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Effect of donor plants and rooting medium on stem cutting propagation of faloak (*Sterculia quadrifida*)

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Abstract. *Rianawati H, Siswadi. 2020. Effect of donor plants and rooting medium on stem cutting propagation of faloak (*Sterculia quadrifida*). Trop Drylands 4: 31-35.* Faloak (*Sterculia quadrifida* R.Br.) is a semiarid species and an important medicinal plant from Sterculiaceae family. This species is threatened by overexploitation and low seed production, reducing its population in the wild. Thus, planting is necessary to conserve this species, but limited knowledge exists regarding its propagation. The study was conducted to investigate the effect of donor plants and rooting medium on stem cutting propagation of *S. quadrifida*. The stem cuttings from *S. quadrifida* seedlings/juvenile (3.7-8.5 mm in diameter) and *S. quadrifida* trees/mature plants with two different size of diameter, small diameter (5.8-13.8 mm) and large diameter (15.4-24.4 mm), were planted in three various growth medium (soil, soil+manure of 1:1 ratio, and coco peat). The result showed that the survival rates of stem cuttings from juvenile donor plants and mature plants with large diameter were higher (15%-25%) than the survival rate of mature cuttings with small diameter (0%-5%). However, the rooting medium had no significant effect on the survival rate of stem cutting. Additionally, variables measured at the end of the observation, such as the number of roots/cutting, root length, number of nodes, number of leaves, leaf size were not significantly different among the survived stem cuttings from different treatments.

Keywords: Cutting, faloak, stem, *Sterculia quadrifida*

INTRODUCTION

Sterculia quadrifida R.Br., or locally called faloak, is a semi-arid species belongs to Sterculiaceae family. *S. quadrifida* can grow naturally in dry and rocky land at altitudes of up to 1000 m above sea level (Siswadi and Rianawati 2014). In East Nusa Tenggara (NTT) Province, Indonesia, *S. quadrifida* barks are used as a traditional remedy for liver diseases, gastroenteritis, diabetes, rheumatoid arthritis, cancer, typhoid, anemia, hypertension and other internal diseases (Siswadi and Rianawati 2014; Siswadi et al. 2013). Scientifically, many studies revealed that plant parts of *S. quadrifida* contain active compounds (Siswadi et al. 2013) such as antioxidant (Amin et al. 2015; Hilaria and Tarigan 2018; Lulan 2018; Saragih and Siswadi 2019), antivirus (Dean et al. 2019), antifungal (Rollando et al. 2019), antibacterial (Kapitan 2018; Syahruni et al. 2017) and anticancer (Rollando and Alfanaar 2017).

Because of its benefits, the demand for *S. quadrifida*, especially *S. quadrifida* barks, has been increasing nowadays, suggesting that *S. quadrifida* has a considerable high economic value (Siswadi et al. 2016). As a consequence, along with the increasing demand for *S. quadrifida* barks, the rate of *S. quadrifida* exploitation is also getting higher that threatens its sustainability. People tend to harvest *S. quadrifida* bark excessively without considering the regeneration ability of *S. quadrifida*. Such practices lead to a decrease in the number of *S. quadrifida* stands. Therefore, both generative and vegetative propagation should be given more attention to conserve *S. quadrifida*.

A previous study by Siswadi et al. (2012) reported that *S. quadrifida* could be propagated by a generative method. The study also revealed that pre-treatment of scarification of *S. quadrifida* seeds is required to improve the germination rate by soaking *S. quadrifida* seeds in the water for 12 hours. The most suitable medium for *S. quadrifida* seedling to grow was the combination of black soil (grumusol), sand, and manure in a ratio of 1:1:1 (Siswadi et al. 2012). However, generative propagation of *S. quadrifida* has some obstacles because of the limited distribution and seed production of *S. quadrifida*. Even though *S. quadrifida* can grow naturally over several regions in NTT (Timor, Sumba, Alor, Flores Islands) (Siswadi et al. 2013), *S. quadrifida* trees are not eventually distributed in adequate population. Furthermore, many *S. quadrifida* trees in the population do not produce fruit/seed annually or do not flower at the same time, so it is also another obstacle for conducting generative propagation and genetic conservation as well. Thus, vegetative method could be an alternative method for propagating *S. quadrifida*. Moreover, vegetative propagation may shorten the rotation time of *S. quadrifida* as compared to generative propagation method.

Siswadi et al. (2017) studied vegetative propagation of *S. quadrifida* by stem cutting in 2016. However, the results indicated that the survival rate of stem cutting *S. quadrifida* was very low (no more than 7%). According to many

studies on vegetative propagation, the success of cuttings to produce roots is affected by many factors including, the plant parts used for cuttings, the sources of donor plants, plant age, cutting size, planting medium and environmental factors. Hence, the objective of this study was to examine the effect of donor plants and rooting medium on the survival rate of stem cutting propagation of *S. quadrifida*. This paper tests the hypotheses that the juvenile donor plants will improve the survival rate of stem cutting; and the variety of cutting media will have an impact on the rooting growth of stem cutting.

MATERIALS AND METHODS

This research was conducted from January to April 2019 in the nursery of Environment and Forestry Research Development Institute of Kupang, East Nusa Tenggara (NTT) Province, Indonesia.

Plant material source and rooting medium

Cutting materials were taken from two types of donor plants of *S. quadrifida*, namely juvenile and mature donor plants. Juvenile donor plants were collected from 3-year olds *S. quadrifida* seedlings which were maintained in the 25 cm diameter of polybag in the nursery. Whereas, mature donor plants were selected from *S. quadrifida* trees that grow naturally around Kupang regency. In the selection of donor plants, both juvenile and mature plants should be vigor and free from pests and diseases.

The diameter sizes of cuttings that are taken from mature donor plants varied, so these were divided into two different sizes; small diameter (5.8-13.8 mm) and large diameter (15.4-24.4 mm). The range of diameter sizes of stem cuttings from juvenile donor plants was 3.7-8.5 mm. The length of cuttings from both mature and juvenile donor plants was the same (27 cm). Three rooting mediums were used in this experiment, i.e. soil, soil and manure in ratio 1:1, and coco peat.

Figure 1. Stem cuttings of *Sterculia quadrifida* planted in the plastic container then covered by transparent plastic

Experimental procedure

The experiment used a completely randomized design, consisting of nine treatments, and each treatment comprised of 20 stem cuttings as replicates. There were three treatments of the sources of donors and the sizes of diameter (juvenile cutting, small diameter of mature cutting and large diameter of mature cutting); and three treatments of rooting media (soil, soil, and manure (1:1), coo peat). Thus, a total of 180 cutting was observed.

The stem cuttings were soaked in 1% Atonik solution for 30 minutes before planted in the plastic container. Each plastic container represents one treatment, so nine plastic containers were used in this experiment. The plastic container was then covered by transparent plastic to maintain the temperature and humidity of rooting media, as shown in Figure 1. Subsequently, all stem cutting in the plastic containers were kept in the propagation chamber made of wooden stick structure and covered with transparent plastic and paranet for ten weeks. The plastic chamber was used to protect the cuttings from both rainfall and direct sunlight. The stem cuttings were watered every alternate day to avoid desiccation.

Data recording and analysis

The success of stem cuttings was assessed for survival rate, callus formation, and rooting. Data collected in this study included rooting (number of roots, root length and percentage of rooting), callus formation (number of nodes, number of leaves and leaf size), daily temperature, and humidity. The data obtained were tabulated to calculate the survival rate, the percentage of stem rooting and the average temperature and humidity. While the analysis of variance (ANOVA) was carried out using SPSS 16 software package to test for a significant effect of treatment on the number of nodes, the number of leaves, leaf size and root length.

RESULTS AND DISCUSSION

The survival rate of *S. quadrifida* stem cutting is presented in Table 1. Table 1 showed that at the end of observation (10^{th} week), the survival rate of stem cuttings from the juvenile donor and mature donor plant with large diameter (15%-25%) was higher than stem cuttings from mature donor plants with small diameter (0%-5%). The rooting medium had no significant effect on the survival rate of *S. quadrifida* stem cuttings (Table 1).

Table 1. The survival rate of *Sterculia quadrifida* by stem cutting

Rooting medium	Survival rate (%) in 10^{th} week		
	Juvenile	Mature, large diameter	Mature, small diameter
Soil	25	15	5
Soil + manure (1:1)	20	25	5
Coco peat	20	15	0

The stem cuttings began to grow in the first week, indicated by the bud growing, as showed in Figure 2. Then in the second week, the new leaves started to grow (Figure 3). In the third week, almost all of the stem cuttings were growing but started in the fifth week the survival rates decreased continuously (Figure 4) because the cuttings failed to produce roots (Figure 5). According to literature study, the first differentiation during vegetative propagation (stem cutting) is buds and leaf growth, which depend on nutrition reserved in the stem, then followed by root development (Swamy et al. 2002). Hence, when the root formation is left behind from the buds and leaf growth, the survival rate will decrease. The results indicated that the source of donor plants and the diameter of stem cutting had significant effects on the survival rate.

Table 2. The effect of donor plant and rooting medium on the number of the root, root length, number of nodes, number of leaves, leaf size and the bud height among the survived stem cuttings (10^{th}-week observation)

Donor plant	Rooting medium	Number of root/cutting	Root length	Number of Nodes	Number of leaves	Leaf size	Bud height
Juvenile	Soil	2	2.1	1.9	3	3.8x6.2	5.4
	Soil: Manure (1:1)	8	2.4	1.8	2.3	4.4x6.8	5.2
	Coco peat	1.7	3.8	2	2	4.8x7.5	6.5
Mature large diameter	Soil	5.5	3.7	3.5	3.5	6.4x8.7	16
(15.4-24.4 mm)	Soil: Manure (1:1)	5.5	2.3	3.7	5	6.4x10.5	13.1
	Coco peat	5.5	3	4	5	5.9x9.3	13.5
Mature small diameter	Soil	2	1.8	2	4	5.3x7.2	6.5
(5.8-13.8 mm)	Soil: Manure (1:1)	5	2.4	3	4	6.1x9.1	13
	Coco peat	0	0	0	0	0	0

Figure 2. The buds were growing in one week after transplanting

Figure 3. The new leaves started to grow in two weeks after transplanting

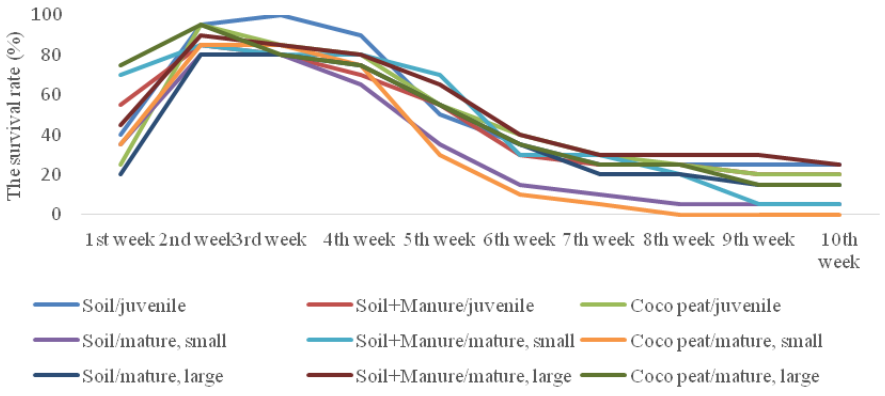

Figure 4. The survival rates of *Sterculia quadrifida* stem cuttings were decreasing from week fifth forward

Figure 5. *Sterculia quadrifida* stem cuttings failed to form roots. The donor plants were taken from mature plants with a small diameter

The stem cuttings from juvenile donor plants effectively improved the survival rate and rooting ability; this result is in line with studies on vegetative propagation of other species such as *Robinia pseudoacacia* and *Grewia optiva* (Swamy st al. 2002), *Dalbergia melanoxylon* (Amri et al. 2010) and *Tectona grandis* (Husen and Pal 2006). Likewise, the cuttings with large diameters derived from mature donor plants also sufficiently increased the survival rate since they had enough reserved food for rooting formation. Similar to research on *Ficus roxburghii* (Rana and Sood 2011) and *Picea abies* (OuYang et al. 2015) that the diameter size increased the survival rate and rooting percentage.

At the end of observation, rooting variables and leaves growth were measured as shown in Table 2. ANOVA revealed that the measured variables of survived cutting were not significantly different among the treatments. The cuttings taken from juvenile donor plants had a better ability to form roots, while the stem cuttings collected from a mature donor with large diameter were better on the above-ground growth variables (shoots and leaves). However, rooting mediums had no consistent effect on the root formation of *S. quadrifida* cutting. Compared to the previous study on stem cutting propagation (Siswadi et al. 2017), the survival rate of stem cuttings in this experiment was increased from up to 6.7% to up to 25%. The average temperature in the plastic tunnel was lower (29ºC) than in the previous study (31ºC) while the humidity was relatively the same around 85%. This experiment was conducted in the wet season while previously was in the dry season, which may affect the survival rate. The study revealed that time, when the donor plants were collected, plays an essential role in increasing root formation (Swamy et al. 2002).

In conclusion, this experiment showed that the donor plants affected the survival rate of stem cutting of *S. quadrifida*. While the rooting mediums had no significant effect on the survival rate. Stem cutting from juvenile donor plants and mature donor plants with large diameters produced a considerably high percentage of survival rate up to 20%. Stem cuttings from juvenile were sufficient in producing roots, whereas stem cuttings from mature donor plant large-diameter were better in producing buds, leaves, and nodes. Thus, *S. quadrifida* is amenable to vegetative propagation.

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