FOREST SEED SCIENCE AND MANAGEMENT FOR PLANTATIONS

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ABSTRACT

Forest are one of the most invaluable natural resources for any country. However, most of the forest are losing the gazzetted area due to deforestation. Planted forests have represented a common land use and a very important resource for centuries as alternative to natural forest. By providing an alternative source of forest products, can reduce pressure to the remaining natural forest. High quality of seedlings needed in the way of realizing the regeneration of planted forests. The availability of the quality seed in seed technology is the most important requirement for forest plantation programme. Seed certification procedure is strictly regulated for all process involve in seed production, testing and distribution of high-quality seeds. Variation in shape, size, colour and behavior for forest seeds need to be consider during collection, testing and handling the seeds. Seed Technology Laboratory in Forest Research Institute Malaysia (FRIM) is focusing on seed collection, seed processing, seed storage, seed certification and research on related aspects for producing high quality seeds for forest species. The time and effort invested in procuring better quality seeds in planted forests will benefit the planters when getting higher rates of survival, higher yields and better quality of wood and other products. Therefore, seed technology can play a major role in providing quality planting materials either for forest plantation or re-forestation programme.

Key words: forest plantation, seed certification, seed procurement, seed science

INTRODUCTION

Reducing deforestation has become an issue of global importance. Deforestation is caused by various factors such agricultural expansion and land development (McMorrow & Talip 2001). The planted forests have become a major component of the productive and protective forest resources in addressing deforestation issue. The most essential factor for the success of plantation is the availability of high-quality seeds. The quality of seed is responsible for the future performance of each and every seedling. The use of seed from stands of high inherent quality will ensure fast-grown and healthy plantations capable of yielding high quality wood. High genetic quality seed is obtained from seed sources that match the planting site, have a good outcrossing rate and are superior in some desirable characters. Good seed production relies upon success of the whole range of reproductive events from flower differentiation to seed maturation. Physiologically sound seed shows a high germination rate, but germination may be restricted by various dormancy mechanisms that in nature aim at delaying or restricting seed germination during time of poor seed survival. Besides that, environmental factors also can reduce seed quality before planting. Therefore, quality seed testing is done to assess seedlot attributes and determine overall quality and also value for seedling production and storage. Our objective was to point out the need for developing standard protocols of seed quality assessment of forest species that required for forest plantations. Besides producing genetically improved seed, poor in handling techniques also may cause losses to the planters. The best practice of seed handling is an essential complement to genetic improvement. In Seed Technology Laboratory, Forest Research Institute Malaysia (FRIM), we provide seed quality testing and consultation to the planters on handling their seeds before sowing or seed stocking.

MATERIALS AND METHODS

Seed's collection

The origin of seed lots were collected from Forest Research Institute Malaysia (FRIM), Kepong, Selangor, residential area in Kepong, Selangor and FRIM research plot in Jengka, Pahang. All collection was in 2019.

Seed processing
Some seed need to be extracted from the fruits such thrashing from the pods (for most of orthodox and intermediate seed) or de-winging by hand (recalcitrant seed).

Seed testing
Seed testing is compulsory in understanding the different aspects of physical and biological characteristics of seed. This procedure will determine the quality of seeds suitable for planting or identify the seed quality problem. Commonly, seed testing involved purity test, seed weight, seed moisture content, germination test and tetrazolium test.

Purity test
Purity test involved on determination of the proportion of seeds sample by weight and proportion in other material. Normally the proportion can be devided into pure seeds, other seeds, damaged seeds and inert matter. The formula involved to determine purity (%):

$$\text{Purity (\%)} = \frac{\text{Weight of pure seed}}{\text{Weight of whole sample}} \times 100$$

Seeds weight
The weight of 1000 seeds and the number of seeds per kg of each seed lot were determined according to International Seed Testing Association (ISTA 2008).

Seed moisture content
Moisture content (MC) is one of the most important factors to determine the overall moisture of seedlot. This procedure will help to establish optimal conditions for storage and to maximize the lifespan of the seed. Seeds were randomly picked from the whole lot for moisture content analysis. Tests are carried out in triplicate where each replicate consist of 5 seeds. The seeds were weighed and placed in oven at 117°C for 17 h. The seeds were weighed for second time after cooling at ambient temperature. The moisture content was calculated by:

$$MC\% = \frac{(M_2 - M_3)}{(M_2 - M_1)} \times 100$$

Seed germination
Four replicates of 25 seeds per seedlot per species were placed on top of tissue paper moistened with de-ionized water in petri dishes (figure 1) or germination box (figure 2) depends on the size of the seeds. Germination test is the most reliable test of seed viability under laboratory conditions.

$$\text{Germination (\%)} = \frac{\text{Number of germinated seed}}{\text{Total number of seeds}} \times 100$$

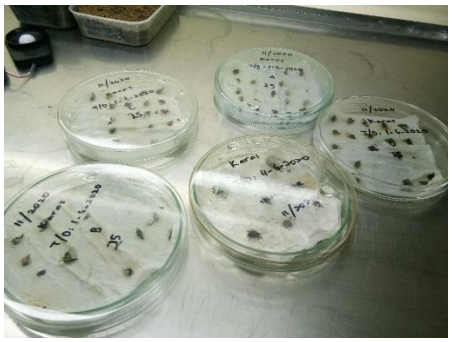

Figure 1 Seed testing in petri dish

Figure 2 Seed testing in germination box

RESULTS AND DISCUSSION

This germination test was carried out for different category of seeds (orthodox, intermediate and recalcitrant). This category was determined by behavior of the seeds based on several factors. Most of orthodox seeds need to be pre-treated before germination test. Normally orthodox seeds from Leguminaceae family covered by thick seed coat, which will delay or disrupt the germination process. By giving pre-treatment to the seeds will speed up the germination process with high germination rate (table 1). Most of the seeds from this study germinated within 14 days.

Table 1. Pre-treatment for seeds before germination test and duration of completed germination

	Pre-treatment	Duration (days)
Orthodox		
Adenanthera pavonina	Chipped and hot water	14
Peltopharum pterocarpum	Hot water	14
Pterocarpus indicus	Nil	16
Sindora echinocalyx	Chipped	12
Intermediate		
Dyera costulata	Nil	14
Swietenia macrophylla	Nil	20
Recalcitrant		
Dryobalanops aromatica	Nil	8
Shorea macrophylla	Nil	24
Shorea singkawang	Nil	10
Shorea sumatrana	Nil	14

Determination of thousand-seeds weight is an essential for estimation of the number of seeds contained per kg. Data was presented in table 2. By knowing the seed weight and number of seed per kg, planters can reduce the cost when purchasing the seeds as they can calculate the seedlings needed by hectarage of plantations.

Table 2. Seed weight, number of seed per kg, purity, germination (%) and moisture content (%) of seedlot from different category

Species	Weight of 1,000 seeds (g)	Number of seeds per kg	Purity (%)	Germination (%)	MC (%)
Orthodox					
Adenanthera pavonina	250	3747	33.76	67.5	8.7340
Peltopharum pterocarpum	45.25	21677	13.5	88.3	12.8794
Pterocarpus indicus	45.5	21975	14.5	86.7	9.9043
Sindora echinocalyx	1900	528	100	91.67	8.5029
Intermediate					
Dyera costulata	166.5	5925	3.28	67.5	14.2608
Swietenia macrophylla	833.3	58.5	29.74	90	35.5088
Recalcitrant					
Dryobalanops aromatica	5702.6	175	100	67.5	40.1371
Shorea macrophylla	43625	23	100	27.5	65.6342

Shorea singkawang	15250	63	100	75	65.6953
Shorea sumatrana	1287.5	762	100	98.3	58.1873

Moisture content for orthodox seed category was lower (between 8-12 %) than the recalcitrant (up to 65%). Moisture content is one of the main factor need to be taken into consideration because it will affect the quality of the seed in storage before sowing or keeping the seed as stock. Orthodox seeds can be dried to low level of moisture content and their longevity increases with decrease in storage moisture content and temperature (Roberts, 1973). Intermediate group or sub-orthodox seeds can be stored under same condition as true orthodox seed but the lifespan only for 6 months to one year. From this study, most of the recalcitrant seed germinated more than 60% though the moisture content was very high. Only for *Shorea macrophylla*, the germination rate was very low. Planters will facing this kind of problem during seed collection when observation of the development of flowering and fruiting shows that the seed already mature. These mature seed will be harvested by the planters but unfortunately with morphologically immature embryo (Rather et al. 2016).

CONCLUSION

Quality seed is one of the components in any tree improvement programme. Efforts have been made for production of superior and quality seeds to ensure better survival and growth of the tree either for plantation or restoration programme. The planters or seed supplier need to enhance the seed quality by looking at different factors affecting the quality such as source, time and techniques of harvest, processing and storage practices. The germination test has immediate implications for seed quality and for estimation of the number of seedlings that can be obtained from a quantity of seeds. The limiting factor on germination capacity of some seeds after the seed testing procedure may give a referral information to the planters before start to sow the seeds in their plantations. Careful seed collection and storage conditions are important factors that affect seed germination that can influence final seed quality The limiting factor on germination capacity of some seeds after the seed testing procedure may give a referral information to the planters before start to sow the seeds in their plantations. Careful seed collection and storage conditions are important factors that affect seed germination that can influence final seed quality before sowing. Improved seed quality is an essential factor of optimal seedling production for the forestry plantations programme.

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