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Rootone-F Concentration and Growing Media for Increasing the Growth of Jasmine Cuttings from Banjar Regency, South Kalimantan Province

Hilda Susanti*, Indya Dewi, Ronaldo Harianto

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ABSTRACT

Jasmine is a superior floriculture commodity in the Banjar Regency with high economic potential. Local jasmine farmers do not yet have operational standards for jasmine propagation. This study aimed to study various concentrations of Rootone-F with growing media to increase the growth of jasmine cuttings from the Banjar Regency. The experiment used a completely randomized factorial design. The first factor was the concentration of Rootone (a_0 = 0, a_1 = 100 ppm, a_2 = 200 ppm, a_3 = 300 ppm, a_4 = 400 ppm) and and the second factor is the growing medium (m1 = soil + chicken manure (1:1), m2 = soil + chicken manure + sand (1:1:1), m3 = soil + chicken manure + rice husk (1:1:1), and m4 = soil + chicken manure + burnt rice husk (1:1:1). The results showed that the interaction between Rootone concentration treatment and growing media significantly affected the number of leaves at 8 WAP. Single treatment with Rootone had a significant effect on budding time. Single treatment with growing media had a very significant effect on the time of budding and the percentage of cutting growth. The recommendation obtained from the results of this study is that the provision of 400 ppm Rootone and a growing medium of soil + chicken manure + burnt rice husks can be used to increase the growth of jasmine cuttings. The results obtained from this study can be used to develop a protocol to produce high-quality jasmine planting material through cuttings.

Keywords: chicken manure, rice husk, Rootone-F

INTRODUCTION

Jasmine (*Jasminum sambac*, *melati*) is declared a national flower and is nicknamed the puspa bangsa, based on the Presidential Decree of the Republic of Indonesia Number 4 of 1993. In South Kalimantan, jasmine plants have been used since ancient times as an inseparable part of the Banjar Tribe culture (Mahyudi and Husinsyah 2021). The flowers are used in ritual activities such as *batapung tawar*, baths, and bouquets (*barenteng*), and are also assembled into wedding equipment as part of makeup. This flower is also used as medicine for fever and headache. The remaining jasmine plants were used as ornamental plants in yards (Ningsih *et al*. 2016). South Kalimantan is one of the three largest jasmine-producing regions in Indonesia, in addition to Central Java and East Java. The production center is in Banjar Regency in two sub-districts, namely Martapura and Karang Intan Districts. Harvest area and flower production continue to increase annually. The harvest area in 2018 was 16.27 ha, increased by 12% to 18.49 ha in 2019 (Central Statistics Agency of South Kalimantan Province 2020) and again increased by 8.78% in 2020 to 20.27 ha. In line with the increase in harvest area, flower production in 2019 was 756.1 t, an increase of 35% (Central Statistics Agency of South Kalimantan Province 2021). In addition to meeting the needs of the province of South Kalimantan, flower production from Banjar Regency also meets the demand of the provinces of Central Kalimantan and East Kalimantan. Increasing jasmine production in South Kalimantan must be prioritized to meet these increasing needs. Increasing production must be supported by appropriate cultivation practices. Cultivation is still traditional in the science of farming, which is believed to be hereditary. Part of the jasmine cultivation that has not yet been given location-specific technical instructions by farmers in the Banjar Regency is the preparation of planting materials. Local farmers have used jasmine stem cuttings as planting materials, without standards for the management and treatment of cuttings, to become good seeds (Indriani *et al*. 2022).

The stems of jasmine plants are woody (Silalahi 2023). The propagation of woody plants using stem cuttings is one of the recommended methods (Ayuningtyas and Sitawati 2019). However, traditional propagation techniques with stem cuttings are often hampered by poor seed quality due to the low percentage of cuttings that take roots and sprouts (Yulia *et al*. 2012). Some of the factors that affect the success of stem cuttings are the condition of the cutting material (including the length of the cuttings, presence of leaves, number of joints, and position of the stem parts taken), season, application of growth regulators, and growing medium (Chaitanya *et al*. 2018). Plant growth regulators from auxin groups such as indole

Agronomy Study Program, Faculty of Agriculture, Universitas Lambung Mangkurat, Banjarbaru 70714, Indonesia
* Corresponding Author: E-mail: hilda.susanti@ulm.ac.id

acetic acid (IAA), indole butyric acid (IBA), naphthalene acetic acid (NAA), and 2,4-dichlorophenoxy acetic acid (2,4-D) have been reported to encourage rooting in cuttings of various plant types, including woody stem cuttings (Singh *et al*. 2017). Rootone-F is a growth regulator that contains auxins and is commercially available, which can promote the formation of root primordia in a short time. However, the use of Rootone-F must focus on the correct concentration to obtain maximum results (Silviana *et al*. 2022). The concentration of Rootone-F has a significant effect on bud emergence speed, plant height, root length, number of roots, wet weight of the plant, and dry weight of the plant from cuttings of several jasmine clones (Gumelar and Handriatni 2019).

Growing media play an important role in the growth of cuttings to produce rapid roots and leaves (Ofodile *et al*. 2013). The use of appropriate growing media can provide optimal environmental conditions. A good medium has sufficient porosity, good aeration, good drainage, high water-binding capacity, and is free of pathogens (Handayani 2006). Growing media in the form of soil and manure provided the best growth at the growth speed and height of the cuttings of two jasmine nodes (Safitri *et al*. 2021). Jasmine cuttings planted on husk charcoal media produce a higher number of shoots, leaves, roots, root length, and percentage of live cuttings than sand planting media, but are not significantly different from alluvial soil media (Muslimah *et al*. 2020).

Research that combines the two in a factorial experiment to increase the growth of jasmine cuttings from the Banjar Regency needs to be conducted. The hypotheses of this study are (1) the interaction between the administration of various concentrations of Rootone-F and the growing medium affects the increase in the growth of jasmine cuttings; and (2) there is a combination of Rootone-F concentration and growing media that results in the growth of the best jasmine cuttings. This study aimed to evaluate the influence of the interaction between various concentrations of Rootone-F and growing media, as well as to obtain a combination of Rootone-F concentration and the best growing media that increases the growth of the best jasmine cuttings from Banjar Regency, South Kalimantan.

METHODS

The material used in this study was jasmine stem cuttings, Rootone (trademark Rootone-F, from PT Rhone-Poulenc Agrocarb, Surabaya, Indonesia) 70% alcohol, polybags (size 7.5 × 18 cm), Ultisol soil, rice husks, burnt rice husks, sand, and chicken manure. The tools used were a cutter (Bison brand), soil sieve, stirrer, oven, and a plastic bucket.

The experimental design was a factorial, complete random design consisting of two factors. The first factor was that the concentration of Rootone-F consisted of five levels: a0 = 0 ppm, a1 = 100 ppm, a2 = 200 ppm, a3 = 300 ppm, and a4 = 400 ppm. The second factor was the planting medium which consists of 4 levels, namely m1 = soil + chicken manure (1:1), m2 = soil + chicken manure + sand (1:1:1), m3 = soil + chicken manure + burnt husk (1:1:1), and m4 = soil + chicken manure + burnt husk (1:1:1). Thus, the 20 treatment combinations were repeated three times.

Implementation of research began with the preparation of growth media. Ultisol taken from the land was drained for one week. Once dried, the soil was sifted using a wire soil sieve. The sifted soil was mixed with other growing media, namely chicken manure, sand, rice husks, and burnt husks, according to their respective treatments with a volume ratio. The mixed growing medium material was placed in polybags.

Rootone-F was prepared at different concentrations. To achieve a concentration of 100 ppm, 100 mg of Rootone was diluted with distilled water to a solution volume of 1000 mL. Similar measurements were taken for other concentrations: 200 ppm (200 mg Rootone in 1000 mL water), 300 ppm (300 mg Rootone in 1000 mL water), and 400 ppm (400 mg Rootone in 1000 mL water).

Plant cuttings were taken from mother trees that had already flowered, and the stems were not too old or too young (Handayani 2006). The stems were cut using sharp, clean cutting scissors 20 cm long (Rahmadani *et al*. 2017), and then the bottom of the stem was cut at an angle of 45° (Directorate of Ornamental Plant Cultivation 2008), and all leaves were removed to reduce evaporation. The cutting material was soaked in Rootone solution for 4 h (Ferianto 2019). The treated cuttings were then planted in each planting medium that had been watered with a plant depth of 5 cm. Each polybag was filled with one stem of cutting and placed according to the layout of the complete random design experimental unit.

Maintenance activities were carried out daily after planting, including watering until 28 days after planting (DAP). Afterward, they were watered every 2 days as needed. The planting medium was sanitized by weed cleaning.

Observations were made at (1) the time of starting sprouting (DAP), that is, when buds appeared were observed every day; (2) the percentage of cuttings growing (%), that is, calculating the number of live cuttings divided by the number of cuttings planted then multiplied by 100%, and observed at 8 WAP; (3) the number of shoots, that is, counting the number of shoots that appeared on each cut planted at 8 WAP; (4) the number of leaves (strands), the number of perfectly open leaves on each cut planted at 8 WAP; and (5) dry weight of the roots (g), by weighing the roots from oven-dried cuttings for 48 h at 70–80°C. The roots were then cleaned and air dried.

The data collected were first analyzed with the Bartlett variety, followed by Analysis of Variance (ANOVA) using the *F* test. If there was a significant difference between treatments, the analysis was followed by Least Significance Difference Test at the 5% test level to determine which treatment is the best for jasmine cutting growth.

RESULTS AND DISCUSSION

Effect of Rootone-F Concentration Treatment Interaction and Growth Media

The interaction between the Rootone concentration treatment and the growing medium had a significant effect on The number of leaves at 8 WAP (Weeks After Planting) (Table 1). The average number of leaves on 8 WAP age jasmine cuttings was influenced by the interaction of Rootone concentration and growth media. The average number of leaves at the eight WAP ranged from 2.28 to 8.88. The highest number of leaves in this study exceeded the leaves number of jasmine cuttings aged 8 WAP that received treatment with coconut water and onion extract in the study by Khair *et al*. (2013), which was 6.89 leaves, but the number of leaves ranged from 4.11 6.89. The highest number was 8.88 leaves was produced by jasmine cuttings obtained from a combination of 400 ppm Rootone and soil-growing media treatment + chicken manure + burnt rice husk. This is in line with the findings by Ulandari *et al*. (2023) that there was an interaction between the treatment of Rootone-F concentration and the growing medium that had a significant effect on the number of leaves of crystal guava branches cuttings at the age of 8 WAP, namely the highest number of leaves produced by the combination of 500 ppm Rootone concentration with soil growing medium + goat manure + rice husk (3:1:1).

The increase in the number of leaves in cuttings is due to good root development so that it can optimally absorb water and nutrients. Root development triggers bud development, which gives rise to the leaves. Leaves that obtain an optimal supply of water and nutrients photosynthesize to produce assimilates. The maximum assimilate translocation to leaf buds will cause an increase in the number of leaves (Dhatrikarani 2019). The combination of 400 ppm Rootone with soil growing medium + chicken manure + burnt rice husk produced the highest number of leaves, possibly because 400 ppm Rootone can increase root growth activity, which is then able to increase bud growth. The growth of buds leads to an increase in the number of leaves due to an increase in the number of joints. The increased growth of shoots and leaves must be supported by the translocation of nutrients and water from the roots to shoots and leaves. Nutrients and water are absorbed by the roots of the growth medium. Soil growing medium + chicken manure + root rice husk is thought to provide a good environment for root growth.

Chicken manure in soil-growing media acts as a nutrient source. Chicken manure contains N, which is high enough that N is absorbed faster by plants than other manure. Elemental N is also needed by plants in large quantities at each stage of plant growth, especially at the stage of vegetative growth, such as leaf development. The N element in fertilizers can spur plants to convert amino acids into proteins (Nurjanah *et al*. 2020). The proteins that are formed are used to produce growth hormones, including auxin. Xiong and Jiao (2019) stated that auxins play an important role in leaf formation and development by stimulating leaf meristem tissue development. The ability of burnt rice husks to support plant growth is thought to be due to their ability to provide sufficient water in the growing medium. According to Guido *et al*. (2024), rice husks that are burned as organic matter form a planting medium that can retain moisture. This is because the burnt husk is more porous because it has almost balanced macro-and micropores, resulting in good air circulation and high water absorption.

Effect of Single Treatment of Rootone-F Concentration and Growing Media

The time of budding onset, number of shoots, percentage of cuttings growing, and dry weight of the roots of the jasmine cuttings were not affected by the interaction of the Rootone-F concentration treatment with the growing medium. Table 2 shows the average time of budding start, number of shoots, percentage of cuttings growing, and dry weight of the root cuttings that received a single treatment with various

Table 1 Average leaves number of jasmine cuttings at various combinations of Rootone-F concentration and growing medium at 8 WAP (Weeks After Planting)

Planting media	Rootone-F concentration (ppm)				
	a_0 = 0	a_1 = 100	a_2 = 200	a_3 = 300	a_4 = 400
Soil + chicken manure	3.46^{ef}	6.35^{de}	3.84^{ef}	6.86^{cd}	2.28^{f}
Soil + chicken manure + sand	7.56^{ab}	5.81^{de}	4.00^{ef}	3.61^{ef}	5.81^{de}
Soil + chicken manure + rice husk	5.11^{de}	6.05^{de}	6.92^{bc}	5.81^{de}	8.07^{ab}
Soil + chicken manure + burnt rice husk	8.07^{ab}	8.53^{ab}	6.00^{de}	7.78^{ab}	8.88^{a}

Remarks: The number followed by the same letter is not significantly different based on the LSD test at the level of 5%.

Table 2 Average growth of jasmine cuttings at various Rootone-F concentrations and planting media

Treatment	Time to start budding (DAP)	Number of buds	Cutting growth percentage (%)	Root dry weight (g)
Rootone-F concentration (ppm)				
a_0 = 0	5.6 a	1.9	69.7	0.15
a_1 = 100	4.8 ab	1.7	75.2	0.16
a_2 = 200	4.7 b	1.8	83.5	0.15
a_3 = 300	4.2 b	1.5	78.0	0.22
a_4 = 400	4.0 c	2.1	83.5	0.19
Planting media				
Soil + chicken manure	5.4 a	1.7	69.2 c	0.10
Soil + chicken manure + sand	5.2 a	1.7	73.6 bc	0.20
Soil + chicken manure + rice husk	4.1 b	1.9	82.4 ab	0.19
Soil + chicken manure + burnt rice husk	4.0 b	2.0	86.8 a	0.10

Remarks: The number followed by the same letter in the column and the same treatment factor did not differ significantly based on the LSD test at the level of 5%.

concentrations of Rootone and growing media. The fastest sprouting start time was 4 DAP on cuttings that received 400 ppm Rootone. These results show that the germination start time is faster than the fastest germination start time in the study of Gumelar and Handriatni (2019), which was 23.9 DAP in jasmine cuttings that received a 3000 ppm Rootone concentration. This proves that the speed at which germination time is determined by the optimal concentration of Rootone-F.

Thomas and Schiefelbein (2004) stated that shoots appear after stem cuttings produce roots. Arinasa (2015) added that Rootone-F contains IBA and NAA, which function as stimulators of cell division that forms a better root system so that it can increase the physiological activity of plants. The germination rate in jasmine stem cuttings that received 400 ppm Rootone compared to the lower concentration in this study is assumed to be a manifestation of the fastest root emergence in cuttings that received the highest Rootone concentration, so that the emergence of these roots promotes the absorption of water and nutrients for faster growth of cuttings.

The jasmine cuttings that received the treatment of soil planting medium + chicken manure with the addition of burnt husks or raw husks showed the fastest germination age, which did not differ significantly at 4 and 4.1 DAP, respectively. This is suspected because jasmine stem cuttings planted in the planting medium with the addition of burnt husks or raw husks give rise to roots faster than other planting media; thus, the transfer of water and nutrients to produce shoots also becomes faster. Putra *et al*. (2017) stated that burnt husk media is a mixture of media that is good enough to drain water, so that the media maintains moisture. Agustin *et al*. (2014) also affirmed that rice husk charcoal has many pores that can increase aeration and high porosity. This trait allows roots to develop quickly. In line with Kusmarwiyah and Erni (2011), soil media added to husk charcoal can improve the porosity of the media so that it is good for root respiration and can maintain soil moisture, because if husk charcoal is added to the soil, the husk charcoal is able to bind water, then released into the micro pores to be absorbed by plants. According to Yelli *et al*. (2021), the addition of raw rice husks prevents the media from easily clumping or compacting so that the roots of the plant can grow perfectly.

Table 2 shows that treatment with Rootone-F concentration and growth media did not affect the number of shoots at 8 WAP. The Rootone concentration treatment produced plants with several shoots of 1.5–1.9, whereas the planting medium treatment produced plants with several shoots of 1.7–2.0. The shoots number of jasmine cuttings treated with Rootone concentration and growing media in this study exceeded the shoots number of jasmine cuttings at the age of 8 WAP that received treatment with various concentrations of onion filtrate, namely 0.0–0.3 buds in the study by Marfirani *et al*. (2014).

The number of shoots in this study was not affected by treatment because the number of shoots that appeared was influenced by the internal conditions of the cutting material used. The cutting material used in this experiment was uniform in both age and size, resulting in several shoots that did not differ significantly. Adriana *et al*. (2014) guessed that the number of shoots is determined by the food reserves contained in cuttings. The age of older cuttings will have a more balanced availability of carbohydrates and nitrogen compared to more juvenile cuttings, so that it is better at supporting the growth of the shoots (Simatupang *et al*. 2020). The cut size, such as the length of the cut, also affects the availability of carbohydrates. The longer the cuttings are used, the more joints have for bud growth (Astiko *et al*. 2018).

The growth percentage of cuttings that received Rootone-F concentration treatment in this study did not differ significantly, namely 69.7–83.5%. The results of this study are not in line with the findings by Netam *et al*. (2018), which showed that the growth percentage of jasmine cuttings up to the age of 8 WAP is influenced

by the concentration of ZPT containing IBA, that is, the maximum growth percentage of jasmine cuttings in the study was 88.3% in the treatment with 1000 ppm IBA. Although the growth percentage of jasmine cuttings in this study was not significantly different, the results showed that cuttings that received the Rootone concentration treatment provided a higher percentage of cuttings growth than those without Rootone.

The growing media in this study had a very real effect on the growth percentage of cuttings. The cuttings with the highest growth percentage (86.8%) were those that received the treatment of soil growing media + chicken manure + burnt rice husk, which was not significantly different from the treatment of soil planting media + chicken manure + rice husk (82.4%). These results are in line with the outcomes of Muslimah *et al*. (2020), in which the highest growth percentage was produced by jasmine cuttings that received the treatment of burnt rice husk planting media, but the highest percentage of cuttings (82.2 %) was lower than the results of this study. The highest percentage of cuttings grown from hedge roses was also obtained in soil with husks or soil with a mixture of husks and manure (Fahmi 2019). The percentage of cuttings that succeed in becoming seedlings is a manifestation of the growth and development of roots and shoots (Awiwi *et al*. 2017), indicating that there is a relationship between the ease of growing media in growing roots and shoots and the percentage of cuttings that grow.

Rootone-F treatment and grow media, both the interaction between the two and single, did not affect the root dry weight of 8 WAP age cuttings. Table 2 shows that the dry weight of roots that received various concentrations of Rootone was 0.15–0.22 g, whereas those that received various growing media were 0.10–0.22 g. The dry weight of these roots was higher than that of jasmine cuttings that received liquid organic fertilizer treatment, which is 0.10–0.17 g in the study by Rahmadani *et al*. (2017). The dry weight of the roots, which was not affected by ZPT and planting media, was also found by Mansur and Kadarisman (2019), that the administration of IBA to various concentrations and combinations of growing media was not effective in supporting the dry weight of eucalyptus roots. This might be because Rootone F is a ZPT that only plays a role in early growth, especially to accelerate the emergence of roots, while the media is a place created to support plant growth and development. The dry weight of the roots reflects the amount of assimilation resulting from photosynthesis in the leaves (*source* organs) that can be translocated to the roots (*sink* organs). The source is the potential capacity for photosynthesis and the sink is the potential capacity for utilizing photosynthetic products. The amount of assimilates that a sink can attract depends on the strength of the *sink* organs present in the plant.

CONCLUSION

It can be concluded that the treatment interaction between the concentration of Rootone-F and the growth medium affects the leaves of jasmine cuttings. The combination of treatments for producing growth in the form of the highest number of leaves is a concentration of 400 ppm Rootone-F and soil growing media + chicken manure + burnt rice husk (1:1:1) can be used for the propagation of jasmine from Banjar Regency, South Kalimantan Province.

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