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# STANDARDIZATION OF STORAGE CONDITIONS TO PROLONG VIABILITY OF SEEDS OF *Artocarpus heterophyllus* Lam- A TROPICAL FRUIT TREE

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**ABSTRACT**

Recalcitrant seeds are desiccation and chilling sensitive and are viable for a very short period. Seeds of *Artocarpus heterophyllus* being recalcitrant in nature pose storage problems. The present study was taken up to identify methods to prolong seed viability of the species. Seeds were stored at four different temperatures: Ambient (25 ± 2˚C), 20˚C, 15˚C and 0 ± 2˚C and subjected to germination tests at the end of 1, 2, 3, 4 and 5 weeks of storage. Seeds stored at 20˚C retained viability for 5 weeks with 41% germination. Experiments to store seeds with and without bulb revealed that seeds should be extracted from the bulb to ensure effective storage. The viability of seeds can be prolonged to 32 weeks (with 48% germination) when stored at 20˚C.

**Keywords:** seed viability, *artocarpus heterophyllus*, fruit tree, storage, recalcitrant, edible, bulb.

## INTRODUCTION

Seeds of several tropical fruit crops show recalcitrant storage behaviour. The seeds do not withstand drying or are unable to survive low temperatures during storage. Thus, they are difficult to store for longer period [1, 2]. The exact causes of recalcitrant seed death and its relationship with moisture content are not fully understood [3]. It is stated that loss of viability could be either due to the moisture content falling below a certain critical value or simply a general physiological deterioration with time [4]. It is also noteworthy that several pre-harvest factors determine the longevity, like cumulative effect of environment during seed maturation, harvesting, drying and the pre-storage environment, time of seed harvesting, duration of drying and the subsequent period before seed is placed in store [2].

Existing thrust for germplasm conservation emphasizes quest for storage techniques, especially the short viable recalcitrant seeds. Germplasm can be conserved in several ways; however, conservation in the form of seeds has many advantages as it is simple to use, easy to handle, practicable, inexpensive and capable of maintaining genetic stability during storage [5].

The jackfruit, *Artocarpus heterophyllus* Lam., is an evergreen tree belonging to the family Moraceae. The species is indigenous to the rainforests of the Western Ghats of India. Although it comes up well at altitudes of 450-1200 m, it is also being cultivated at low elevations and hotter parts throughout India [6]. In South India, jackfruit is a popular fruit ranking next to mango and banana in total annual production. There are more than 100,000 trees in homesteads and grown for shade in betel nut, coffee, pepper and cardamom plantations. The total area under jack cultivation throughout India is approximately 26,000 ha.

Jack is monoecious in nature. In India, a good yield is 150 large fruits per tree annually. Jackfruits turn brown and deteriorate quickly after ripening. The fruits contain about 100-500 oval seeds [7]. Seeds are large, oblong about 3 × 2 cm in size having thick gelatinous yellow covering and belong to recalcitrant group [8].

Seed propagation is the most common method of reproduction practiced [9]. The seed viability of the species has been reported as 14 days [10]. The need for prolonging the viability of *A. heterophyllus* seeds gains attention both on the basis of being a recalcitrant species and for the purpose of germplasm conservation. Hence the aims of this investigation were: (1) to confirm the existence of recalcitrant storage behavior of the seeds (2) to observe if this behavior could be overcome through control of the external environment (temperature and moisture) and (3) to assess the effects of the bulb on storability of the seeds.

## MATERIALS AND METHODS

### Collection and processing

Fruits of *A. heterophyllus* were collected from Kolli Hills, Tamilnadu. Random sampling was followed during collection. Ripe fruits were split open and bulbs were peeled out manually. Seeds were extracted from the bulbs after removing the thin leathery sheath wrapping the seed. Extracted seeds were washed and surface dried at room temperature (25 ± 2$^{o}$C) under shade and used for the study.

### Moisture content and germination test

Initial moisture content and germination percentage were tested as per the ISTA rules [11]. Germination study was conducted in the nursery on sand medium. Germination was complete after 45 days of sowing.

### Storage studies

Freshly collected and completely cleaned seeds were stored at four different temperatures namely ambient

(25 ± 2 °C), 20 ˚C, 15 ˚C and 0 ± 2 ˚C in air-tight plastic jars. The viability of the seeds was tested at weekly intervals for five weeks.

To compare the storability of seeds with and without the retention of the bulb, another trial was conducted. This experiment was designed to study the role of fleshy edible fruit (bulb) portion covering the seed, on the viability of seeds. Both seeds with and without bulb were stored at 20 ˚C in plastic jars. The seeds were subjected to germination test after 12, 14, 16, 24 and 32 weeks of storage.

**Statistical analysis**

All the experiments were carried out in randomized block design with four replications of twenty-five seeds each. The germination percentages were transformed to arc sine values and tested for significance [12].

**RESULTS**

The moisture content of fresh seeds was 56.34% with 88 % germination. Initiation of germination was noticed after 15 days of sowing. Effect of temperature on storability of *A. heterophyllus* seeds (Table-1) reveals that under ambient (25 ± 2°C) conditions seeds lose their viability drastically from 88% initial germination to 53% within one week of storage. The germination percentage diminished to 17 and 16% after two and three weeks of storage respectively under ambient conditions.

Storing seeds at 15 and 20˚C showed better results when compared to ambient storage (Table-1). *A. heterophyllus* seeds stored at 20˚C gave promising results up to five weeks time. A linear reduction in germination was observed over a period of five weeks. Seeds stored at 15˚C remained viable for two weeks while low temperatures (0 ± 2˚C) were deleterious to the seeds.

**Table-1.** Effect of storage temperature on germination of *Artocarpus heterophyllus.*

| **Treatment** | **Germination** (%) | | | | |
|---|---|---|---|---|---|
| | **I week** | **II weeks** | **III weeks** | **IV weeks** | **V weeks** |
| Ambient (25 ± 2 ˚C) | 53 (46.8) | 17 (23.2) | 16 (23.1) | 0 (0) | 0 (0) |
| 20˚C | 47 (43.3) | 48 (43.9) | 40 (39.2) | 39 (38.6) | 41 (39.8) |
| 15˚C | 43 (40.9) | 42 (40.3) | 28 (31.6) | 0 (0) | 0 (0) |
| 0 ± 2˚C | 0 (0) | 0 (0) | 0 (0) | 0 (0) | 0 (0) |

Values in parenthesis are arc sine values.

| | **SEd** | **CD** |
|---|---|---|
| Temperature | 1.323 | 2.648 |
| Storage period | 1.479 | 2.961 |
| Temp. x Storage period | 2.957 | 5.922 |

Experiments on storage of seeds at 20˚C with and without bulb showed that seeds stored without bulb was found to be better than with bulb storage (Table-2). The moisture content of both the seeds was 39.8%. Germination tests after 12, 14, 16, 24 and 32 weeks storage period showed that seeds without bulb consistently gave better germination. On the other hand the seeds stored with bulb showed only 13% germination after 12 weeks storage and completely lost the viability after 24 weeks storage.

**Table-2.** Effect of seed extraction on storability of *Artocarpus heterophyllus* at 20˚C.

| **Treatment** | **12 weeks** | **14 weeks** | **16 weeks** | **24 weeks** | **32 weeks** |
|---|---|---|---|---|---|
| Seed without bulb | 54 (46.7) | 62 (51.9) | 52 (46.2) | 50 (45.0) | 48 (43.8) |
| Seed with bulb | 13 (18.1) | 3 (5.3) | 16 (17.0) | 0 (0) | 0 (0) |

Values in parenthesis are arc sine values.

| | **SEd** | **CD** |
|---|---|---|
| Treatment | 2.76 | 5.66 |
| Storage period | 4.36 | 8.95 |
| Treatment x St. period | 6.17 | 12.65 |

## DISCUSSIONS

The moisture content of fresh seeds was very high (56.34%) with 88 % germination. The reports are similar to the earlier studies conducted [13], wherein fresh *A.* heterophyllus seeds germination was observed to be 80% without any pretreatment. This is a characteristic feature of recalcitrant seeds, which are shed from parent plant with high moisture content ranging from 30 to 70% [4].

Variations in temperature affected the storability of *A.* heterophyllus seeds. Ambient (25 ± 2°C) conditions were not conducive for the storage of seeds for more than three weeks. Seeds stored better at 15 and 20 ˚C. Reports are available by various other researchers using different methods to control temperatures and maintain the lowest safe moisture content (LSMC) of recalcitrant of seeds. 40% germination was obtained in Mango stones after 90 days of storage at 25°C in polyethylene bags with charcoal powder while those stored at lower temperatures (8°C) did not germinate [14]. In the present study, *A.* heterophyllus seeds stored at 20˚C gave promising results up to five weeks time. A linear reduction in germination was observed over a period of five weeks. Seeds stored at 15˚C remained viable for two weeks while low temperatures (0 ± 2˚C) were deleterious to the seeds. It has been reported that temperatures well above 0 ˚C are able to induce total loss of viability in several species like mango (5-10˚C) [15], mangosteen (10˚C) [16] and rambutan (6˚C) [17]. From the observations it could be concluded that *A.* heterophyllus seeds could not withstand freezing temperatures suggestive of their recalcitrant nature.

Seeds stored with the bulb were also found to be highly susceptible to fungal attack which could be one of the reasons for poor germination of the seeds. This could be overcome by the use of fungicides. Earlier studies suggest that jack seeds can be preserved in fruit for 32 days with 58% germination and 72 days with 6% germination following fungicidal treatment [18]. Storage of Litchi chinensis fruits was found to retain the seed viability for 24 days in sealed polyethylene bags after treatment with the fungicide Benomyl (0.05%) and 6% wax emulsion [19].

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