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Research Article

The Growth Response of Rendeu (*Staurogyne elongata* (Neese) Kuntze) to Shoot Pruning and Its Propagation by Shoot Cutting

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ABSTRACT
Rendeu (*Staurogyne elongata* (Neese) Kuntze) is a native Indonesian plant used as food and traditional medicine in the daily life of the people residing around Gunung Halimun-Salak National Park. Due to the potential source of herbal-based medicines and traditional food in the long-run purposes, the proper method of its propagation is required so that Rendeu can be conserved and utilised sustainably. This study employed two research designs. First, a completely randomized design with pruning and IAA (indole-3 acetic acid) treatment was used for seedling growth. Second, plant propagation applied a factorial randomized block design: planting media types and plant growth regulator (PGR) (rootone F) treatment. Observation included the number of buds, number of leaves, number of flowers, plant biomass, root length, and relative chlorophyll content using the SPAD tool. The data were analysed using ANOVA (SPSS ver. 17.0), followed by Pearson correlation analysis. The results showed that applying IAA and leaf pruning could increase the number of buds, the number of leaves and the fresh weight of *S. elongata* plants compared to the control plant. The addition of rootone increased the growth of Rendeu shoot cuttings, shown in all growth parameters and chlorophyll content. Humus was the best media for Rendeu's growth among all planting medium. Planting media affected the increase in the number of leaves and the number of buds of *S. elongata* significantly. The interaction of planting media and PGR somewhat influenced root length and total leaf chlorophyll. The growth and production of *S. elongata* increased with the time of planting.

INTRODUCTION
Indonesia possesses diverse ethnicities, and each uses various plants to meet its daily needs. Rendeu (*Staurogyne elongata* (Neese) Kuntze) is one of Indonesia's native plants that is widely utilized by people residing around Gunung Halimun-Salak National Park (TNGHS), West Java. The previous research (Dewi et al. 2023) reported that Rendeu is the most extensively used for traditional medicine by local people in the Cikaniki area, TNGHS. The Rendeu leaf boiled water is usually consumed to cure diseases such as; kidney problems, liver, and postpartum treatment. People located in five hamlets in the Cikaniki area, namely Garung, Cilanggar, Citalahap Kampung, Citalahab Sentral, and Citalahab

Bedeng, use Rendeu for food (*lalap* and vegetables). Local people believe that the consumption of Rendeu's fresh leaves has significant impacts on health. It is handed down from generation to generation. Sutandi et al. (2017), stated that indigenous vegetable plants have high levels of vitamins and minerals such as vitamin A, vitamin C, calcium, iron (Fe) and zinc (Zn).

Rendeu leaf extract is well-known to have antibacterial and antioxidant activity (Noverita & Sinaga 2021). Reundeu leaf surface is the favourable habitat for specific microflora such as phyllosphere bacteria. They actively inhibit gram-positive bacteria (e.g. *E. coli*) and gram-negative bacteria (e.g. *B. subtilis* and *S. aureus*) (Rizqoh 2009). The five isolates of phyllosphere bacteria had different inhibitory concentrations. Genetic identification showed that those were closely related to the species *Klebsiella pneumoniae*, *Bacillus subtilis*, *Pseudomonas stutzeri*, and *Bacillus sp*. (Rizqoh et al. 2016). The ethyl acetate fraction of Rendeu contains flavonoids, saponins, tannins, steroids and triterpenoids, as well as phenols (Maulani et al. 2017). Previous research highlighted that the ethanolic extract of *S. elongata* leaves has antioxidant and antibacterial activity, containing several compounds, including phytol, oleic acid, valeric acid and stearic acid (Dewi et al. 2023). It indicates that Rendeu has biological activities with health benefit.

The trend of nature-based materials or herbal medicine is growing remarkably. Many pharmaceutical companies compete to find plants raw materials that have medicinal properties (Superani et al. 2008). In general, many indigenous vegetable plants grow wild in open places, such as natural forests, yards, gardens and fields, and-along the river. Sutandi et al. (2017) pointed out that indigenous vegetable cultivation is generally less intensive, so their production level tends to be lower. In the case of Rendeu, they usually grow in shaded areas and are often found on the sidelines of other plants. Cuttings or seedlings can be the two promising propagation techniques for Rendeu. In this study, the cuttings method was selected due to some advantages. Kang et al. (2011) mentioned that the cuttings promoted adventitious buds' growth, and influences morphological and reproductive descriptors, also biomass yield (Sarwar et al. 2020). Some previous research also underlined that applying growth hormone treatment combined with various planting media types could significantly affect the growth of cuttings (Danu et al. 2017; Kumar et al. 2022; Manohar et al. 2022). Concerning the high potential advantages of Rendeu, conservation initiatives and sustainable use are urgently needed, one of which is through plant propagation. The study aims to disseminate and seek the appropriate propagation methods for Rendeu using a combination of pruning, growth hormone, and planting media types. Thus, observing the interaction of the three above factors might help find the best propagation method approach. It leads to assisting sustainable utilization of Rendeu in the context of ex-situ conservation.

MATERIALS AND METHODS

Materials

The study was conducted at the Nursery Unit of the Cibodas Botanic Gardens - Research Center for Plant Conservation, Botanic Gardens and Forestry, National Research and Innovation Agency of Republic Indonesia (BRIN). The plant material source was *Staurogyne elongata* seedlings taken from the mountain forest of Gunung Halimun Salak National Park, West Java (Figure 1). We used Rendeu seedlings with 5-10 cm height in vegetative phase.

Figure 1. *S. elongata* seedlings taken from the mountain forest of Gunung Halimun Salak National Park.

Methods

Shoot Pruning of Rendeu's Mother Plant

This study employed a randomized complete design (RCD), each treatment with 20 replications. The treatment consisted of seedlings with the application of the hormone IAA (indole-3 acetic acid) and the one without the hormone IAA. Pruning of shoots was carried out at the beginning of planting in polybags with a combination of humus-husk media. The addition of IAA was conducted two weeks after planting with a dose of 1 M.

Parameters investigated in this study included the number of shoots, number of leaves, number of flowers, and biomass per plant material. The observation process was carried out for 20 weeks after pruning. Measurement of the production amount of per plant material is conducted by harvesting plant shoots and young leaves. Then, they were calculated as the fresh weight of Rendeu. Furthermore, the dry weight of the yield per plant was obtained by drying the yield per plant at a temperature of 65 ^{o}C for three days.

Vegetative Propagation of Rendeu by Shoot Cutting

The plant material was *S. elongata* shoots taken from the Cibodas Botanical Gardens nursery. The leaves were trimmed from the shoots, then the base of the shoots was slashed. After that, the shoots were immersed in a solution of growth regulators (rootone-F) for 10 minutes. The shoots were planted in a box containing planting media. Rootone-F is primarily used to accelerate plant physiological processes, especially for root primordia formation.

The propagation of Rendeu used a Randomized Complete Block Design (RCBD) with grouping based on the provision of plant growth regulators (PGR). The treatment consisted of two factors arranged in a factorial (Table 1).

Table 1. Design of Rendeu propagation with a RCBD.

Plant growth regulators	Media				
	C	C-HS	H	H-HS	S
NR	NR + C	NR + C-HS	NR + H	NR + H-HS	NR + S
R	R + C	R + C-HS	R + H	R + H-HS	R + S

Notes: C = compost, C-HS = compost and husk (1:1), H = humus, H-HS = humus and husk (1:1), S = sand, NR = non rootone, R = rootone (2 mg/500 ml).

Each treatment combination was repeated nine times. Growth parameters observed included the number of shoots, number of leaves, number of flowers, root length, and relative leaf chlorophyll content. Leaf chlorophyll measurements were conducted using the SPAD-502 Plus tool. The observation process was carried out for 20 weeks after planting.

Data Analysis

The data were analysed using ANOVA (analysis of variance) with SPSS 17.0 software. Moreover, Pearson correlation analysis was carried out to determine the relationship between characters (Gomez & Gomez 1995).

RESULTS AND DISCUSSION

The Growth of *S. elongata* with Shoot Pruning Treatments

The results demonstrated that applying IAA and leaf pruning could increase the number of buds and the number of leaves and flowers of *S. elongata* in humus-husk media. The growth has developed alongside the increased time (weeks). However, bud growth stabilised and decreased between 18 and 20 weeks after pruning (Figure 2). Hence, the plant has entered the generative phase, which focuses on flowering.

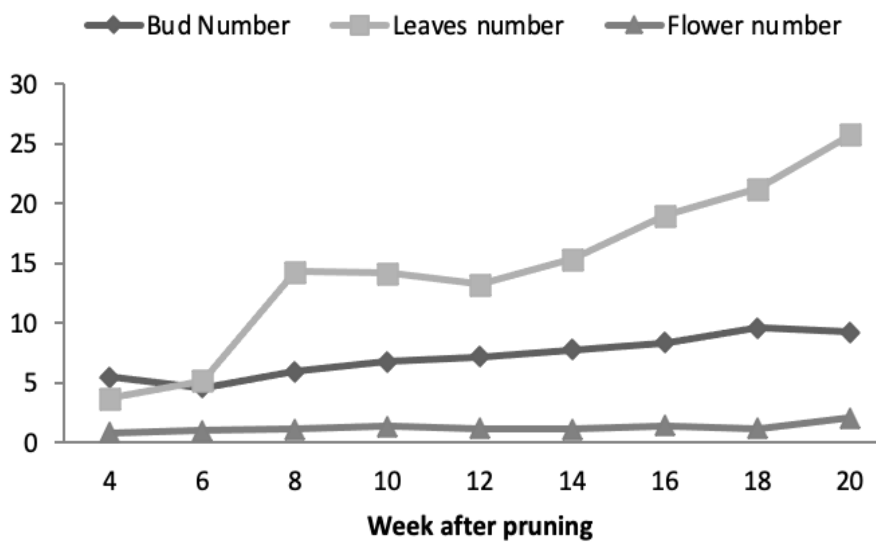

Figure 2. *Staurogyne elongata* growth rate for 20 weeks after pruning.

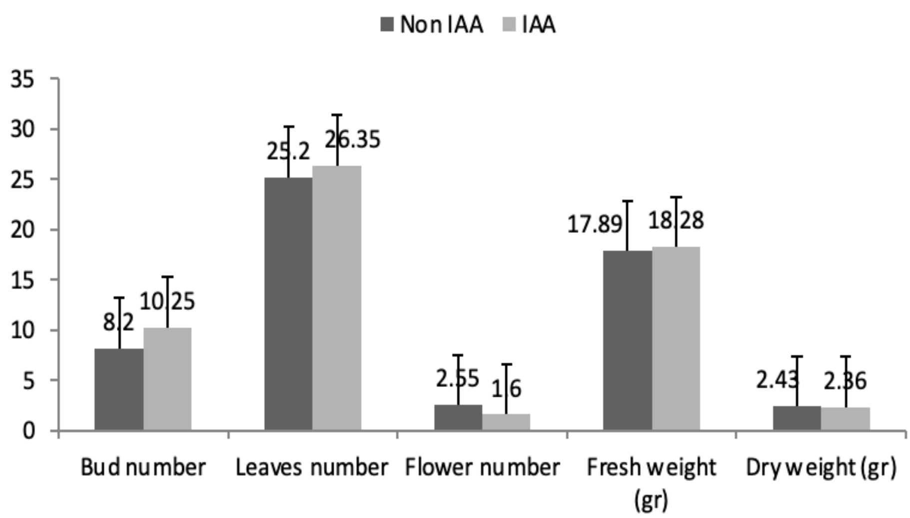

Figure 3. Growth and production of *Staurogyne elongata* by pruning and IAA treatment.

The addition of IAA can raise the number of buds and leaves also plant fresh weight of *S. elongata* compared to treatment without IAA in humus-husk media (Figure 3). Auxins play a vital role in the elongation of plant cells, root formation and root elongation, tropism, apical dominance, ripening fruits, also the promotion of ethylene production. Indole-3-acetic acid (IAA) is the common natural auxin that demonstrates all auxin-doing actions and extensively affects plants physiology (Narula et al. 2000). It is in line with Adinugraha et al. (2006), who underlined that treatment of exogenous growth regulators–containing synthetic auxin can support indigenous auxin to produce a higher percentage of bud than the control. Auxin accelerates the process of cell differentiation to form new cells, which in turn affect the formation of new buds. Those are in accordance with the study results which illustrated an increase in the number of shoots and leaves every week in the IAA treatment.

Based on statistical analysis, the IAA treatment did not exhibit a significant difference in the growth of *S. elongata* compared to the treatment without IAA (Table 2). Plant hormones and plant growth regulators (PGR) encourage plant growth and development. The effect of PGR depends on plant species, the PGR site of action on plants, plant growth stage and concentration of PGR. A PGR does not work alone in influencing the growth and development of plants. In general, some PGR concentrations' equilibrium will control plants growth and development (Fathonah & Sugiyarto 2019). In this study, the application of IAA with a dose of 1 M can increase the fresh weight of the plant, although it is not significant (Figure 3). It means the plant growth regulator provided at that concentration affects the plant growth optimally.

However, the application of IAA has not been able to increase the number of flowers and plant dry weight (Figure 3). On the other hand, auxins play an essential role in hormonal activity for plant flower production, especially for gibberellin formation. Auxin and gibberellin are synergists to flower induction (Hanaa & Safaa 2019). So, the IAA treatment can increase the number of flowers over time, although the yield is not higher than the control treatment.

Meanwhile, the dry weight of plants depends on the speed capability of cells to divide, enlarge, and elongate. The growth of hormones, such as endogenous auxin and cytokinin, can influence cell activity. The addition of some exogenous growth hormones is expected to accelerate the growth process. Auxin affects stem length increment, growth, differ-

Table 2. Effect of pruning and IAA treatment on the growth of *Staurogyne elongate*.

Plant age number	Parameter								
	Bud number			Leaves number			Flower		
	Non IAA	IAA	sig.	Non IAA	IAA	sig.	Non IAA	IAA	sig.
4 WAP	5,60	5,40	ns	3,75	3,70	ns	1,00	0,70	ns
6 WAP	4,15	5,00	ns	4,30	6,10	*	1,40	0,60	ns
8 WAP	5,20	6,70	*	13,85	14,80	ns	1,60	0,60	ns
10 WAP	6,95	6,55	ns	13,05	15,30	ns	1,90	0,80	ns
12 WAP	7,40	6,95	ns	12,00	14,50	ns	1,60	0,75	ns
14 WAP	7,25	8,25	ns	13,50	17,25	*	1,50	0,70	ns
16 WAP	9,10	7,60	ns	17,80	20,25	ns	1,65	1,20	ns
18 WAP	8,90	10,30	ns	19,60	22,85	ns	1,35	1,00	ns
20 WAP	8,20	10,25	ns	25,20	26,35	ns	2,55	1,60	ns

Notes: sig.= significance; ns = not significantly different; * = significantly different at the 5% alpha level; WAP = week after pruning entiation and branching roots (Fathonah & Sugiyarto 2019). Based on plant biomass measurement, it indicated that the dry weight of plants with IAA treatment is no different from the control. It is because the dry weight of the plant is more related to the water content of the plant. In addition, the gibberellins hormone can also promote bud development, stem elongation and leaf growth, influencing growth and differentiation, which affects plant dry weight. Surya et al. (2020) reported that PGR's treatment such as NAA, GA_3, BA could be significantly affecting leaf area, SLA, water content, leaf weight, chlorophyll, stomata and transpiration rate in the seedling of loquat.

Vegetative Propagation of *S. elongata* by Shoot Cutting

The growth of *S. elongata* shoot cuttings has developed alongside the planting time stages. However, flower growth decreased at week 15 after planting (Figure 4). The growth regulator (rootone) treatment increased the growth of Rendeu shoot cuttings, as shown in all growth parameters and relative chlorophyll content (Table 3). The results illustrate that rootone treatment can increase the bud number and root length of *S. elongata*. It corresponds to Adinugraha et al. (2006), the use of growth regulators on breadfruit shoot cuttings significantly produced a higher number of bud and root lengths than that of the control treatment. The use of Rootone-F with a low concentration of 100 ppm resulted in a higher bud number and number of roots than that of the higher concentration. The proper concentration of auxin plays a significant role in cell differentiation. Still, it can be toxic at the above optimum concentration and reduce the yield.

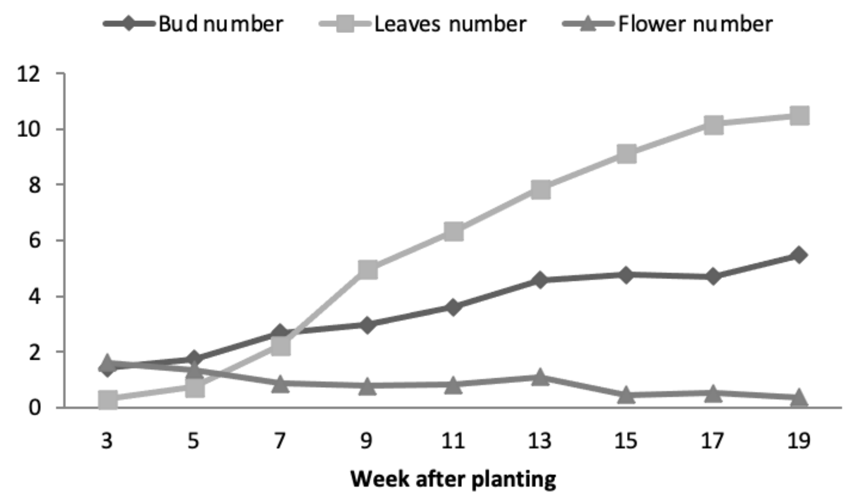

Figure 4. *Staurogyne elongata* shoot cutting growth rate for 19 weeks after planting.

Humus was the best planting media for shoot cuttings of *S. elongata*'s growth (Table 3). It is in line with the research of Normasiwi & Lailaty (2016) that humus media grants the best growth success rate for Violces leaf cuttings, herbs with beautifully coloured flowers. Leaf-based humus is the result of weathering of organic matter by microorganisms. Leaf-based humus has high ion exchange ability, so it can store nutrients. However, the weakness of humus media is that it induces fungus growth quickly once there is a change in temperature, humidity, or extreme aeration.

Planting media affected on the bud number and the number of leaves of *S. elongata* significantly (Table 4). According to Balitbanghut

(2007), planting media is one of the determinants of the success of the root formation process. Media selection must pay attention to several specific characteristics of the media. Good media must have minimal chemical content to interfere with the water absorption process by cuttings. Planting media should have appropriate physical properties, closely related to the ability to bind water and the porosity of the media. The ideal cutting media has sufficient aeration but can bind water. In addition, good media is a hygienic medium or has the low microbial population. The roots formation on cuttings is an initial and critical factor in shoot cuttings treatment. Roots absorb nutrients from the soil and are very influential for the growth of cuttings, especially buds and leaves on *S. elongata.*

This study also measured the relative chlorophyll content of *S. elongata* leaves. Chlorophyll is the most vital pigment in the process of photosynthesis. The amount of chlorophyll per unit leaf area is a crucial indicator of the overall condition of the plant. Healthy plants generally have more chlorophyll than unhealthy plants. This amount of chlorophyll can be used to identify the plants' growth rate and fertility, which can later be linked to predicting the production of these plants (Sukmono et al. 2012). Detection of this chlorophyll content conventionally takes a long time and adequate energy. At the same time, the chlorophyll data is needed quickly for fertility and production analysis. For that, we need a technology that can be used to detect leaf chlorophyll content promptly and efficiently. Then, we employed SPAD to measure the relative chlorophyll content of leaves.

Table 3 displayed that the application of rootone can increase the relative chlorophyll content of *S. elongata* leaves. The interaction of planting media and PGR were significantly different at the 1% alpha level (Table 4). The highest leaf chlorophyll content was produced from plants on humus media in SPAD units. Putri et al. (2016) explained that the SPAD value has a close relationship with plant health. A fertile and well-nourished plant will look green on its leaves and indicate sufficient nitrogen (N) content. Besides, plant productivity will also be higher if the nutrient content is adequate (Cen et al. 2006). Knowing the SPAD value contained in plants will also inform us about the N content of the leaves (Gholizadeh et al. 2009). The chlorophyll meter (SPAD meter) is a non-destructive alternative technology to effectively and efficiently determine the relative chlorophyll content in leaves.

The increase in bud number and the number of leaves were posi-

Table 3. Growth parameters and relative chlorophyll content of *S. elongata* with media and PGR treatments.

Media	Bud number		Leaves number		Flower number		Root length (cm)		Relative Chlorophyll Content (SPAD)	
	NR	R	NR	R	NR	R	NR	R	NR	R
C	11.44±1.02	13.56±3.15	5.11±0.51	8.56±2.27	0.11±0.19	0.11±0.19	4.89±1.73	5.11±2.57	18.57±2.05	21.63±2.05
H-HS	10.56±0.69	11.00±1.45	5.00±0.00	4.11±1.02	0.11±0.19	0.56±0.51	18.83±2.09	18.44±4.22	17.35±2.34	15.66±2.55
H	10.33±2.40	14.11±6.26	7.11±1.95	9.44±4.07	1.00±1.00	0.22±0.39	18.95±3.77	18.00±2.61	27.29±5.06	36.04±3.78
C-HS	8.00±3.61	8.67±3.22	3.33±1.00	2.11±0.19	0.56±0.39	0.44±0.77	7.17±3.46	14.06±3.74	10.05±3.64	14.73±8.14
S	7.78±0.69	9.44±0.69	4.89±1.02	5.00±1.53	0.00±0.00	0.56±0.51	14.78±4.69	14.39±5.06	20.10±3.36	14.57±3.25
Mean	9.62	11.36	5.09	5.84	0.36	0.38	12.92	14	18.67	20.53

Notes: C = compost, H-HS = humus and husk (1:1), H = humus, C-HS = compost and husk (1:1), S = sand, NR = non rootone, R = rootone.

Table 4. Significance of the effect of planting media, growth regulators and their interactions on the growth of *Staurogyne elongata* shoot cuttings.

No.	Parameters	Media	PGR	Interaction
1.	Number of leaves			
	3 WAP	**	ns	ns
	5 WAP	ns	ns	ns
	7 WAP	ns	ns	ns
	9 WAP	ns	**	ns
	11 WAP	ns	**	ns
	13 WAP	ns	*	ns
	15 WAP	ns	ns	ns
	17 WAP	*	*	ns
	19 WAP	**	*	ns
2.	Number of buds			
	3 WAP	ns	**	ns
	5 WAP	ns	*	ns
	7 WAP	**	ns	ns
	9 WAP	ns	ns	ns
	11 WAP	**	ns	ns
	13 WAP	**	ns	ns
	15 WAP	**	ns	ns
	17 WAP	**	ns	**
	19 WAP	**	ns	ns
3.	Number of flower (footstalk)			
	3 WAP	ns	ns	ns
	5 WAP	ns	ns	*
	7 WAP	ns	ns	ns
	9 WAP	ns	ns	ns
	11 WAP	ns	ns	ns
	13 WAP	*	ns	ns
	15 WAP	ns	ns	ns
	17 WAP	ns	ns	ns
	19 WAP	ns	ns	ns
4.	Relative chlorophyll content	**	*	**
5.	Root length (cm)	**	ns	**

Notes: ns = not significantly different; * = significantly different at the 5% alpha level; ** = significantly different at a 1% alpha level; PGR = plant growth regulator; WAP = week after planting

Table 5. Correlation value of three growth characters of *Staurogyne elongata* shoot cuttings.

		Leave number	Bud number	Flower number
Leaves number	Correlation coefficient	1	0.981**	- 0.843**
	Sig.		0.000	0.004
Bud number	Correlation coefficient	0.981**	1	- 0.838**
	Sig.	0.000		0.005
Flower number	Correlation coefficient	- 0.843**	- 0.838**	1
	Sig.	0.004	0.005	

tively correlated. The more of bud number, the more leaves are produced. On the other hand, the number of flowers negatively correlated with the bud number and the number of leaves (Table 5). These are because the formation of flowers is a part of the reproductive phase that focuses on assimilating results in leaves on flower growth and development. The results of Rendeu propagation with PGR treatment and variations of planting media are presented in Figure 5. This is in line with Surya et al. (2021) that the interaction of fertilization and plant growth regulators was significantly affecting the seedling growth such as plant height, number of leaves, bud, stem diameter, roots length, leaf surface area and total biomass. The study's results will be applicable for utilization by the

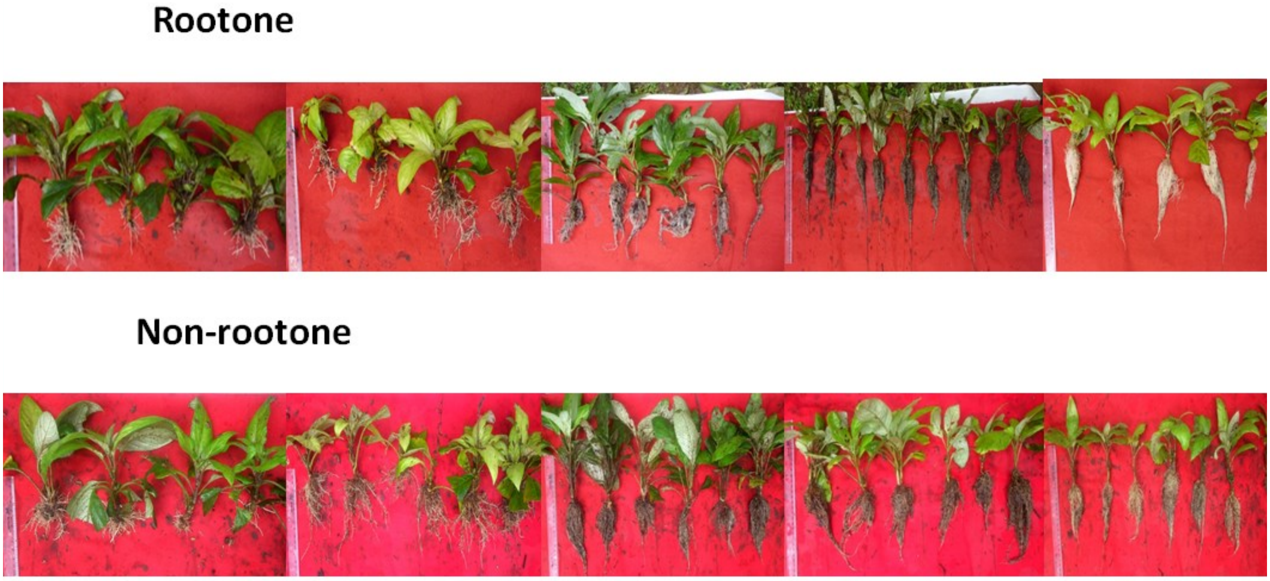

Figure 5. Growth of *S. elongata*'s shoot cuttings in various planting media. The picture from left to right: compost, compost-husk, humus, humus-husk, sand media.

community residing around Mount Halimun-Salak and serve as material sources for further research. Hopefully, this native Indonesian plant can continue to be conserved and more usable.

CONCLUSIONS

The combination of leaf pruning, the IAA hormone treatment, and planting media can promote *Staurogyne elongata's* growth development and production. In this study, the treatment of leaf pruning, IAA 1 M, and humus media indicates the best results on *S. elongata*'s growth parameters. The application of plant growth regulation (rootone-F) can increase the relative chlorophyll content of *S. elongata* leaves. Further research is required to increase the production of *S. elongata* using various combinations of growth regulators and planting media. Thus, the above propagation methods can assist the sustainable utilization of Rendeu.

AUTHOR CONTRIBUTION

M.I.S. designed the research, collected data, analysed data and wrote the manuscript, S.A. collected data and wrote the manuscript, I.Q.L. analysed the data, literature study, and wrote the manuscript.

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CONFLICT OF INTEREST

There is no conflict of interest regarding this research.

REFERENCES

Adinugraha, H.A., Moko, H. & Cepi, C., 2006. Pertumbuhan Stek Pucuk Sukun Asal dari Populasi Nusa Tenggara Barat dengan Aplikasi Zat Pengatur Tumbuh. *Jurnal Penelitian Hutan Tanaman*, pp.93–100. doi: 10.20886/jpht.2006.3.2.93-100.

Balitbanghut, 2007. *Pedoman Pembuatan Stek Jenis-Jenis Dipterokarpa Dengan KOFFCO System.* Bogor: Cooperation between Badan Litbang Kehutanan, KOMATSU and JICA.

Cen, H. et al. 2006. Non-destructive estimation of rape nitrogen status using SPAD chlorophyll meter. *International Conference on Signal Processing Proceedings, ICSP*, 1. doi: 10.1109/ICOSP.2006.344481.

Danu, Putri, K.P. & Sudrajat, D.J., 2017. Effect of media and growth regulators on the propagation of Nyawai (*Ficus variegata* Blume) shoot cutting. *Jurnal Pemuliaan Tanaman Hutan*, 11(1), pp.15–23

Dewi, A.P. et al. 2023. Ethnobotany of food, medicinal, construction and household utilities producing plants in Cikaniki, Gunung Halimun Salak National Park, Indonesia. *Journal of Mountain Science*, 20(1), pp.163-181 doi: 10.1007/s11629-021-7108-5.

Fathonah, D. & Sugiyarto, S., 2019. Effect of IAA and GA3 toward the growing and saponin content of purwaceng (*Pimpinella alpina*). *Nusantara Bioscience*, 1(1), pp.17–22. doi: 10.13057/nusbiosci/n010103.

Gholizadeth, A. et al. 2009. Evaluation of SPAD chlorophyll meter in two different rice growth stages and its temporal variability. *European Journal of Scientific Research*, 37, pp.591–598.

Gomez, K.A. & Gomez, A.A., 1995. *Statistical procedure for agriculture research.* Second eds. Universitas Indonesia Press.

Hanaa, H. & Safaa, A., 2019. Foliar application of IAA at different growth stages and their influenced on growth and productivity of bread wheat (*Triticum aestivum* L.). *Journal of Physics: Conference Series*, 1294(9). doi: 10.1088/1742-6596/1294/9/092029.

Kang, DJ., Ishii, Y. & Nishiwaki, A. 2011. Effects of the shoot-cutting method on field propagation in napiergrass (*Pennisetum purpureum* Schum.). *J. Crop Sci. Biotechnol.*, 14, pp.139–142. doi: 10.1007/s12892-010-0114-8

Kumar, P., Patel, P.K. & Sonkar, M.K., 2022. Propagation through juvenile shoot cuttings in difficult-to-root *Dalbergia latifolia* – examining role of endogenous IAA in adventitious rooting. *Plant Physiol. Rep.*, 27, pp.242–249. Doi: 10.1007/s40502-022-00664-x

Manohar, A.K. et al. 2022. Effects of plant growth regulators and growing media on propagation and field establishment of *Stevia rebaudiana*: a medicinal plant of commerce. *CABI Agric Biosci* 3, 4. doi: 10.1186/s43170-021-00072-5

Maulani, M. I., Purwanti, L. & Dasuki, U. A., 2017. Uji Aktivitas Antibakteri Ekstrak Daun Reundeu (*Staurogyne elongata* (Bl.) O.K) terhadap Staphylococcus aureus dan Eschericia coli. *Prosiding Farmasi*, 3(2), pp.565–569.

Narula, N. et al. 2000. Effect of P-solubilizing Azotobacter chroococcum on N, P, K uptake in p-responsive genotypes grown under greenhouse condition. *J. Plant Nutr. Soil Sci.*, 163, pp.393-398. doi: 10.1002/1522-2624(200008)163:4<393::AID-JPLN393>3.0.CO;2-W

Normasiwi, S. & Lailaty, I. Q., 2016. Inisiasi Perlakuan Media Tanam terhadap Pertumbuhan Stek Daun Violces (*Saintpaulia ionantha* H . Wendl.). *Seminar Nasional Biologi V*, UNNES, pp. 532–538.

Noverita & Sinaga, E., 2021. Antibacterial Bioactivity from Extract of Reundeu Caret (*Staurogyne longata*) and Honje (*Etlingera hemisphaerica*). *Journal of Tropical Biodiversity*, 2(1), pp. 21–32.

Putri, R. E. et al. 2016. Variability of Rice Yield With Respect To Crop Health. *Jurnal Teknologi*, 78(1–2), pp.79–85.

Rizqoh, D., 2009. *Bakteri filosfer daun Reundeu (Staurogyne elongata) penghasil senyawa antibakteri asal Wana Wisata Cangkuang*. Institut Pertanian Bogor.

Rizqoh, D. et al. 2016. Aktivitas Bakteri Filosfer Daun Reundeu (*Staurogyne longata*) Sebagai Penghasil Senyawa Antimikroba Potensial. *Jurnal Analis Laboratorium Medik*, 1(1), pp. 1–7.

Sarwar, A.K.M.G. et al. 2020. Influence of shoot cutting on growth descriptors and biomass yield of Dhaincha plant. *J Bangladesh Agril Univ.* 18(3), pp.585-592. doi: 10.5455/JBAU.116218

Sukmono, A., Handayani, H. H. & Wibowo, A., 2012. Algoritma Estimasi Kandungan Klorofil Tanaman Padi Dengan Data Airborne Hyperspectral. *Geoid*, 8(1), 47. doi: 10.12962/j24423998.v8i1.707.

Superani, R., Hubeis, M. & Purwanto, B., 2008. Prospek pengembangan obat tradisional perusahaan farmasi skala kecil menengah (Kasus PT Molex Ayus Pharmaceutical). *Jurnal MPI*, 3(2), pp.84-98

Surya, M.I. et al. 2020. Plant growth regulators affecting leaf traits of loquat seedling. *Annual Research & Review in Biology*, 35(11), pp.73-85.

Surya, M.I. et al. 2021. Response of loquat seedling growth to interaction between fertilizers and plant growth regulators. *Journal of Physics: Conference Series*, 1811, 012052. doi: 10.1088/1742-6596/1811/1/012052

Sutandi, I. A., Rahayu, A. & Rochman, N., 2017. Pertumbuhan dan Produksi Tanaman Pohpohan (*Pilea melastomoides* (Poir.) Wedd) dan Reundu (*Staurogyne elongate* Kuntze) Berbagai Taraf Naungan. *Jurnal Agronida*, 3(1), pp. 46–52.