Scholars Academic Journal of Biosciences (SAJB) **ISSN 2321-6883 (Online)**
Sch. Acad. J. Biosci., 2014; 2(12B): 909-912 **ISSN 2347-9515 (Print)**
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Research Article

Mutual Effect of Drying on Jackfruit (*Artocarpus heterophyllus* Lamk.) Seed Viability to Water Critical Level for Storage Indicator

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Abstract: Deterioration of Jackfruit seed is rush, and it is causing difficulty to store large quantities and or long transport of the seeds. This study objective was to examine the biochemical and physiological aspects of jackfruit seed when it has been deteriorated. The decreasing effect of water content on the seed viability was studied by air drying the seeds namely for 0,1,2,3,4 and 5 hours with three replicates and arranged in a completely randomized design. Seed water content, total viability, potential viability, vigor strength, respiration rate and membrane leakage were measured to determine the effect of jackfruit seed deterioration. The results showed that jackfruit seeds were highly recalcitrant because the viability potential was reduced 50 % with water content of 60.39 %, this recognized as critical water content level, only after 4 hours of air drying.
Keywords: critical water content , recalcitrant seeds , viability

INTRODUCTION

Jackfruit is a tropical well known fruity tree which its seed categorized as recalcitrant seeds. Recalcitrant seeds are often characterized by large size, sensitive to desiccation, low shelf life, high water content, thickness of pulp, untolerant to temperature and low humidity, and sensitive to drying [1-3].

Jackfruit seeds have no dormancy period, low shelf life and sensitive to environmental changes during storage, it must be immediately sown after removal from the fruit (the pulp). This is the main constrain if seeds should any delay either to be stored or distributed for the f generative and vegetative propagation purposes.

Physiological weakness of recalcitrant seeds that sensitive to drying is the inability of cell organelles to recovery (recovery and repairing mechanism) that is deformed by decreasing of the seeds water content [4].

If the moisture content of recalcitrant seeds is not reduced then the seeds will germinate during the storage period and fungi may attack in such condition seeds are sensitive and with continue of thisseeds metabolism process the sensitivity to drying will increase. Recalcitrant seed viability can be maintained if it is stored in optimum condition, however can keep up to a few weeks or months only [5].

The decrease of jackfruit seed viability as a result of a decrease in water content levels because of drying duration have not been well studied yet, so there was hardly information on drying duration of jackfruit seed to reach critical water content level whereas the seed can stay in good viability for better seed storage. The specific purpose of this study was (A) to investigate the mutual effect of seed drying duration on physiological and biochemical aspects of the seeds (B) to determine on water seed critical level as a reference for storage and provide high quality of seeds

METHODOLOGY

Drying DurationTreatment

Jackfruit of Tulo cultivar from Tulo Village of Central Sulawesi, Indonesia, was used as a seed source, seeds were manually extracted from the fruits and collected, then thoroughly washed and dried (air dried) for 0,1,2,3,4 and 5 hours at daily average temperature was 28º C and 70 % of humudity.

Measurement of Water Content, Seed Viability Test, respiration rate and Electrical Conductivity

Measurement of water content on every drying duration and seed viability test based on ISTA method. Seed viability test consists of total viability measuring based on maximum growth potential, the potential viability based on germination ability and vigor strength based on growth rate whereas performed in a sterile sand medium for 14 days. Respiration was measured by titration method and electrical conductivity of each treatment was measured by conductivity meter in the soaking water of the seeds.

Statistical Analysis

This study used a completely randomized design (CRD) with single factor that was drying duration seed (T). Data were analyzed using analysis of variance (ANOVA). HSD test (honestly significant differences) of 5 % will be used to test the significance between treatments. Each treatment was repeated three times resulted to 18 experimental units; with total seeds used in this study were 1908.

RESULTS

The drying duration on jackfruit seed viability (Table 1) reduced the seed viability and respiration rate but increased the membrane leakage of jackfruit seeds.

Drying treatment have reduced the water content of the seeds from 75.033 to 22.95 % and germination rate from 97.33 to 24.67 %, the maximum growth potential reduced from 100 to 30 %, growth rate from 8.013 to 1,85 % /etmal, decreased in respiration rate from 7.189 to 5.32 mg CO_2 kg^{-1} hr^{-1} and membrane leakage (DHL) from 9.44 to 19.7 µS cm^{-1} only in five hours after drying.

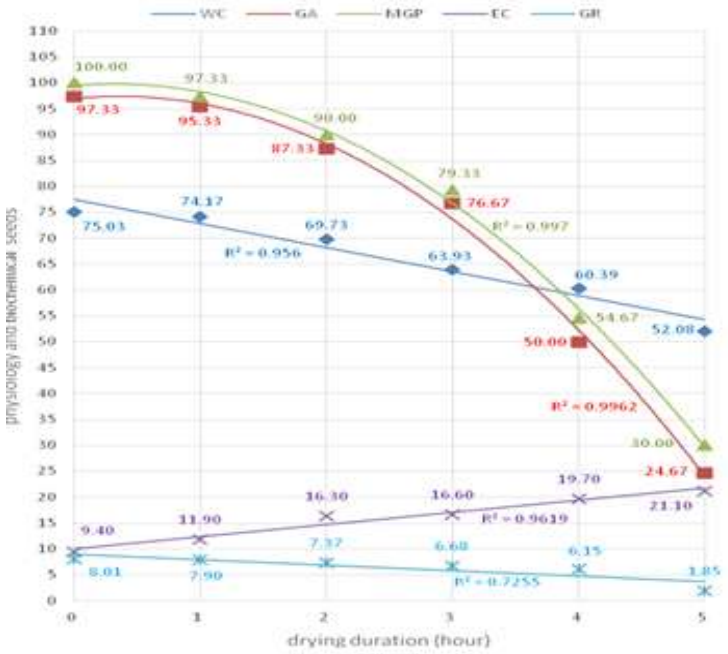

Fig. 1.Effect of air drying on biochemical and physiology of jackfruit seeds (Source: Result of analysis in 2013)

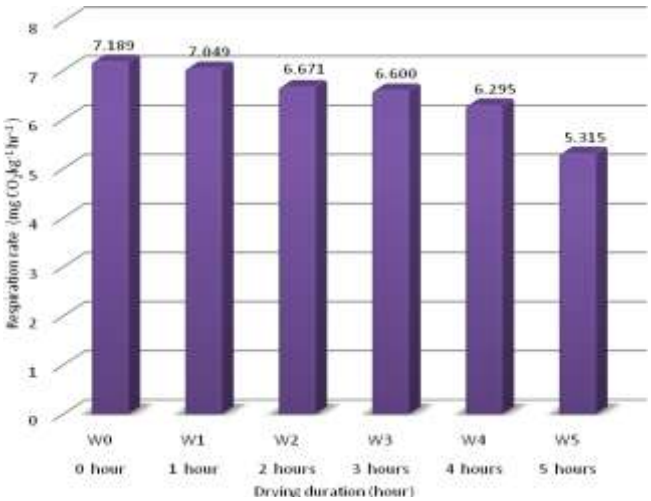

Fig. 2: Effect of air drying on respiration (Source: Result of analysis in 2013)

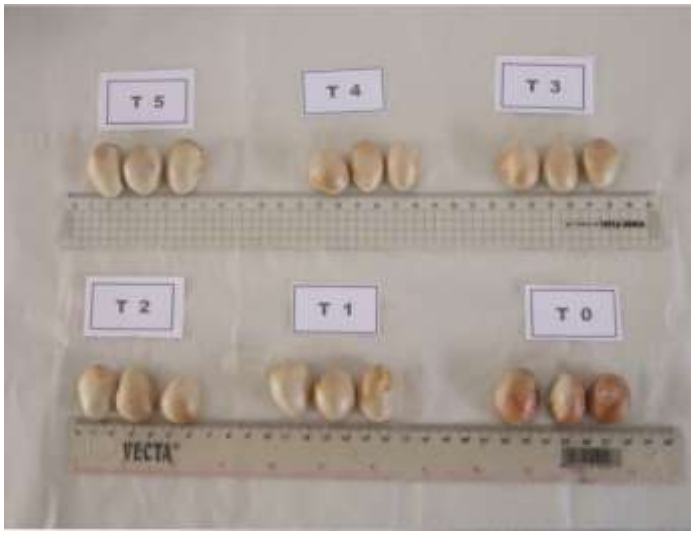

Fig. 1: Jackfruit seed performance after 0-5 hours (Source: Documentation of drying research and jackfruit seed germination at seed technology laboratory the faculty of agriculture Untad Palu, 2013)

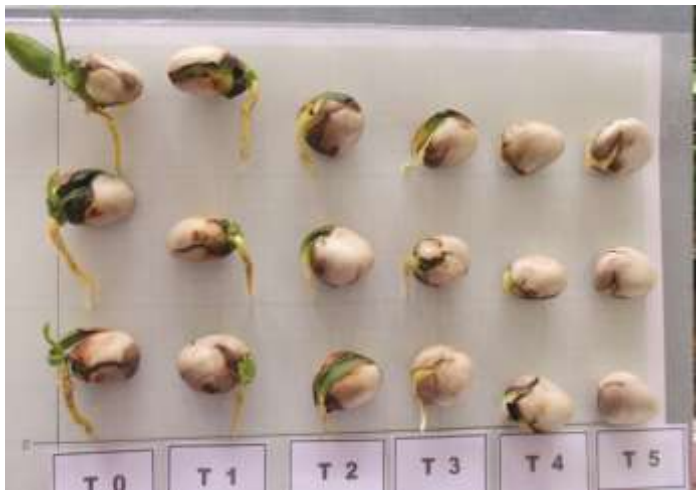

Fig. 2: Effect of seed drying 0-5 hours on jackfruit seedling morphology after 14 days on seedling bed (Source: Documentation of drying research and jackfruit seed germination at seed technology laboratory the faculty of agriculture Untad Palu, 2013)

DISCUSSION

Reduction in Jackfruit seed water content has led to a decrease in the respiration rate of seeds which are closely related to the rate of seed deterioration as explained by Taiz and Zeiger [6] while respiration is the process of releasing chemical energy of organic molecules in the cell such as proteins, carbohydrates and fat in a controlled environment for the use of the cell.

High water content in recalcitrant seeds is needed to maintain the cell structure in contrast to orthodox seeds a decrease in seed moisture content do not affect their seed viability even increase the their shelf life, it is because that germination occurs during imbibition process and will not damage the protein structure, it distinguishes to the recalcitrant seeds which seed cell will damage if exposed to drying [4, 7, 8].

Seeds which have been deteriorated affected their biochemical status such as changing in respiration rate, form free fatty acid, change in chromosome, membrane damage, change in enzyme activity and reduced in food storge [9, 10]. This is relevant to our finding which showed a decrease in seed water content up to 52.08% after 5 hours air drying and resulted to a decreased of respiration rate to 5.32 mg $CO2\ kg^{-1}\ hr^{-1}$ respectively, while membrane leakage increased to 21,100 µS cm^{-1}.

Seed respiration rate tends to decrease aligned with seed deterioration level, changes in respiration is reflected by the low oxygen consumption caused by damage of the membrane structure in particular the cristae of mitochondria [10].

Seeds after 5 hours drying only content 52.080% water and has high electro conductivity, it much due to membrane damage problem. Damage of membrane caused the leakage of cytoplasm metabolites from the cell and cell lost its integrity.

The stronger the membrane damage would increase the leakage of cell metabolite and seed can not grow while the cell metabolism was negatively affected, and seeds are eventually lost their viability. This experiment showed that the longer the drying the higher the lost of seeds viability, indicated by lower growth potential, lower germination rate, reducing growth rate, due to the lost of seed water while air drying.

Seed water content reduced to 60.39% and the viability potential to 50%, respectively, when seeds were exposed to 4 hours drying, this figure known as the critical water content and become a reference in determining the initial water content for storage recalcitrant seeds, where the critical water content represents water level that seed still can maintain its viability.

Cleg in Farrant *et al*. [7] reported his assumption that all cell metabolism can take place in conditions of water available that structurally bound, the increase of free bounding water will only increase the rate of metabolism and not initiate any new metabolism, so if the free bound water bound is lost then the metabolic rate will decrease, but if water structurally bound is lost then the metabolism will be disturbed.

Based on the finding it is assumed that the status of critical water content of jackfruit seeds that air dried for 4 hours caused the lost of free bounding water and slowing down the cell metabolism therefore the seed deterioration can be controlled.

CONCLUSION

- The deterioration of Jackfruit seed viability marked by the rush declining in seed water content, the potential viability decreased from 97.33 to 24.67% only in 5 hours of air drying, this is indicating jackfruit seed is categorized as highly recalcitrant seed.
- Seed water content was 60.3 and seed viability was 50% after 4 hours of air drying, this was found as critical water content level which is important as indicator of initial seed water content for seed storage.
- Critical water content status of jackfruit seeds represented the lost of free bound water and this slowed down the cell metabolism while the seed deterioration viability rate therefore was controlled.

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