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Research Paper

Water apple (*Syzygium samarangense*) cuttings growth in response to a plant growth regulator

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Abstract
This study aims to determine the effect of various doses of plant growth regulator (PGR) Rootone-F on growth of water apple cuttings (*Syzygium samarangense*). The research was carried out at the Balai Pengembangan dan Produksi Benih Tanaman Pangan Hortikultura in the Province of South Sumatra from July 2022 to September 2022. The experimental method used a randomized block design (RBD) which consisted of 4 (four) treatments and 6 (six) replications. The treatments included P0 = (without PGR), P1 = (PGR 100 mg/l water), P2 = (PGR 200 mg/l water), P3 (PGR 300 mg/l water). Parameters observed were the percentage of growing cuttings, branch length, number of branches, root length and number of roots. The results showed that application of the plant growth regulator Rootone-F with dose of 200 mg/l water had the best effect on the percentage of growing cuttings, namely 55.00%, branch length 0.88 cm and root length 6.13 cm, while the treatment with dose 300 mg/l water had the best effect on the growth of the number of roots, namely 5.50.

Keywords
cuttings propagation; guava; plant growth regulator; plant hormone; vegetative propagation; water apple.

1. INTRODUCTION

Citra water apple is belongs to the big water apple species (*Syzygium samarangense*). Water apple is now widely developed throughout Indonesia. It has a sweet fruit taste with a sweetness level reaching 12 to 15 bricks, and has a large fruit size, making water apple a new prima donna as a tropical fruit. This Citra water apple variety has a water content of up to 93% of the total weight and contains vitamins C and A which are good for health. In 100 g of water apple fruit, the nutritional content consists of 80 KJ calories, 90% water, 0.7 g protein, 0.3 g fat, 4.5 g carbohydrates, 1.9 g fiber, 253 IU vitamin A and 8 mg vitamin C (Muna, 2015).

The present review comprehensively and critically discussed the current literature and patents, implicating the therapeutic and pharmaceutical effects of S. aqueum and its active constituents. A search in different electronic databases was carried out to prepare the review. The search terms included "Syzygium aqueum," "water apple," and "Eugenia aquea." The gathered data represented the outstanding effects of S. aqueum in the treatment of diabetes, inflammation, and cancer. The plant also has antiaging effects, which are in general, most likely mediated by the antioxidant properties of the plant and its richness of phytoconstituents like polyphenols and flavonoids (Yassir et al., 2022).

Extracts of leaves, branches, and fruits of green honey deli water apple contain antioxidant activities, according to DPPH and CUPRAC method. According to according to CUPRAC method range from 10.46 to 222.51 mg AAE/g extract. Based on the results, ethanol extracts of green honey deli water apple leaves and branches have the most potential for further research as of discovery and development of antioxidant. The highest TPC was found in ethanol leaves extract (68.14 ±1.69 g GAE/100 g extract) and the highest TFC was found in ethyl acetate leaves extract (18.65 ± 1.04 QE/100 g extract). Phenol and flavonoid compounds gave great contribution to antioxidant activities (Hartati et al., 2022).

Quality of water apple fruit is affected by the growth of new branches as a result of pruning. Branch pruning is done at least once a year. This pruning is done so that a new canopy is formed so that it forms a perfect canopy and will affect the number of water apple fruit produced. Waste from pruning branches or twigs of water apple is usually just thrown away and used as animal feed, whereas it needs to be used optimally as planting material in vegetative plant propagation (Anggraeni et al., 2019).

Plant propagation can be done generatively and vegetatively. Generative plant propagation uses seeds, while vegetative propagation uses plant parts such as roots, stems, twigs and shoots. Cuttings is a technique of vegetative propagation of plants using parts such as shoots, leaves, stems, roots, twigs or branches. The advantage of this cutting is

that it produces new plants in large quantities, has the same characteristics as its parent, as well as faster flowering and fruiting. Cuttings material used for propagation material must come from healthy trees, known quality and origin. Quality cuttings material is produced from mother plants that have already bearing fruit (Duaja et al., 2020).

Material for cuttings should be taken from healthy plants and located on the side exposed to the sun so that it contains enough nutrients to provide food for cuttings. The material for the cuttings is taken from the middle or the top of the branch which is green-brown in color. The cuttings have at least 3 (three) nodes or 3 (three) buds with cutting material length ranging from 10 cm to 15 cm. Cuttings are carried out using an oblique slice which aims to expand the surface and increase the production of the number of roots (Limbongan and Yasin, 2016).

Water apple plant propagation can be done by cuttings and applying natural or synthetic plant growth regulators (PGR) such as Rootone-F. The purpose of using PGR is to stimulate the growth of roots and shoots. Synthetic PGR will be effective at certain concentrations, if the concentration used is too high it can damage the cuttings because cell division will be excessive thereby inhibiting root growth, whereas giving concentrations that are too low results in the giving of these growth regulators being ineffective (Anggraeni et al., 2019).

The purpose of this study was to determine the effect of giving various doses of growth regulator Rootone-F on the growth of cuttings of the Citra water apple (*Syzygium samarangense*). This research is expected to increase knowledge and information about the effect of giving various doses of growth regulators on the growth of cuttings of the water apple image (*Syzygium samarangense*), so that the dose of growth regulator that gives the best effect on the growth of cuttings is obtained.

2. EXPERIMENTAL SECTION

2.1 Research Location and Cultivation Procedures

This research was carried out at the Center for Development and Production of Horticultural Food Plant Seeds in South Sumatra Province, which is located in Suka Maju Village, Sako District, Palembang City. This research was conducted from the first week of July 2022 to the second week of September 2022.

The materials used in this study were cuttings from the mother tree of the water guava tree which was 5 (five) years old. PGR Rootone-F, water (as PGR solvent). The planting medium is in the form of top soil, roasted husks and manure. The tools used in this study included: cutting scissors, bucket, knife, hoe, plastic cup, paranet, UV plastic, PE plastic (15 cm x 30 cm), plastic rope, rubber band, ruler, digital scale and glass measuring.

2.2 Variable observed

Variables observed in this study were included: growth percentage (%), shoot length (cm), number of shoots, root length (cm), number of roots.

2.3 Data Analysis

The treatment was arranged by single factor in randomized block design (RBD) with repeated 6 (six) times. The single factor was 4 doses of PGR as P0 = 0 (control), P1 = Rootone-F 100 mg/l water, P2 = Rootone-F 200 mg/l water, P3 = Rootone-F 300 mg/l water.

3. RESULTS AND DISCUSSION

Rootone-F PGR 200 mg/l (treatment P2) gave the best results with a shoot growth percentage of 55.00% which was very significantly different from treatments P0 and P1, but not significantly different from treatment P3 (Table 1).

Table 1. The effect of PGR Rootone-F dosage on percentage of new shoot from cuttings (%)

Treatment	Percentage of new shoot (%)	$LSD_{0,01}$ = 14.70
P0	31.67	a
P1	41.67	a
P2	55.00	b
P3	43.33	ab

Remarks: Treatment means followed by the same letter in the same column indicated not significant difference at LSD 0.01.

Table 2. Effect of Rootone-F PGR on Shoot Length (cm)

Treatments	Shoot Length (cm)			
	2 WAP	4 WAP	6 WAP	8 WAP
P0	0.21 a	0.34 a	0.41 a	0.46 a
P1	0.23 ab	0.42 ab	0.45 a	0.55 a
P2	0.31 b	0.51 b	0.61 b	0.80 b
P3	0.24 a	0.41 a	0.51 ab	0.66 ab
$LSD_{0.01}$	0.8	0.10	0.17	0.32

Remarks: Treatment means followed by the same letter in the same column indicated not significant difference at LSD 0.01.

Table 2 shows that P2 treatment (200 mg/l) gave the best results for shoot length. The P2 treatment at 2 WAP (weeks after planting) produced a shoot length of 0.31 cm, which was very significantly different from P0 and P3, but not significantly different from the P1 treatment. At 4 WAP,

treatment P2 produced a shoot length of 0.51 cm, which was very significantly different from treatments P0 and P3, but not significantly different from treatment P1. At 6 WAP, treatment P2 produced a shoot length of 0.61 cm which was very significantly different from P0 and P1, but not significantly different from treatment P3. Observations at 8 WAP, treatment P2 resulted in a shoot length of 0.80 cm, which was very significantly different from treatments P0 and P1, but not significantly different from treatment P3.

Table 3. Effect of Rootone-F PGR dose on root length (cm)

Treatment	Root length (cm)	$LSD_{0,01}$ = 1.84
P0	3.13	a
P1	3.55	a
P2	6.13	b
P3	4.58	ab

Remarks: Treatment means followed by the same letter in the same column indicated not significant difference at LSD 0.01.

Table 3 above shows that the application of Rootone-F PGR in treatment P2 (200 mg/l) resulted in the best average root length with a root length of 6.13 cm which was very significantly different from treatments P0 and P1, but not significantly different from P3 treatment.

Table 4. Effect of Rootone-F PGR dose on the number of roots

Treatment	Root length (cm)	$LSD_{0,01}$ = 2.08
P0	1.83	a
P1	2.50	ab
P2	4.00	bc
P3	5.50	c

Remarks: Treatment means followed by the same letter in the same column indicated not significant difference at LSD 0.01.

Table 4 above shows that the appication of PGR Rootone-F in treatment P3 (300 mg/l) resulted in a root number of 5.50 strands which was very significantly different from P0 and P1, but not significantly different from treatment P2.

The results of the analysis of diversity showed that the administration of growth regulator (PGR) Rootone-F had a very significant effect on the parameters of percentage of cuttings growth, shoot length at 2 WAP, 4 WAP, 6 WAP and 8 WAP. PGR Rootone-F also had a very significant effect on the observation of root length and number of roots, but had no significant effect on the growth of the number of shoots aged 2 WAP, 4 WAP, 6 WAP and 8 WAP.

Auxin is able to increase the percentage of cuttings survival. This is supported by the research of Anggraeni et al. (2019) which stated that the giving of Rootone-F was able to increase the survival percentage of Citra water apple cuttings. Auxin can stimulate cell differentiation, cell elongation and root formation, so that the use of PGR at the right dose gives optimal results on the percentage of growing cuttings. The percentage of growth on cuttings is also influenced by several external factors such as temperature and humidity (Pujiasmanto, 2020).

Auxin is a growth regulator that can affect growth such as elongation of shoot cells or shoots in plants (Setiawan, 2022). Aauxin IAA (Indole Acetic Acid) which is produced in the shoots of stems or branches of plants can stimulate the growth of apical shoots and inhibit the growth of lateral shoots, so that the lateral shoots remain in a dormant condition. Apical dominance is the inhibition of the growth of all or part of the lateral shoots caused by increased growth in apical shoot length, causing the lateral shoots to remain in a dormant state (Tamam, 2016). This is also supported by the results of research by Madhav et al. (2023) and Sari et al. (2019) which stated that the use of auxin on cuttings had no significant effect on the growth of the number of shoots.

According to Nugraha (2022) the auxin hormone in plants is found in shoots or shoot tips which has an important role in stimulating growth and root elongation. This is in accordance with the research of Mulyani and Ismail (2015) that the use of Rootone-F on cuttings has a very real effect on the growth of root length.

According to Wiraatmaja (2017) auxin types such as NAA (Naphthalene Acetic Acid) function in root initiation and root growth and administration of relatively high doses can increase the growth of the number of roots. This is also supported by the results of research by Ryadin et al. (2014) that the use of auxin NAA (Naphthalene Acetic Acid) on jamaica guava cuttings gave the best results on root production.

4. CONCLUSION

Based on the research that has been carried out, it can be concluded that the administration of growth regulator Rootone-F has a good effect on the growth of Citra water apple cuttings (*Syzygium samarangense*). Treatment P2 (200 mg/l) had the best effect on shoot length growth of 0.80 cm, root length 6.13 cm and cuttings growth percentage of 55.00%, while P3 (300 mg/l) had the best effect on growth the number of roots is 5.50.

It is necessary to carry out further research by comparing the effect of using PGR Rootone-F with other PGRs to get the best results on the growth of guava cuttings (*Syzygium samarangense*) and sterilize the planting medium and conduct research with a longer observation time.

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