Vol. 9(2): 280-290, May 2021

DOI: https://doi.org/10.23960/jsl29280-290

Jurnal Sylva Lestari

P-ISSN: 2339-0913
E-ISSN: 2549-5747

Journal homepage: https://jurnal.fp.unila.ac.id/index.php/JHT

Full-Length Research Article

Assessment of the Physical Quality of *Eucalyptus pellita* Seedlings from Shoot Cutting by Age Level

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ARTICLE HISTORY:

Received: 21 October 2020
Peer review completed: 7 January 2021
Received in revised form: 21 January 2021
Accepted: 23 January 2021

KEYWORDS:

Cocopeat
Eucalyptus pellita
Seedling quality index
Shoot cuttings
Target seedling

ABSTRACT

The criteria for target seedling of *Eucalyptus pellita* F. Muell are at least 90 days old, with consequences for the length of stay of the seedlings in the nursery. This study must assess the suitability as a target seedling first if it wants to plant the seedlings under 90 days old in the field. The research aimed to evaluate and obtain the regression equation for the seedling's age with the seedling's morphological characters. The shoot seedlings cuttings aged 45, 60, 75, and 90 days after planting in the cocopeat growing medium were assessed. The study was used a survey method with a purposive sampling technique to obtain 60 samples by assessing the growth and appearances of the seedling. Furthermore, 15 samples were taken at random to determine the dry weight of the seedlings. Seedlings aged 75 and 90 days indicated the standard criteria as target seedlings for height, diameter, number of leaves, seedling's health, shoot appearances, and seedling roots. The two seedlings' age levels have a sturdiness index of 8.34-9.78; shoot-root ratio 3.9-4.5; and seedling quality index (SQI) 0.22-0.23. Seedling age had a powerful positive correlation with the sturdiness index and SQI (r = 0.84 and r = 0.96). The regression equation of the sturdiness index is $y = 0.048x + 5.435$ ($R^2 = 0.996$) and SQI is $y = 0.004x - 0.064$ ($R^2 = 0.926$). This research implies that 75 and 90-days seedlings can be considered as one of the criteria for the age of *E. pellita* shoot cuttings as the target seedling in the SOP of PT. Finnantara Intiga.

1. Introduction

The development of Industrial Plantation Forests (HTI) is one of the strategic efforts to meet the demand for raw materials of the wood processing industry. The eucalyptus (*Eucalyptus* spp.) is the most important plantation species in several tropical countries to date (Booth 2013). Eucalyptus wood is a major pulp and paper raw material source (Leksono 2010), including in Indonesia. Eucalyptus wood can also be used as raw material for construction wood, veneer, plywood, and renewable energy (Hii et al. 2017; Lumbres et al. 2015; Simetti et al. 2018). In Southeast Asia, six types of eucalyptus are cultivated in plantations, including *E. dunni, E. grandis, E. globulus, E. urophylla, E. camaldulensis*, and *E. pellita* (Nambiar and Harwood 2014). In Indonesia, *E. pellita* is the most popular species because of its high productivity with wood properties suitable for pulp and paper raw materials (Mindawati 2011), fast-growing, short cycle (6-8 years harvestable), high adaptation to the environment, straight-trunked, more resistant to pests and diseases, and easy to propagate (Harwood et al. 1997). *E. pellita* can be propagated generatively (seeds), vegetatively (shoot cuttings), and through budding culture (Adinugraha et al. 2007; Herawan and Leksono 2018).

The success of planting *E. pellita* in the field, especially for planting in plantations, is determined mainly by the quality of the seedlings produced in the nursery. The criteria for the quality of *E. pellita* seedlings suitable for planting based on morphological (physical) and physiological characters refer to technical guidelines in the Regulation of the Director-General of Land Rehabilitation and Social Forestry (RLPS) No. P.05/V-SET/2009. Apart from these regulations, usually industrial plantation forest companies (HTI) such as PT. Finnantara Intiga is also prepared Procedure (SOP) for Seedling Physical Quality Criteria used as a reference in assessing the quality of target seedlings. Generally, the age of target seedlings of *E. pellita* is a minimum of 90 days and a maximum of 180 days (DirJen RPLS 2009). The criteria for the age of the target seedlings made by PT. Finnantara Intiga is ≤ 120 days. The seedlings that are ready for planting in the field were mentioned by Rose et al. (1990) as a target seedling. This age range has consequences for the length of time against the seedlings in the nursery.

Good quality seedlings are shown by morphological and physiological characters that can adapt, grow and develop well when the seedlings are planted in specific sites (Jacobs et al. 2004). Research by Landis and Dumroese (2006) showed that the morphological and physiological characters of seedlings are equally important in assessing the quality of *Pinus* spp. The assessment of morphological characters is more practical and more manageable than the assessment of physiological characters. Seedling morphological characteristics are a physical manifestation of physiological processes in seedlings, which are generally carried out on hardwood species (Nurhasybi et al. 2019). The assessment is carried out by measuring several seedling growth variables (height, diameter, number of leaves, and seedling stem shape) and observing root physicality (root volume, root length, root system fibrosity, and new lateral roots) (Haase 2008; Nurhasybi et al. 2019). Root volume and root length have a positive correlation with the ability of seedlings to grow after planting in the field (Chiatante et al. 2002; Gazal and Kubiske 2004). The fibrosity of the root system, which is a root fiber system, and new lateral roots are closely related to nutrient and water absorption areas that can support the growth and development of seedlings in fields (Deans et al. 1990). In this study, the evaluation of the root physical characteristics (root distribution and media cohesiveness) in the polytube followed the SOP of PT. Finnantara Intiga (Finnantara Intiga 2018). Furthermore, the assessment of the physical quality of seedlings also used the sturdiness index, shoot-root ratio, and seedling quality index (SQI), which can reflect the appearance of seedlings in the field (Munguambe 2018; Nurhasybi et al. 2019).

The increasing age of fast-growing species, such as *E. pellita*, is always followed by the rapid growth of seedlings. This condition will undoubtedly affect the density of the seedlings in the nursery. For seedlings that are too dense when in the nursery, the stems get less sunlight so that the lignification of the stems is slower, which causes the seedlings to be low in sturdiness (Nurhasybi et al. 2019; Rowan 1986). Dense seedlings may also reduce the viability of the seedlings. Research by Leach et al. (1986) showed that if the density of loblolly pine seedlings in the nursery was reduced, the viability of the seedlings could be increased by 4% to 10% compared to those that were tightly laid. If the density of the seedlings is to be reduced and the work efficiency in the nursery is to be improved by planting seedlings less than 90 days old, the feasibility of seedling quality needs to be evaluated first. This evaluation needs to be carried out considering that it has not been tested whether the seedlings less than 90 days old can fulfill the physical quality standard criteria for target seedlings. If the prediction of physical quality based on the age of the seedlings will be carried out with a regression equation, then the morphological parameters that have a high correlation with the seedlings' age need to be analyzed.

This study aimed to assess the quality feasibility of *E. pellita* shoots cuttings aged 45 days, 60 days, 75 days, and 90 days as target seedlings and to determine regression equations for several morphological parameters that were strongly correlated with seedling age. The results are expected to enrich the technical reference for determining the physical quality of *E. pellita* seedlings from shoot cuttings, especially those grown in cocopeat media based on the age of the seedlings as the target seedling.

2. Materials and Methods

The seedlings of *E. pellita* shoot cuttings were assessed: those aged 45, 60, 75, and 90 days in the permanent nursery of PT. Finnantara Intiga, Mengkiang Village, Sanggau District. The sampling technique for assessing the quality of target seedlings was referred to the Regulation of DirJen RLPS No. P.05/V-SET/2009. In the first stage, a sample of 10 trays was taken from 1 beach tray (98 trays) purposively by selecting relatively uniform seedlings (height, diameter, and health). Furthermore, as many as 60 shoot cuttings from the ten trays were randomly selected to measure and observe their morphological characters. In the second stage, 15 seedlings were taken randomly (random sampling) to determine the dry weight of shoots (from stem to shoot) and roots at the Laboratory of Silviculture and Forest Products Technology Laboratory , Faculty of Forestry, Tanjungpura University. The sampling method was applied to each group of seedlings aged 45, 60, 75, and 90 days. The age of the seedlings was assessed that was the age since planting of shoot cuttings in cocopeat medium in polytube (75 ml), which was maintained in a greenhouse and a shaded area for 44 days. At the age of 45, the seedlings were transferred and maintained in an open area with 33% thinning.

Measurement and assessment of morphological parameters were followed the standard criteria for *E. pellita* shoot cuttings according to the SOP of PT. Finnantara Intiga (Finnantara Intiga 2018). Measurement of shoots (stem and leaf) and roots dry weight was carried out on seedling samples that had been separated between shoots and roots and oven at 105 ºC until a constant dry weight was conducted for 48 hours. Furthermore, the results of measurements of height, diameter, shoots, and roots dry weight were used to quantify physical quality parameters such as the sturdiness index (Haase 2008), shoot-root ratio (Haase 2008), and seedling quality index (SQI) (Dickson et al. 1960).

$$\text{Sturdiness Index} = \frac{\text{Seedling Height (cm)}}{\text{Stem Base Diameter (cm)}} \quad (1)$$

$$\text{Shoot-Root Ratio} = \frac{\text{Shoots Dry Weight (g)}}{\text{Roots Dry Weight (g)}} \quad (2)$$

$$SQI = \frac{\text{Shoot Dry Weight (g)} + \text{Root Dry Weight (g)}}{\text{Shoot-Root Ratio} + \text{Sturdiness Index}} \quad (3)$$

Seedlings are considered ready for planting if it is fulfilling the following criteria: the seedling sturdiness index in the nursery is 6.3-10.8 according to SNI 01-5005.1-1999 (BSN 1999); the standard shoot-root ratio for seedlings in containers generally has a shoot-root ratio of 2:1 or less (Haase 2008); general standard SQI > 0.09 which will have high survival when moved to the field (Hendromono 2003).

Variance analysis was carried out to determine the effect of seedling age on the variables of height, diameter, sturdiness index, shoot-root ratio, and SQI after testing the assumption of homogeneity of variety with the Lavene test. The least significant difference test (LSD) was carried out to determine the mean difference in the mean age of each seedling for each variable being assessed. Besides, correlation analysis was carried out to examine the degree of relationship between seedling age and the sturdiness index, shoot-root ratio, and SQI variables. Simple regression analysis was performed to obtain a regression equation used to predict the physical quality of the seedlings at several age levels of the seedlings. Data analysis was performed using MS Excel 2016 software.

3. Results and Discussion

3.1. Seedling Quality of E. pellita Based on Age Level

In this study, the physical quality of *E. pellita* shoot cuttings from four age levels (45, 60, 75, and 90 days) grown in cocopeat media in a polytube was assessed based on morphological characters. Seedlings that have passed the acclimatization phase at the age of 29-44 were then kept in open areas (without shade) with 33% thinning. The results of the variance fingerprint showed that the response to growth in height and seedling diameter was very significant for the age of the seedlings (**Table 1**). It indicated that the growth of *E. pellita* cuttings in cocopeat medium in polytube was quite responsive in 15 days of seedling age. Furthermore, the difference in height and diameter of seedlings at each age level were analyzed using the LSD test (α = 5%). The results showed that the difference in height for seedlings of 90 days was significantly higher than those of < 90 days. However, the difference in diameter of 90 days old seedlings was not significant only with 75 days old seedlings. It means that until the age of 90 days, the growth of *E. pellita* cuttings in the polytube is not hampered by the increasing age of the seedlings while it is still in the container (polytube). Nurhasybi et al. (2019) explained that the growth in height and diameter are indicators of the seedlings' root system. The remarkable growth in height and diameter of *E. pellita* cuttings until the age of 90 days indicates that the root system of the seedlings can still support seedling growth.

Based on the measurement results, the height and diameter of *E. pellita* seedlings, seedlings aged 60, 75, and 90 days have fulfilled the standard criteria according to the SOP of PT. Finnantara Intiga (Finnantara Intiga 2018) as target seedling (**Table 1**). The minimum standard for seedling height varies for each type and age (Nurhasybi et al. 2019). PT. Finnantara Intiga determined the minimum height for different *E. pellita* shoot cuttings for seedlings < 90 days and 90-120 days. The minimum standard of seedling height can be achieved by seedlings of 60-90 days. Seedling diameter at all assessed age levels was also fulfilled the minimum standard according to the range of seedling heights (**Table 1**). Large diameter showed with a root system and large stem volume (Nurhasybi et al. 2019) and an indicator of good quality seedlings (Haase 2008). Diameter correlates with seedling growth in the field, so it is a good predictor of further seedling growth, although it is not always correlated with percent survival (Sianturi and Sudrajat 2019; Thompson 1985).

Table 1. Height and diameter of *E. pellita* shoot cuttings at four age levels in the cocopeat growing media

Seedling age (days)	Height[1)] (cm)	Diameter[1)] (mm)
45	16.85 ± 1.25 d	2.31 ± 0.17 c
60	26.30 ± 1.58 c	2.97 ± 0.26 b
75	28.52 ± 2.28 b	3.12 ± 0.18 ab
90	32.08 ± 3.33 a	3.27 ± 0.34 a
Standard [3)]	Age < 90 days: 18-50 Age 90-120 days: 25-50	Height 18-30: > 2.2 Height 31-40: > 2.5 Height 41-50: > 2.9
F count	2543.45 [2)]	10.75 [2)]
LSD α = 0.05	1.62	0.18

Notes: The numbers followed by the same letter are not significantly different in the LSD test α = 0.05. [1)]Mean ± SD, (n = 60); [2)]$F_{table\ 1\%}$ = 3.87; [3)]Finnantara Intiga (2018).

Table 2. Morphological characters of *E. pellita* shoot cuttings at four age levels in cocopeat growing media

Age (days)	Numbers of shoot[1)] (strands)	Seedling health[2)]	Stem hardness[2)]	Media cohesiveness[2)]	Root distribution[2)]
45	8 ± 1	100%	100%	100%	73%
60	10 ± 2	100%	100%	100%	67%
75	10 ± 1	100%	100%	100%	75%
90	9 ± 1	100%	100%	100%	48%
Standard [3)]	≥ 5	Free of HPT	Wooden	Compact and intact	Balanced

Notes: [1)]Mean ± SD, (n = 60); [2)]Percentage of 60 seedlings; [3)]Finnantara Intiga (2018); HPT: plant pests and diseases.

Other morphological character assessments were the appearance of seedlings (number of leaves, seedling health, and stem hardness) and seedling roots (media cohesiveness and distribution of roots in the container). Seedlings of *E. pellita* shoot cuttings at all age levels were considered to have fulfilled the criteria for the physical quality standard of seedlings based on the number of leaves, health, stem hardness, and media cohesiveness, except for root distribution (**Table 2**). The number of leaves exceeding the minimum standard of 5 strands on 45 days old seedlings indicates that the seedlings can very well undergo the acclimation process. Furthermore, the seedlings can adapt well in open areas with temperatures and light intensities that are very different from when the seedlings are acclimatized. Shoots number correlates with seedling height and reflects photosynthetic and transpiration capacity (Nurhasybi et al. 2019). HPT-free seedlings showed seedlings' health in all samples of seedlings assessed to prove the success of protecting seedlings from HPT attacks in the nursery. The woody stems indicate that watering, fertilizing, lighting and seedlings are good enough, which will support the seedlings' ability to adapt to the growing environment. Karyaatmaja et al. (2001) reported that the woody tropical *Pinus merkusii* was performed better after planting in the field. The seedlings equally showed the cohesiveness of the media and the distribution of roots in the container at all age levels (**Fig. 1**). It is vital for the development of seedlings when is planted in the field because a sound root system is closely related to the absorption of nutrients and water by the root fibers that can support the growth of seedlings (Thompson and Schultz 1995).

(a) (b) (c) (d)

Fig. 1. Distribution of roots in polytube on seedlings aged (a) 45 days, (b) 60 days, (c) 75 days, and 90 days.

Other seedlings' physical qualities assessed were the sturdiness index, shoot-root ratio, and SQI due to quantification of the parameters of height, diameter, shoot, and root dry weight. **Table 3** shows that the sturdiness index and SQI of *E. pellita* shoot at all ages were considered in the recommended physical quality standard criteria, except for shoot-root ratio. As getting older, the seedling's sturdiness index increases. The seedling sturdiness index is an indicator of the balance between height and diameter growth. The smaller the sturdiness index reflects that the seedlings are getting stronger to survive in wind pressure when planted in the field (Yudohartono and Herdiyanti 2013). The sturdiness of the seedlings can be affected by the distance between adjacent seedlings in the nursery. Nurhasybi et al. (2019) explained that seedlings that are too dense would reduce the reception of sunlight on the stems so that the seedlings tend to be weaker due to the slower lignification process. Several studies were used a seedling sturdiness index to predict the percent survival and growth of seedlings in the field, such as for Shorea spp. and white Jabon with a sturdiness index of 6.3-10.8 and less than 6, respectively (Budiman et al. 2015; Omon 2008). Roller (1977) found that *Picea mariana* (black spruce) seedlings with a sturdiness index of more than 6 were very prone to damage when hit by the wind.

Table 3. Sturdiness index, shoot-root ratio, and seedlings quality index of *E. pellita* at 45, 60, 75, and 90 days in cocopeat growing media

Seedling age (days)	Sturdiness index*	Shoot-root ratio*	Seedling quality index (SQI)*
45	7.55 ± 0.53 d	4.98 ± 0.70 a	0.08 ± 0.02 c
60	8.95 ± 0.88 b	4.71 ± 0.62 a	0.15 ± 0.02 b
75	8.34 ± 0.49 c	3.93 ± 0.52 b	0.22 ± 0.03 a
90	9.78 ± 0.93 a	4.50 ± 0.77 a	0.23 ± 0.04 a
Standard	6.30 – 10.80 [1)]	≤ 2.00 [2)]	> 0.09 [3)]
F count	24.81**	6.83**	78.38**
BNT 0.05	0.54	0.48	0.02

Notes: The numbers followed by the same letter are not significantly different in the LSD test α = 0.05. (*Mean ± SD, n = 15); **$F_{table\ 1\%}$ = 4.15. [1)]BSN (1999); [2)]Haase (2008); [3)]Hendromono (2003).

Table 3 showed that the shoot-root ratio for seedlings at all age levels is greater than 2. It is different from the seedlings planted in containers with a shoot-root ratio of 2:1 or less when referring to Haase (2018). PT. Finnantara Intiga does not set the shoot-root ratio standard for *E. pellita* cuttings. Roots and shoots of *E. pellita* shoots begin to grow at 18-28 days after planting. As seedlings age, root growth from cuttings to 90 days is slower than shoot growth (the top of the seedling). This condition is common in seedlings grown in containers, where the size of the container limits space for the roots to grow. It is shown by the *E. pellita* shoot cuttings that have a shoot-root ratio > 2. The shoot-root ratio is an indicator of the balance of the transpiration area (shoots) and water absorption area (roots) (Nurhasybi et al. 2019); hence, target seedlings in the tropics should have a low shoot-root ratio (close to 1) (Mindawati and Susilo 2005). This is closely related to the ability to survive and early growth of seedlings when planted in the field. Also, a high shoot-root ratio showed a small root dry weight compared to shoot dry weight. Nurhasybi et al. (2019) explained that seedlings with large root weights tend to grow better and survive than seedlings with small root weights. The shoot-root ratio criteria for target seedlings are different for different types of plants. Information regarding the relationship between the shoot-root ratio of *E. pellita* > 2 cuttings and the percentage of survival and growth of seedlings after planting in the field remains investigated. A previous study (Omon 2008) indicated that shoot-root ratio *Shorea* spp. were range 2.19–2.59, supports the best growth up to one year after planting in the field.

The SQI increases significantly with increasing age (**Table 3**). Seedlings aged 45 days have not been able to fulfill the standard criteria for SQI > 0.09. Based on the results of the LSD test, the difference in SQI of *E. pellita* cuttings aged 75 days was not significant with an SQI of 90 days. It showed that 75 days old seedlings have the same quality of target seedlings as 90 days old seedlings. The SQI quantifies the growth in height, diameter, and dry weight of the plant and determines the overall quality character of target seedlings if > 0.09 (Hendromono 2003). Therefore, 75 days and 90 days of cuttings can be recommended as target seedlings based on the SQI value. The three parameters of the physical quality of the seedlings (sturdiness index, shoot-root ratio, and SQI) are often used to predict the appearance of seedlings after planting in the field until a certain age. 2019). The shoot-root ratio is used to predict the percentage of live seedlings in the field but is not good at predicting seedling growth in the field (Mullin and Christi 1982). Seedling quality index, which is a combination of morphological parameters, has been used to estimate the performance of *Picea glauca* and *Pinus strobus* seedlings after planting in the field (Dickson et al. 1960).

In the nursery practice of *E. pellita*, the results of propagation by shoot cuttings at PT. Finnantara Intiga, seedlings that have passed the selection as target seedlings at the age of 90, must be maintained in the nursery area until it was 120 days old before planting in the field. The maintenance was carried out, including fertilizers at intervals of 2-3 days, spraying insecticides and fungicides once a week in the morning or evening. All of the evaluated seedlings were healthy, indicating no attacked seedlings by pests and diseases, and there were no leaves with chlorosis. Overall evaluation results, the physical quality of seedlings 60 days to 90 days has fulfilled the standard criteria for target seedlings. However, the 75 days old seedlings had the same quality as the 90 days old seedlings based on the SQI criteria. Therefore, the 75 days old seedlings were the most recommended as target seedlings. The implication is that the seedlings' density can be reduced because the length of stay for the seedlings in the nursery can be shortened. The consequence of reducing seedling density in a nursery has been shown to increase viability by 4-10% compared to seedlings that are not reduced in density (Leach et al. 1986; Rowan 1986). A seedling age of 75 days can be included in the criteria for target seedlings, especially for seedlings from *E. pellita* shoot cuttings.

3.2. Correlation and Regression Equations for Seedling Age and Seedling Quality

Quality assessment at several levels of seedling age based on morphological characters is the most common because it is relatively fast and cheap. In this study, the strength of the relationship between seedling age and several morphological characteristics of the target seedlings was determined by correlation analysis. Morphological parameters tested were height, diameter, sturdiness index, shoot-root ratio, and quality index of *E. pellita* cuttings. The degree of the strong relationship is indicated by the correlation coefficient (r) with numbers -1 to +1 (Hijriani et al. 2016; Katemba and Djoh 2017). The results of the correlation analysis showed that the correlation coefficient of height, diameter, sturdiness index, and quality index of seedlings had an extreme degree of relationship (r > 80%) with seedlings of up to 90 days old (**Table 4**). Morphological characteristics correlate with the appearance of the seedlings after planting in the field, so they are used as the criteria for target seedling. In other studies, several parameters such as height and leaf size often had a low correlation with the appearance of seedlings in the field after planting (Nurhasybi et al. 2019).

Table 4. Age correlation with several morphological parameters of *E. pellita* shoot cuttings

Morphological parameters	Correlation coefficient (r)	Regression equations
Height	0.95	$y = 0.3218x + 4.316$ ($R^2 = 0.902$)
Diameter	0.88	$y = 0.022x + 1.506$ ($R^2 = 0.790$)
Sturdiness index	0.84	$y = 0.048x + 5.435$ ($R^2 = 0.996$)
Shoot-root ratio	0.71	$y = -0.016x + 5.628$ ($R^2 = 0.511$)
Seedling quality index (SQI)	0.96	$y = 0.004x – 0.064$ ($R^2 = 0.926$)

Furthermore, regression analysis was carried out to determine the regression equation between the variables of seedling age and the variables of height, diameter, sturdiness index, shoot-root ratio, and SQI. Shoot-root ratio had a negative relationship with seedling age with a low coefficient of determination ($R^2 = 0.5$), so it was not used as an estimator variable for the age of the seedlings for planting (**Table 4**). The sturdiness index is the best predictor, followed by SQI, to predict the age of the target seedling, with a high coefficient of determination ($R^2 > 0.90$). Both showed a positive relationship with the age of the seedlings. The seedling sturdiness index is an essential parameter for estimating the percentage of live seedlings after planting in the field. Both indexes are parameters that indicate the level of readiness of seedlings to be planted in the field. Sharma et al. (2007) stated that the seedling sturdiness index of *Pinus radiata* was the best predictor for the percentage of plant life up to 1 year of plant life. The prediction of the quality of *E. pellita* seedlings can only be used if the seedlings are planted in cocopeat growing media in a polytube container with optimal seedling maintenance. A forest development program will be successful if there are enough good quality seedlings and a high survival percentage. In general, the age of the seedlings will illustrate the group of seedlings that are ready for planting. Good quality seedlings can grow well and even survive in an environment that is not good in terms of the quality of the place where it grows. Planting with good quality seedlings or plant material is expected to produce plants with a high degree of adaptation, fast initial growth, and appearance that align with expectations (Nurhasybi et al. 2019).

4. Conclusions

The physical quality evaluation of *E. pellita* shoot cuttings aged 45 to 90 days on cocopeat growing media showed that the 75 and 90-days seedlings had fulfilled the physical quality criteria of the target seedlings based on the morphological character criteria (growth, health, and seedling quality index). Therefore, 75 and 90 days of the age of *E. pellita* shoot cuttings can be recommended as the age of target seedlings. The sturdiness index and SQI of *E. pellita* shoot cuttings on cocopeat growing media in polytube had a robust correlation ($r > 0.80$) with the age of the seedlings. The regression equation for the sturdiness index is $y = 0.048x + 5.435$ and the SQI is $y = 0.004x - 0.064$ with a coefficient of determination > 90%.

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