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# Influence of seed moisture and storage conditions on seed quality parameters in bael

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**Abstract**

Viable seeds of bael (*Aegle marmelos* L.) are essentially required for raising rootstocks and propagation. The effect of seed moisture at various levels and their relationship with some physiological parameters was studied in bael. The overall result depicted conversely, less moisture contents (2 and 5%) in seeds influenced more germination percentage and vigour index under all conditions of storage that high moisture (10%) level in seeds which have been stored for three years at all storage temperatures have significantly influenced least survival rates. The electrical conductance and UV-absorbance were low with less moisture level in seeds. The importance of seed moisture and storage conditions is discussed in the paper.

**Key words:** *Bael, seed germination, vigour index, storage conditions, electrical conductivity, total proteins*

## Introduction

*A. marmelos* commonly known as bael is an important drought hardy plant commonly found in the arid and semi-arid tracts of the country. Although whole tree is considered medicinally important the fruits are specially used in Ayurvedic drug i.e, Rasayana. Seed germination, seedling vigour and slow growth of bael plants have been the problem under adverse environmental conditions. In order to formulate suitable seed treatment strategies for enhancing germination and further growth it is essential to have the basic information with reference to seed physiology under variable storage conditions. Seed longevity is mainly influenced by the environmental conditions such as storage temperature (which affects the rate of biochemical activities), moisture content of the seed and oxygen pressure. It has been generally observed in most of the crop species that generally cooler and dry conditions can prolong the life span of the seeds, while the ultimate effect of adverse environmental conditions is seed deterioration which causes the loss of viability and vigour. In the tropical and sub tropical conditions, under high ambient relative humidity, the seed take moisture from the environment resulting in high ambient temperature, hereby leading seed deterioration. It is therefore, necessary to develop appropriate storage regimes for the maintenance of quality seeds. Therefore, establishment of such methodology for this medicinal and fruit crop *Aegle marmelos* was the aim of present investigation and the results are discussed research work.

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## Materials and methods

Physiologically mature seeds of bael were received from Jawahar Lal Nehru Medicinal Plants Garden and Herbarium, Kothrud Pune, for long term conservation in the National Gene Bank at National Bureau of Plant Genetic Resources, Pusa Campus, New Delhi. The samples were processed and conserved at the National Gene Bank. The remaining seed samples were used for the present investigation. Small seed lots were prepared and conditioned to maintain different moisture contents of 2%, 5% and 10% using desiccants. To attain the moisture content of 2%, the seeds were kept in a dessicator containing sulphuric acid for ten days whereas, to achieve the moisture content of 10%, the seeds were kept in desiccator having water at 25°C for 2 days. However, to attain the moisture content of 5% the seeds were kept on silica gel in a dessicator. All the seed samples were subjected to long term (LTS), medium term (MTS) and ambient (AMB) storage at -20°C, 0°C and 25 ± °C respectively. Various physiological and biochemical parameters were studied in these conditioned and three year old naturally aged seed sample.

### *Germination percentage*

Twenty five seeds of each accession were placed for germination using the towel paper methods. This was done in four replications and incubated in a seed germinator maintained at a constant temperature of 30 ± 2°C. Seeds were considered as germinated after the emergence of radicle (1mm). The germination percentage was calculated after 15th day of incubation. (ISTA,1993).

### *Seedling vigour*

In this experiment 10 seeds were planted between towel papers and kept in the vigour stands which were maintained

at a constant temperature of 30°C in a germinator for 15 days. The root length and shoot length were recorded on 15th day and mean of ten seedlings was taken into consideration for accessing the vigour index.

***Vigour index***

Vigour index was calculated as the product of seedling vigour (root + shoot length) and germination percentage by following the formulae described by (Abdul Baki and Anderson, 1973).

Vigour Index = Germination% x Seedling length

***Leachate conductivity***

Ten seeds were weighed and soaked in 25ml of deionized water at 20°C for 16 hours. The electrical conductance was determined with a digital conductivity meter at cell costant of 1. The UV absorbance of the leachate was recorded at 264 nm and 280 nm (Table 2).

***Protein estimation***

Two gram seeds from each treatment were ground to fine powder and defatted for two days using chloroform, acetone and methanol mixture ( 2:1:1). The proteins were extracted from the defatted dry powder (10 mg) with 0.5 ml of phosphate buffer (pH 7.0) , mixed thoroughly and then centrifuged at 12000 rpm for 15 min. Supernatant was used as a source of protein and the results were expressed in terms of µg $g^{-1}$ of seeds. Protein content in each sample was estimated using Lowry's Folin test method (Lowry, *et al.*, 1951). Data from all the experiments were analyzed statistically using MSTAT software.

## Results and discussion

***Seed germination***

Freshly harvested seeds exhibited maximum germination potential but when the storage period was increased they lost vigour and eventually the ability to germinate as compared to initial stage.

In present study bael seeds in all storage conditions at high moisture content (10%) resulted in significantly low level of germination compared to the less moisture contents of 5% and 2%. The germination percentage decreased from 100 to 80 % at lower moisture content (2% and 5%) in comparison to control (Table 1 and 2). Whereas at higher moisture content (10%) the decrease was tremendous (30%) at all the storage conditions ( Table 2). Incase of other crops increased rate of seed deterioration has been reported in many orthodox species (pea) stored above and below the optimum moisture content at which maximum viability was observed (Vertucii and Roos, 1990) and Vertucii *et al.* (1994). In addition, increased aging rates have been noted in very dry and moist seeds stored at a high temperature (Hu *et al.*,1998). The present study also supports the same trend in *A. marmelos*.

**Table 1.** Various physical parameters in untreated seed

| Physical parameters | Units |
|---|---|
| Weight of 20 seeds (gm) | 1.18 |
| Initial moisture (%) | 4.0 |
| Germination (%) | 100 |
| Vigour Index | 1720 |
| Electric conductivity (µS $g^{-1}$ $ml^{-1}$) | 0.57 |
| O.D of leachate at 264 nm | 0.511 |
| O.D of leachate at 280 nm | 0.036 |

**Table 2.** Physiological and biochemical parameters of bael seeds in different storage conditions three year old seeds of *Aegle marmelos*

| Storage conditions/ (Moisture%) | | Germination percentage | Vigour Index | Electrical conductivity (µS $g^{-1}$ $ml^{-1}$) | UV Absorbance (at 264 nm) | Protein Content (µg $g^{-1}$ seed) |
|---|---|---|---|---|---|---|
| LTS (-20°C) | 2 | 100 | 1093 | 0.079 | 0.547 | 620 |
| | 5 | 81 | 1037 | 0.077 | 0.626 | 540 |
| | 10 | 29 | 516 | 0.176 | 0.862 | 540 |
| MTS(10°C) | 2 | 100 | 990 | 0.079 | 0.674 | 800 |
| | 5 | 90 | 897 | 0.077 | 0.697 | 500 |
| | 10 | 30 | 447 | 0.185 | 1.097 | 80 |
| AMB(25±5°) | 2 | 99 | 966 | 0.077 | 1.121 | 840 |
| | 5 | 80 | 888 | 0.044 | 1.220 | 450 |
| | 10 | 29 | 222 | 0.199 | 1.533 | 20 |
| Control | 2 | 97 | 1102 | 0.078 | 0.547 | 705 |
| | 5 | 80 | 1095 | 0.078 | 0.584 | 680 |
| | 10 | 79 | 995 | 0.078 | 0.574 | 700 |
| C D at 5% | | | | | | |
| Storage condition (A) | | 3.52 | 97.59 | 0.018 | 0.84 | 32.13 |
| Moisture content (B) | | 1.84 | 47.51 | 0.001 | 0.04 | 29.71 |
| AXB | | 3.69 | 95.01 | 0.015 | 0.07 | 59.42 |

LTS –Long term storage; MTS-medium term storage ; AMB- ambient temperature.

***Vigour index***

Loss of vigour is associated with seed deterioration. Loss in seedling vigour is reported to produce with loss of seed viability in a number of crops (Dey and Basu, 1982; Yadav *et al.*1987; Dharamlingam and Basu, 1990). In present studies decline in seedling vigour index proceeded with reduction in germination which is in conformity with the earlier results of Raghuveer Rao (1988). In *A. marmelos* maximum vigour index was observed at 2% moisture and stored under –20°C. In general it was observed that lower storage temperature and lower moisture content maintained good vigour and viability in comparison to ambient storage condition (25-28°C) and high moisture (10%) level

***Electrical conductivity***

Cell membrane is the most important site of a seed which appears to be adversely affected by seed deterioration or ageing (Ching and Schoolcraft, 1968, Harman and Mattick: 1972). Degradation changes in cellular membranes are some early events of seed ageing (Heydecker, 1972), it enhances solute leakage from imbibed seeds resulting in loss of viability and seed vigour ( Dadlani and Agrawal, 1985a). The increase in electrolyte leakage was associated with reduction in germination and vigour index under different storage conditions and various moistures levels . These results are in agreement with reports of Halder *et al.* (1981).The amount of seed leachate was positively correlated with increasing moisture content. In *A. marmelos* maximum electrolyte leakage was observed at 10 % moisture content and ambient storage condition. Therefore, it is essentially required to conserve the bael seeds under suitable conditions to maintain the seed viability.

***UV Absorbance of Leachate***

Results presented in the Table 2 demonstrate a positive correlation of UV absorbance at 264 nm and 280 nm under different storage conditions in *A.marmelos.* At 264 nm and 280 nm the minimum value was observed in the sample stored at –20 °C and 2% moisture content, whereas the ambient storage condition with 10% moisture content resulted in maximum absorbance of 1.530 in case of *A.marmelos.*

***Total seed protein***

Estimation of total seed protein content showed significant difference with respect to seed moisture content. Maximum seed protein content (840 µg $g^{-1}$ seed) was observed at 2% moisture level and stored at –20°C, whereas with increase in moisture content (10%) and stored at ambient conditions showed a gradual decline in total seed protein content (20 µg $g^{-1}$seed) .However, it was observed that this decrease was minimized from 620 to 540 µg $g^{-1}$ seed when the same moisture content of the seed lots were stored at lower temperatures of -20°C in *A. marmelos.*

It can be concluded from the above study that lower seed moisture favours high germination and seedling vigour when compared to high moisture content of the seeds. The best storage conditions for *A. marmelos* are low moisture content of 2-5% and storage temperature of 5 and -20°C for extending the seed longevity. Therefore, *A. marmelos* confirms to be an orthodox seed.

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