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RESEARCH ARTICLE

THE ROLE OF FRUIT COAT IN GERMINATION OF *PTEROCARPUS MARSUPIUM* SEEDS

***Maitreyee Kundu and Nimisha Chaturbedi**

Tropical Forest Research Institute, P.O. R.F.R.C., Mandla Road, Jabalpur 482021, M. P. India.

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ABSTRACT

Pterocarpus marsupium belonging to the family Fabaceae is distributed in deciduous forest throughout the India. Germination of fresh seeds was reported to be low due to their hard fruit coat. Experiments were conducted on the role of fruit coat in restriction of germination and to test whether the seeds have any physical dormancy. Imbibition test was performed to determine water uptake of seeds with intact fruit coat, scarified fruits, and extracted seeds. No significant difference in percentage increase in mass was observed between scarified and non-scarified fruits. Moisture content of fruit coat and seed of intact fruit and scarified fruit was determined during imbibition. Difference in moisture content of fruit coat and seed between intact and scarified fruits were found negligible. Therefore, the fruit coat is water-permeable and makes requisite water available to the seed for germination. However, highest germination of 100% was observed in extracted seeds, whereas 76.7% and 72.9% seeds germinated in scarified and intact fruit coat. The cause of variation in germination and ecological significance of hard fruit coat in regeneration of seeds in natural condition have been discussed.

INTRODUCTION

Pterocarpus marsupium (Family: Fabaceae) or Bijasal is a large tree that commonly grows in the central, western, and southern parts of India. It is a light-demander, tolerate shade, drought-hardy, fire-hardy species. Golden yellow flowers appear June to October. Pods, dark reddish brown in color, mature from February to May. The species has multiple uses. Its timber is moderately heavy; strong and hard; easy to saw and turn very durable. It is the most valued timber for constructional and furniture purposes after teak and rosewood (Kirtikar and Basu, 1999). Mixed with other species, it can be used in pulp for wrapping paper. Its bark, leaves and flowers have various medicinal uses. The bark gives an astringent, blood-red or ruby colored gum, known as Kino or Malabar Kino. Wood extract in water is believed to cure/control diabetes. *Pterocarpus marsupium* occurs in the greater parts of India from Gujrat, Mount Abu in Rajasthan, Bundel Khand in UP and MP up to Bihar and Orissa. *P. marsumium* is a tree of tropical and sub-tropical climates genenally growing on hills or undulating land between 150 to 500m and ascending to 900m (Luna, 1996). The natural regeneration of this species occurs through seeds. The fruit is samara having hard woody fruit coat. The germination percentage was reported to be low (Das and Chatterjee, 1993). This study investigates on the role of fruit coat in restriction of germination and to test whether the seeds of *Pterocarpus marsupium* (Bijasal) have any physical dormancy. The experiments were carried out in the laboratory of Seed Technology, Silviculture Division, Jabalpur, Madhya Pradesh. Mean annual temperature in this area of the study is 32°C and average minimum of 15°C and maximum of 42°C.

***Corresponding author: Maitreyee Kundu,** Tropical Forest Research Institute, P.O. R.F.R.C., Mandla Road, Jabalpur 482021, M. P. India.*

MATERIALS AND METHODS

Fully mature seeds were collected from 10 trees of *Pterocarpus marsupium* growing in the Mandla District of MP. Fruirs/pods from this mass collection pooled and stored in a sealed polythene bag at 15°C, until used in experiments.

Experiment 1

Seeds were treated in the following ways for enhancement of germination:

1. Non-scarified fruits- Intact fruits were allowed to germinate.
2. Scarified fruits- Fruits were cut at one side without any injury to the seeds.
3. Extracted seeds- Seeds were extracted from fruits before germination.
4. Seeds soaked in water for 24 hrs.- Seeds were soaked in water for 24 hrs. before germination.

Seeds were placed on blotted paper moistened with distilled water in 9-cm diameter glass petri dishes and kept in the laboratory at room temperature, 26-31^{0}C, 10-12h of natural light, supplemented by cool white fluorescent room light each day.

Experiment 2

Rate of water uptake were monitored for scarified and for non-scarified fruits. Three replications each of 100 were treated: 1) Non-scarified fruits 2) Scarified fruits. Fruits were placed on paper moistened with distilled water in 9-cm diameter glass petri dishes and kept in the laboratory at room temperature, 26-31^{0}C, 10-12h of natural light, supplemented by cool white fluorescent light. Initial (M_0) fruits mass was determined for air-dried fruits that had been wetted for 2 min, blotted dry, and weight was measured to the nearest 0.1 mg. Thereafter, seed mass was determined every 24 h upto 10 days following same procedure. Percentage water uptake was calculated as actual increase in seed mass based on seed mass.:

$\%M = [(M_1 - M_0)/ M_0] \times 100$,

where M = increase in mass of fruits, M_1 = mass of fruits/seeds after a given interval of imbibition, and M_0= Initial fruit mass.

Experiment 3

To determine the water uptake, another two sets of 100 seeds were placed on blotted paper sheets after following treatments: 1) Non-scarified fruits 2) Scarified fruits. Sampling was done after fixed intervals for three replications of 25 seeds. During each sampling, surface water of fruits was dried up with blotting paper and moisture contents of fruit coat and seeds of non-scarified and scarified fruits were estimated by drying at 103^{0}C for 17 hrs. Moisture content was estimated as percentage of fresh weight. Data were evaluated by ANOVA and application of least significant difference tests (LSD, P= 0.05) to test the significance of difference between means.

RESULTS AND DISCUSSION

Scarification i.e. cutting the fruits (pods) at one side showed germination of about 76.66%, whereas untreated fruits achieved only 72.83% germination. Extracted seeds did not show any problem in germination and 100 % seeds germinated within 5 days after germination. Soaking of seeds in water for 24 hrs reduced both the germination percentage and speed of germination in *Pterocarpus marsupium* seeds (Figure 1).

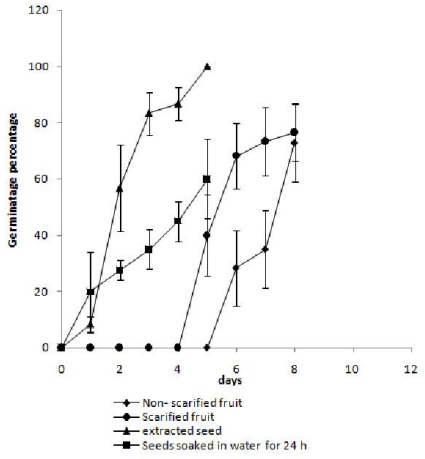


Figure 1. Time course for germination of seeds of *Pterocarpus marsupium*. Error bars represent ± standard error

There was no significant change in percentage increase in mass in scarified and non-scarified or control fruits (Figure 2). Fruit coat is hygroscopic and seed could get the water through the fruit coat. Extracted seeds also did not show any barrier to absorb water and percentage increase in mass was observed in imbibed condition. However, water intake was found more in seeds treated with 24-h soaking within 48 hrs of imbibitions, then it slowed down due to deterioration.

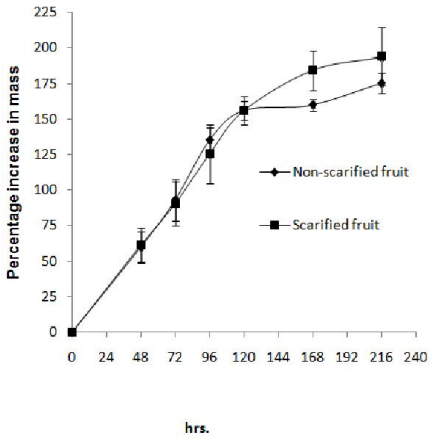
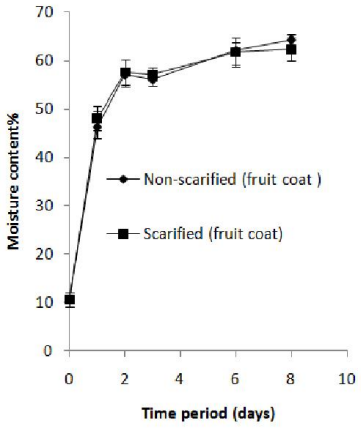


Figure 2. . Time course of increase in mass of fruits/seeds of *Pterocarpus marsupium*. Error bars represent ± standard error



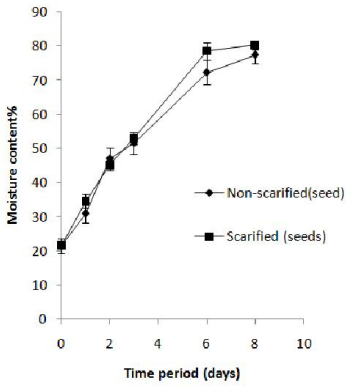


Figure 3. Changes in moisture content of fruit coat and seed in non-scarified and scarified fruits of *Pterocarpus marsupium*. Error bars represent ± standard error

In fact, germination procedure starts within few hrs of imbibitions of seed and prolonged imbibition period resulted in the death of the seeds. Figure 3 shows that no significant of changes were observed in moisture content of fruit coat and seed between the control and scarified fruits. Therefore the fruit coat is water permeable and made requisite moisture available to the seed for germination.

The fruit coat of the seed of *Pterocarpus marsupium* is very hard and woody. It is difficult to extract seed manually, even with the help of sharp razor. Bharmukh and Nikam (2008) studied the seed germination of *Pterocarpus marsupium* and reported that 30 min. scarification treatment with concentrated H_2SO4 is found fruitful to induce seed germination up to 85%. This suggests that some kind of physical dormancy exists in *Pterocarpus marsupium* seeds. In the present experiment it was observed that the fruit coat is hygroscopic. The moisture content of fruit coat was increased from 46% to 64% within 8 days of imbibitions in control seeds. Also water uptake capacity of the seeds in scarified and non-scarified fruits was nearly same. Therefore, the fruit coat does not impose any physical dormancy in *Pterocarpus marsupium* seeds, as both intact and scarified fruits imbibed water at similar rates and to similar final fresh weight percentages. Seeds having physical dormancy do not generally imbibe water. For example Perez *et al*. (2009) observed an increase in fresh weight in the scarified seeds of summer farewell (*Dalea pinnata*, Fabaceae) reaching 142% over an 8-h period compared with only a 12% increase when seeds were not scarified. The seeds of this species was considered as physically dormant. On the other hand fresh weight increased in similar manner in intact and scarified seeds of two *Polygonella* spp, that suggested non-existence of seed-coat dormancy in these species (Heather *et al*., 2010). However the germination capacity of extracted seeds exceeded than the seeds of scarified and non-scarified fruits. The difference was not due to the barrier imposed by the hard fruit coat . Instead, it was noted the difference in germination percentage will be negligible, if the empty, rotten and ill-developed seeds in the fruits were considered (data not shown).

The ecological significance of hard but hygroscopic fruit coat may be due to the fact that the fruits/pods of this species mature during February-March and disperse with the help of wing. But they have to wait till rain appears in June-July for germination and survival. The woody fruit coat helps the seed to save it from deterioration, predation and insect and fungal attack during this period till the seed gets enough moisture from rain that enable the germination procedure to start. In this case, germination largely depends on the absorption of water by the fruit coat. So availability of water is responsible for seedling emergence. Poor supply of water to fruit coat may result in decrease in germination percentage and ultimately in low regeneration capacity of seeds.

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