SEED AGEING DETECTION METHOD ON DORMANT SEED BEFORE PLANTING AND STORAGE

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ABSTRACT

Seed companies used to harvest high-quality seeds and store them for sale, while tree planters acquire and store these seeds for next planting season. However, seeds often begin to deteriorate during harvesting, drying, and prolonged storage. The natural ageing process affects seed germination capability and reduces seedling vigor. Since germination results provide limited information, it is difficult to determine how long seedlots can be stored effectively. Therefore, a method for detecting ageing in dormant seeds is essential to prevent dormancy release and seed degradation, especially for long-term storage and conservation purposes. The ageing process is accelerated by high temperatures and relative humidity. A study was conducted using four seedlots of *Falcataria moluccana* (Batai) seeds and tested for germination after being exposed to high temperatures (41°C) and high humidity (~100%) for a period of time (42 hours), according to International Seed Testing Association, ISTA Rules (2016). The germination results varied across the seedlots, with some showing a positive correlation between high temperature, relative humidity, and accelerated ageing in the laboratory. The results suggested that seedlots showing significant deterioration have a higher risk of dormancy release and ageing prior to storage, making them more suitable for immediate planting rather than long-term storage.

Keywords: Seed deterioration, germination, accelerated ageing, seed storage, *Falcataria moluccana*

INTRODUCTION

The fast-growing *Falcataria moluccana* Nielsen has been widely planted in Malaysia since the 1980s (King *et al.* 2013) for veneers, plywood, block board, and interior furniture parts (Nemoto 2002). Seeds are the primary source of regeneration in this species; however, seeds do not germinate well if sown directly (Rupinta *et al*. 2020). Recent research has focused on seed dormancy, pre-germination treatments, and germination media (Sajeevukumar *et al.* 1995, Rupinta *et al.* 2020). However, there has been a lack of studies on seed deterioration and its effect on the storage ability of dormant seeds. With extended storage periods and changes in metabolic activity, seed coat dormancy can result in poor seedling emergence (Sajeevukumar *et al.* 1995). The permeability of the seed coat, which can influence seed deterioration, is highly complex and not-well understood (Clemens *et al.* 1977). The accelerated ageing method, which is well-correlated with natural ageing, is widely used to evaluate seed viability and vigor. The purpose of this study is to investigate changes in germination and seed water content in *F. moluccana* in response to accelerated ageing treatment.

MATERIALS & METHODS

Seed materials

Mature pods of *Falcataria moluccana* were collected from four trees at the Segaliud Lokan Forest Reserve (N05°38'52.3", E117°31'34.8"; 39 m.a.s.l.) in Sabah, Malaysia. The fruit pods were sun-dried, and seeds were manually extracted after the pods cracked open. The extracted seeds were weighed and tested following the International Rules for Seed Testing (ISTA 2016) and stored in aluminium bags at 5°C in a refrigerator until use.

Accelerated Ageing (AA)

Seed treatments, consisting of (1) a control and (2) an accelerated aging treatment, were applied to four seedlots: SEP4334, SEP4337, SEP4338, and SEP4342. Four replicates of 25 *Falcataria moluccana* (Batai) seeds were used as a control, without any treatment, under ambient conditions. Four replicates of 50 seeds were subjected to accelerated ageing using Accelerated Aging (AA) boxes. The seeds were placed on dry screen dishes with 50 ml of distilled water, and each AA box was covered with a lid. The AA boxes were placed on shelves in the ageing chamber for 72 hours ± 15 minutes in the dark, at a temperature of 41 ± 0.3°C (ISTA 2016). After the ageing period, a standard germination test was conducted using four replicates of 25 seeds. A seed was considered germinated when its radicle reached 1.0 cm in length and the hypocotyl became visible (Sajeevukumar *et al.* 1995). The mean germination percentages were analysed to determine differences among the means, using a t-test at $p \leq 0.01$.

Water Content

Three replicates of eight seeds were used to measure the initial water content (IWC), and two replicates of eight seeds from each of the four seedlots, after accelerated ageing (WCAA), were weighed in moisture containers. The seeds were dried at 103°C for 17 hours and then reweighed to calculate their water content (ISTA 2016). The containers were weighed again to calculate the moisture content (ISTA 2016). The mean moisture content was calculated and analysed to determine differences among the means, using a t-test at $p \leq 0.01$.

RESULTS & DISCUSSION

The mean germination of four seedlots of *Falcataria moluccana* (Batai), under both control conditions and after accelerated ageing for 72 hours, is shown in Figure 1. High temperature (41°C) and relative humidity (>95%) during the accelerated ageing treatment posed major stresses on the seeds (ISTA 2016). Statistical analysis showed significant differences in germination for SEP4334 and SEP4338, while no significant differences were found for SEP4337 and SEP4342 at $p \leq 0.01$, using a t-test.

Seedlots SEP4334 and SEP4338 exhibited resistance to the stresses of high temperature and humidity, while SEP4337 and SEP4342 were sensitive, potentially leading to a loss in germination. Similar findings have been reported for barley and wheat seeds, where fresh seeds aged rapidly under accelerated ageing at 42°C and 45°C (Chauhan & Deswal 2019a). Accelerated ageing has also been shown to progressively reduce seed viability and vigor in radish seeds (Neeru *et al.* 2006) and groundnut genotypes (Aderiye *et al.* 2021).

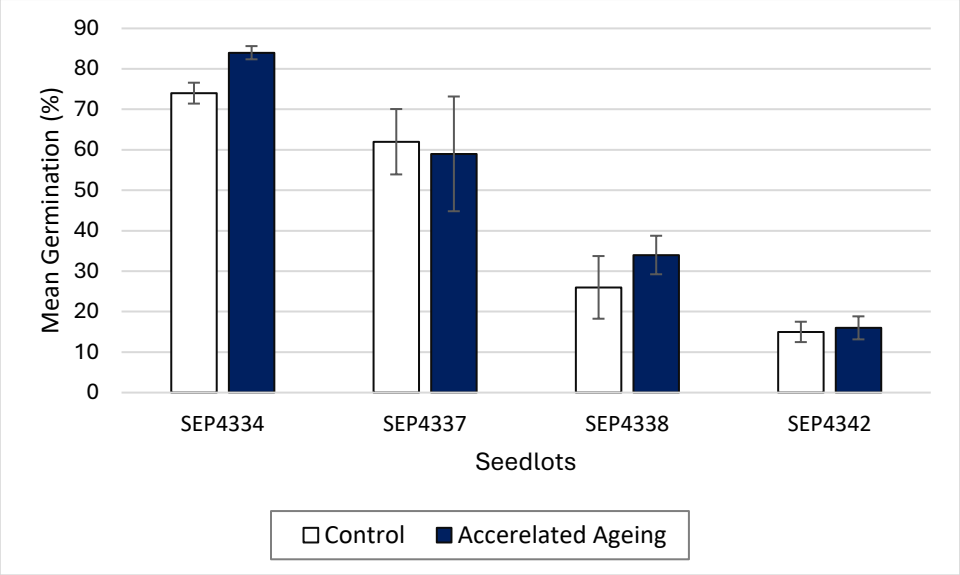

Figure 1. The mean seed germination of four seedlots of *F. moluccana* after accelerated ageing.

The seed water content of *Falcataria moluccana*, including initial water content (IWC) and water content after accelerated ageing (WCAA), is shown in Table 1. The water content ranged from 4.87% to 8.16% initially and increased to 6.71% to 19.89% after accelerated ageing. The data showed significant differences in water content for seedlots SEP4334 and SEP4338, while no significant differences were found for SEP4337 and SEP4342 ($p \leq 0.01$), based on a t-test.

Seed lot SEP4337 recorded the highest water content at 19.89%, followed by SEP4342 at 10.53%. This high water content likely contributed to seed deterioration, which led to a drop in seed vigor and reflected the loss in germination capacity. This may be due to the hygroscopic nature of the seeds when exposed to high humidity (>95%) (Chauhan & Deswal 2019b). Moisture content continues to increase until equilibrium moisture content is reached.

Table 1. The average water content of Batai Seeds in control (IWC) and after accelerated ageing (WCAA)

Seedlots	CONTROL IWC (%)	AFTER AA WCAA (%)
SEP4334*	6.90	16.35
SEP4337	6.01	19.89
SEP4338*	4.87	6.71
SEP4342	8.16	10.53

*Significant in the mean of water content before and after AA treatments

CONCLUSION

Seed germination alone did not reveal the true seed quality of *Falcataria moluccana*, as seeds may deteriorate due to stresses caused by high temperature and moisture during handling and storage. In this study, the four seedlots exhibited different responses to accelerated ageing. Two seedlots, SEP4337 and SEP4342, were sensitive to the ageing period (71 hours),

high temperature (41°C), and high relative humidity (>95%), leading to dormancy release and germination loss. In contrast, seedlots SEP4334 and SEP4338 were resistant to these stresses and showed improved germination.

The results suggest that defects in the seed coats, which increase water permeability, may have caused some seedlots to become more sensitive and deteriorate faster during accelerated ageing. However, seed water content in aged seeds does not always have a significant effect on dormancy release or seed viability loss in *F. moluccana*, as sensitivity to adverse conditions varies among seedlots. Early detection of sensitivity in certain seedlots can assist in decision-making, especially when determining if seeds should be planted immediately due to their unsuitability for long-term storage.

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