was observed in seeds stored in cold (4-6°C), desiccator (25°C) and polythene bag (25°C) after 6, 4 and 2 months of storage respectively. Moisture content increases from 20.7 to 21.1% after 8 months in cold as well as desiccator. Loss of viability was faster at 25°C and gradual at 4-6°C, even after 4 months of storage only 5% seeds lost their viability in the latter condition but thereafter the loss was accelerated. Seeds of this species seem to be highly sensitive for storage and need further attempts to devise techniques for retention of seed viability for long period.

Seeds of *P. amplexicaule* showed more than 50% germination after 6 months of storage in refrigerator (4-6°C) and desiccator (25°C), while only 27% germination was observed in seeds stored in polythene bag (25°C) for the same storage period. Moisture content was around 13.5% (1.5% more than initial moisture content) at the time of total viability loss in all the conditions applied for storage.

The slow loss of viability in seeds stored at low temperature (4°C) was possibly due to reduced rate of metabolic activities and inactivation of enzymes, thus helping to retain seed viability [5]. Seeds stored in desiccator retain their germinability for longer period due to the facility of desiccation. However, the periodical opening and closing of the containers at higher temperature for sowing the seeds during the experimental period might have affected the storage atmosphere to a limited extent. Harrington [6] made generalization that orthodox seeds storage life is halved by each 5°C increase in temperature or by each 1% increase in (seed) moisture content. All the selected species seems to follow this rule as the increase in moisture content in the seeds stored in polybags at 25°C was comparatively high and loss of viability was also higher as well as earlier. ANOVA also indicates the significance of results described in the following para.

On the basis of ANOVA and Critical Difference (CD), variation in germination and moisture content were found significant in all the species except CD on germination data in *P. rumicifolium* in respect of increasing days of storage and different conditions of storage. Variation in germination during different

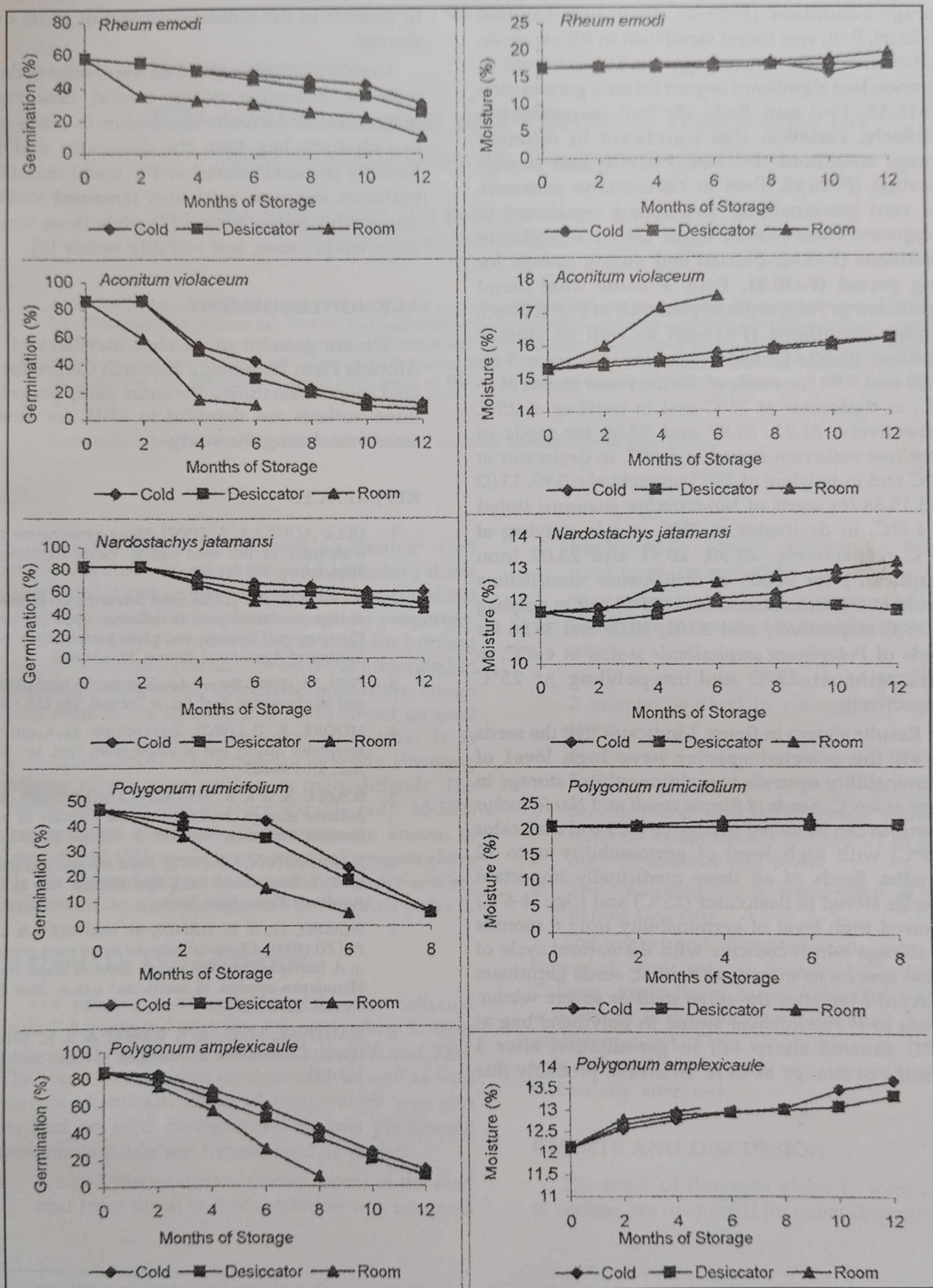


Fig. 1. Germination (%) and moisture content (%) of alpine medicinal plants during storage.

storage conditions ($F=31.49$, $P=0$) and duration ($F=23.09$, $P=0$) was found significant in *Rheum emodi*. In *Aconitum violaceum*, storage conditions as well as duration had significant impact on seed germination ($F=15.48$, $P=0$ and $F=56.35$, $P=0$ respectively). Similarly, variation was significant in different storage conditions ($F=11.60$, $P=0.001$) and storage duration ($F=40.48$, $P=0$) in *Nardostachys jatamansi*. Per cent germinability was found significant in *Polygonum rumicifolium*, when stored in different conditions ($F=5.92$, $P=0.02$) and during storage for long period ($F=30.41$, $P=0$). F value were found significant in *Polygonum amplexicaule* at $P=0$ for both storage conditions ($F=13.68$) as well as storage duration ($F=63.61$). CD values ($t=0.05$) were 9.46, 11.88 and 9.90 for seeds of *Rheum emodi* stored at 4-6°C, in desiccator at 25°C and in polybag at 25°C respectively; 31.21, 32.97 and 38.89 for seeds of *Aconitum violaceum* stored at 4-6°C, in desiccator at 25°C and in polybag at 25°C respectively; 9.99, 13.02 and 15.88 for seeds of *Nardostachys jatamansi* stored at 4-6°C, in desiccator at 25°C and in polybag at 25°C respectively, 23.30, 20.91 and 23.09 (non significant) for seeds of *Polygonum rumicifolium* stored at 4-6°C, in desiccator at 25°C and in polybag at 25°C respectively and 30.01, 30.05 and 38.86 for seeds of *Polygonum amplexicaule* stored at 4-6°C, in desiccator at 25°C and in polybag at 25°C respectively.

Results shown in figure 1 indicates that the seeds of all the selected species have high level of germinability upto six to eight months of storage in frige at 4-6°C. Seeds of *Rheum emodi* and *Nardostachys jatamansi* can be stored in frige (4-6°C) and desiccator (25°C) with high level of germinability upto 12 months. Seeds of all these medicinally important species stored in desiccator (25°C) and frige (4-6°C) showed high level of germinability upto 6 months of storage which coincide with the natural cycle of these species as in natural habitat, seeds germinate in April-May after the snow melt or severe winter. Seeds of *P. rumicifolium* stored in polythene bag at 25°C showed sharp fall in germination after 4 months of storage as in *A. violaceum*, probably due

to increase in the moisture content of seeds during storage.

Germination of seeds of all the species decreased with the increasing storage period, however, the magnitude of decrease was higher in seeds stored in polythene bag than the desiccator and frige. Possibly the seeds stored at 4°C could maintain an optimum moisture level thus remained viable for comparably longer period [7] while those stored at room temperature, lost viability earlier [8].

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