



Research Article

Critical moisture level for seed viability in jackfruit (*Artocarpus heterophyllus* Lam.)

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Abstract

Jackfruit (*Artocarpus heterophyllus* Lam.) seeds are recalcitrant in nature. Hence, loss of seed viability in short period during storage imposes a problem in seed germination. Softwood grafting method is standardized for rapid multiplication. However, due to recalcitrant nature the availability of rootstock for grafting throughout the year is the main constraint. Hence, an experiment was undertaken during the year 2017-18 to study the critical moisture loss percentage for viability of jackfruit seeds under ambient storage condition at College of Horticulture, Mulde Tal. Kudal, Dist. Sindhudurg. Hundred seeds per treatment were stored under ambient storage condition for 15, 30, 60, 90, 120 and 150 days. In the present study, maximum germination percentage (53.25 %) was recorded with minimum water loss (18.51 %) when jackfruit seeds stored at 15 days storage period. The linear regression equation $\hat{Y}$ moisture loss = $43.68 - 0.49X$ with R^2 value of 0.97 explained the rate at which the germination percentage was lowered against percent loss of water. The study revealed that the 43.68 percent moisture loss was critical moisture level beyond which germination could not occur.

Keywords germination, jackfruit seeds, moisture, recalcitrant, seed viability

Introduction

Jackfruit (*Artocarpus heterophyllus* Lam.) is a native fruit of India and it is preferred in homesteads as a shade tree or a mixed crop. It is estimated that about 1.53 lakh hectare area is covered by this crop with production of 17.22 lakh tones in India [1]. At present, soft wood grafting technique is being followed for production of jackfruit grafts. However, graft production is limited due to lack of availability of the rootstock year round. Loss of viability of jackfruit seeds due to recalcitrant nature imposes a problem in getting seedlings year round. The recalcitrant seed have a characteristic feature that they require the moisture levels above some critical value. If water reaches below this level then the seeds lose the ability to germinate. The recalcitrant behavior of jackfruit has been studied by several researchers [2-4]. Loss of viability may be either due to the moisture content falling below a certain critical value or simply a general physiological deterioration with time [5]. Jackfruit is such kind of perennial species where storage of seeds is a constraint. Hence, research on optimal storage condition for this species needs to be under taken by conducting logical experiments. Thus, investigation on seed viability

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against moisture loss under ambient storage condition was undertaken.

Methodology

The investigation was undertaken at College of Horticulture, Mulde Tal. Kudal, Dist. Sindhudurg during the year 2016- 17. The experiment was conducted under ambient storing condition i.e. at temp. ($32^{\circ}\text{C} \pm 2^{\circ}\text{C}$) for period of 15 days, 30 days, 60 days, 90 days, 120 days and 150 days. Hundred seeds per treatment were considered as a unit.

Table 1. Moisture loss and germination percentage observed under different Storage period at ambient temperature storage

Storage Method	Storage Period (days)	Moisture loss (%)	Germination percentage (%)
Ambient Temperature	15	18.51	53.25
	30	28.15	29.00
	60	36.29	9.50
	90	43.07	0.00
	120	45.36	0.00
	150	45.39	0.00
$\hat{Y}$ critical moisture = $43.68 - 0.49X$ $R^2 = 0.97$			

Fresh seeds from ripe soft flesh type fruits were collected and healthy cleaned seeds weighing more than 3 g were treated with Carbendazim (50 % WP @ 2 g/L) for 5 minutes. After treatment, seeds were kept for surface drying under shade for three hours at room temperature (32°C) to remove moisture. Such seeds were used to expose treatments as suggested by Doijode [6]. The seeds were stored after taking initial weight and at this stage seeds were having moisture content of 40.82 per cent. Final weight of stored seeds was recorded after completion of storage period that is 15, 30, 60, 90, 120 and 150 days. Seeds were sown in the black polythene bag of 200 gauges of size 15 x 20 cm containing soil and FYM in 3:1 proportion. Polybags were kept in polyhouse for germination. Watering was done immediately after sowing the seeds and then after every day light irrigation for each polybag was given till the seedling emergence.

The germination for all 100 seeds in treatment was observed at every alternate day from the first germination until no further seeds germinated.

Per cent loss in seed weight (moisture loss) was calculated by using the formula as given below.

Per cent loss in seed weight (%)

$$= \frac{\text{Fresh weight during storage} - \text{Final weight during sowing}}{\text{Fresh weight during storage}} \times 100$$

Germination percentage was calculated by dividing the total number of germinated seeds to the total number of seeds sown and multiplied by 100 as given below.

Germination percentage (%)

$$\frac{\text{No. of seeds germinated}}{\text{Total number of seeds sown}} \times 100$$

In the present investigation, the constants of polynomials was worked out on SPSS statistics 17.0 program and the level of R^2 was fixed as 0.80 and fitting was done in such a way that lowest possible degree of polynomial was obtained with $R^2 > 0.80$.

Results and Discussion

Critical moisture level for germination of jackfruit seeds

The recalcitrant seeds require the moisture levels above some critical value. If water reaches below that level then the seeds become nonviable and lose the ability to germinate. According to Chin et al., [5] loss of viability may be either due to the reduction in the moisture content below a certain critical value or simply a general physiological deterioration with time. In current investigation, the seeds of jackfruit were subjected to six treatments of storage period during which they expected to lose moisture at various level. This provides an opportunity to ascertaining the critical magnitude of moisture loss beyond which the seed loose viability.

Data regarding moisture loss (%) and germination observed at different storage period under ambient temperature condition and the polynomial fitted on periodic observations on germination percentage are presented in Table 1 and illustrated in Figure 1 and Figure 2.

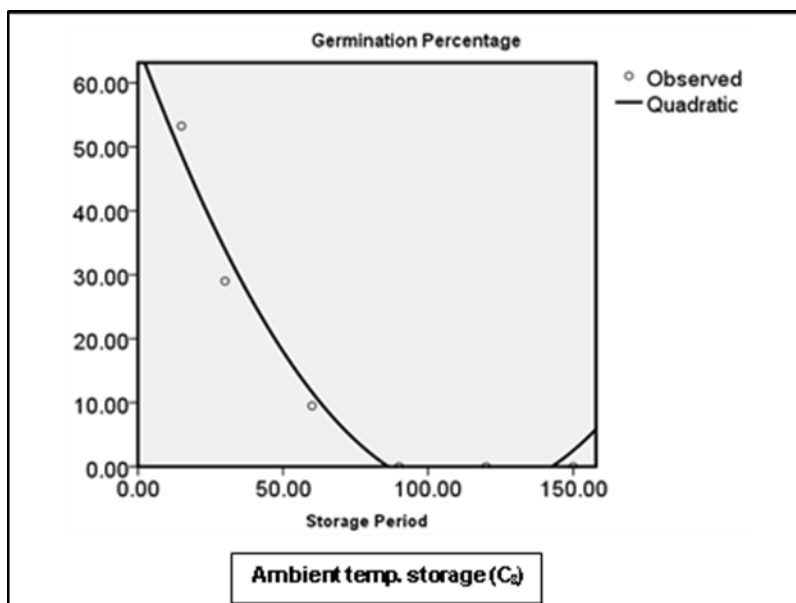


Figure 1. Polynomial observed on germination percentage of jackfruit seed at ambient storage period

The seeds kept at ambient temperature condition exhibited 53.25 per cent germination when stored for 15 days. During this period there was a loss of water by 18.51%. Under 30 day stored period water loss was 28.15 per cent contributing germination of only 29.0 per cent. Under 60 days storage period the water loss was 36.29 per cent under which hardly 9.5 per cent germination was noticed. With further prolongation of storage period the ability to germinate was totally lost and per cent water loss was also increased. This particular data was subjected to linear regression analysis. The present findings were similar to those observed by Shanmugavelu [7] and Shivalingam et al [8]. Around 80 per cent and 52 per cent germination was observed in fresh jackfruit seeds and *Embelia ribes* [7, 8].

The linear regression equation $\hat{Y}_{\text{moisture loss}} = 43.68 - 0.49X$ with R^2 value of 0.97 explained the rate at which the germination percentage was lowered with per cent loss of water. The interpolation of the value of water loss against germination per cent revealed that at 43.68 per cent loss of water,

the germination became zero. In other word, it can be stated that if the loss of water in seeds is beyond 43.68 per cent, the germination of jackfruit seed is completely lost. Hence, based on our results, 43.68 per cent water loss can be considered as the critical value beyond which germination cannot occur. While studying the critical water content in jackfruit seeds, it was observed that critical water content status represents the loss of free bound water which slowed

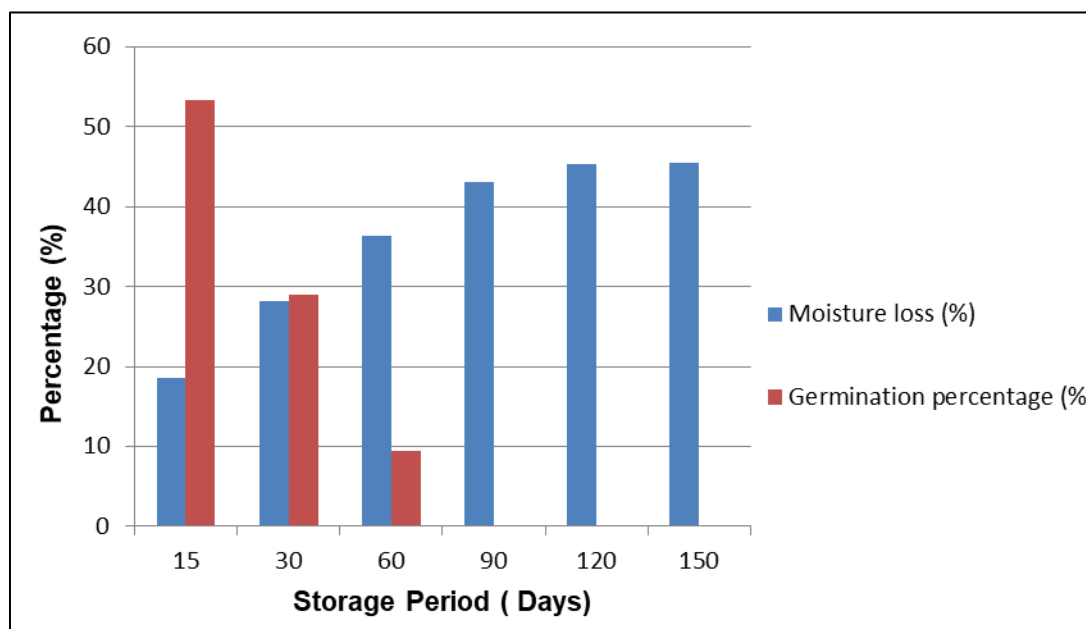


Figure 2. Graphical presentation of moisture loss and germination percentage against storage period at ambient temperature in jackfruit seed

down the cell metabolism resulted in controlling seed deterioration and viability rate [3]. The findings of Abbas et al., [9], Sheela [2] and Anandalakshmi et al., [10] conducted in jackfruit support the findings of the present study. However, 39 per cent was the critical seed moisture content for jackfruit at which 93 per cent germination was observed in the study conducted by Krishnasamy [11].

In current investigation, the conventional practice like mud coating, cow dung coating and seed storage in earthen pot or in polybag could not prevent the loss in the ability to germinate. This is obviously because of the inability of methods to prevent the water loss. However, when the seeds were kept either in screw cap bottle or in polybag kept in screw cap bottle or in earthen pot (buried in soil), it showed very promising results and could maintain the viability of seed even up to 150 days. This appears to be a simple phenomenon of preventing the water loss to a considerable extent so that it is kept away from critical value of 43.68 per cent. The highest germination percentage of jamun seeds (99.1%) at moisture content (60%) and further reduction in seed moisture content showed significant loss in viability depicting the recalcitrant storage behavior [9].

The current investigation has revealed that under ambient temperature the germination percentage was lost over the course of storage up to 150 days and this was primarily due to loss in moisture content. This phenomenon was quite predictable. The critical point estimated by interpolation of linear equation revealed that when per cent moisture loss of the seed reaches up to 43.68 per cent then the ability to germination was completely lost.

Conclusion

It can be concluded that jackfruit seeds could be stored only up to 15 days under ambient temperature which recorded 18.51 per cent water loss and 53.25 per cent germination. If the loss of water in seeds is beyond 43.68 per cent, the germination of jackfruit seed is completely lost.



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