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Effect of IAA Addition and Some Organic Supplements on Growth and Rooting of Cavendish Banana (*Musa Acuminata*, AAA) In-Vitro

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ABSTRACT

In vitro propagation of Cavendish banana is an alternative to produce healthy, uniform and sufficient plant materials of high qualities. Appropriate culture media formulation is needed for shoot growth and rooting stage. This experiment aimed to study effects of IAA and organic supplements on in vitro shoot growth and rooting. Explants were subjected to MS medium with IAA and various organic supplements, in a factorial arrangement of a completely randomized design. The first factor was IAA concentrations (0; 0.5; 1 and 1.5 mg/L), and the second factor was types of organic supplement (control, coconut water, potato extract and banana extract). At 8 weeks after planting, shoot growth and root performance of plantlets were recorded. The results showed that addition of IAA did not affect shoot height. Addition of potato extract and banana homogenate resulted in the highest plantlets. Medium with IAA at 1 mg/L resulted in the highest number of roots. The highest number of shoots was produced on media with IAA 1 mg/L + coconut water and IAA 1.5 mg/L + potato extract. The highest number of roots was produced in medium with potato extract. The longest roots were produced in media with 0.5 mg/L IAA + banana homogenate.

1. INTRODUCTION

Cavendish banana (AAA) is one type of banana that has high economic value because it has various superior characters, namely having an attractive fruit skin color, thicker and tougher fruit skin, having a favorable aroma and having a relatively long fruit freshness. The nutritional content in bananas consists of carbohydrates, sugars, fiber, vitamins, and proteins so that they are widely popular and beneficial for all people, both little children and adults because of the sweet taste and nutrition content. Based on data from the BPS (2019), banana production in Indonesia from 2016 to 2019 was 7,007.117 tons; 7,162,678 tons; 7,264,379 tons and 7,280,658 tons. This shows that banana production has increased from 2016 to 2019.

Propagation of banana plants is usually done to meet the availability of banana seedlings. Conventional propagation of bananas using tillers has various disadvantages, namely the relatively slow propagation rate, the potential for seedlings to carry pests and disease inoculum, and it takes longer to bear fruit. Cavendish banana propagation through tissue culture can overcome these problems, because it can produce large quantities of disease-free seeds in a relatively short time, the plants bear fruit more quickly and the production is greater than seedlings produced by conventional methods (Kumari & Kumar, 2018). Therefore, propagation through tissue culture or in vitro is an alternative to meet the availability of seedlings in large quantities and can improve quality, one example is being free from pests and diseases (Silalahi, 2015). One of the activities carried out in propagation is multiplication.

In vitro shoot multiplication is an important step which is repeated several times to obtain the desired number of shoots by replanting (subculture) the shoots in new media containing complete nutrients and growth regulators (ZPT). The ZPTs that function to multiply shoots in vitro are cytokinins, or cytokinins and auxins. These PGRs can be synthetic compounds or natural compounds contained in complex organic addenda (Hapsoro & Yusnita, 2018).

The synthetic growth regulator (PGR) used in this study was indoleacetic acid (IAA). IAA is one of auxins that are often used in the banana shoot multiplication stage, which is often combined with cytokinins to multiply the number of shoots (Sipen & Davey, 2012). In addition to PGR, some organic supplements such as coconut water, potato extract and banana extract can also have a positive effect on in vitro shoot multiplication and growth. Coconut water contains auxins, various cytokinins, gases and ABA which are important additives in tissue culture of some plants (Yong *et al*., 2009). Potato extracts added to culture media are known to contain various types of mineral nutrients, vitamins and amino acids that can increase plant growth in vitro (Marpaung, 2019). Banana extract is widely used in in vitro tissue culture because it contains natural auxin and gibberellins hormones and contains nutrients (needed by every plant), namely iron, magnesium, potassium, and phosphorus which affect the growth and development of embryonic shoots (Sitanggang, 2022). Based on the description above, it is necessary to conduct research using synthetic ZPT treatment from IAA and organic supplements from coconut water, potato extract and banana extract combined with several treatment concentrations to determine the best combination of treatments for the growth of Cavendish banana plantlets (*Musa acuminata*).

2. MATERIALS AND METHODS

The research was carried out from April 2021 to June 2021, at the Biotechnology Laboratory, Faculty of Agriculture, the University of Pembangunan Nasional "Veteran" East Java. The plant material used in this study was aseptic Cavendish banana shoots in in vitro culture obtained from the Laboratory of Plantation Seed Development and Production Center, West Java province.

This experiment was carried out using a completely randomized design (CRD) with three replications. The treatments were arranged in a factorial manner with the first factor was IAA and the second factor was the type of organic supplements. The factor of IAA (I) consisted of 4 levels, namely I0 (0 mg/L), I1 (0.5 mg/L), I2 (1.0 mg/L) and I3 (1.5 mg/L). The factor of organic supplement addition (A) consisted of 4 levels, namely A0 (without organic supplements), A1 (coconut water 50 mL/L), A2 (potato extract 50 g/L) and A3 (banana extract 100 g/L). These concentrations were based on the results

of researches that have been done previously. The use of bananas extracts by 100 g/L is recommended by Djanegara (2010), coconut water of 50 ml.L^{-1} is according to Nambiar et al (2012) and potato of 50 g/L is from Aisyah & Sukma (2016). The two factor experimental setup resulted in 16 treatment combinations with 3 replications each of which consisted of 3 samples. Overall there were 144 culture bottles of total, filled with 1 explant each.

The research activities carryed out included sterilization of tools and materials; sterilization of working environment; preparation of IAA solution according to the treatment mentioned. Making 50 mL/L of coconut water hormone was done by filtering 50 mL of coconut water and then mixing it into 1 liter of MS media. Making 50 g/L potato extract was firstly done by cleaning the potatoes in running water and peeling the skin then cut into small pieces to weigh as much as 50 g, then pounded using a mortar and squeezed first using a sterile cloth. After that, 100 ml of distilled water was added to the potatoes that had been filtered using Whatman no.1 filter paper and placed in an Erlenmeyer through a glass funnel. By doing this step the potato extract was ready to use.

Other important step was manufacturing of 100 g/L banana extract first by peeling the banana from the skin then cutting it into small pieces to weigh as much as 100 g. After that the banana was pounded using a mortar and squeezed using a sterile cloth. Distilled water as much as 100 ml was added to the potatoes that had been filtered using Whatman no.1 filter paper and placed in an Erlenmeyer through a glass funnel. Hence the banana extract was ready to use.

Manufacturing of MS media with the basic media used was done by formulating of MS mineral salts (Murashige & Skoog, 1962) with the addition of 0.1 mg/L thiamine H-Cl, 0.5 mg/L pyridoxine H-Cl, 0.5 mg/L nicotinic acid, 2 mg/L glycine, 100 mg/L mio-inositol and 30 g/L sucrose. This basic medium solution was added with IAA and the organic supplements according to the treatment being designed. The media was then adjusted for pH to 5.8 – 6.0 before added with media compactor. The media was compacted by the addition of 7 g/L agar powder, then as much as 30 mL of the media was put into 350 mL culture bottles. At last the media sterilization was carried out using an autoclave at a pressure of 1.5 atm and a temperature of 121^{o}C for 15 minutes. All activities of the Cavendish banana plantlet multiplication were carried out in LAF.

Observations in this study were carried out at the 8th week after planting explants for the parameters of live plantlet percentages, plantlet height, shoot emergence time, number of shoots, number of leaves, root emergence time, number of roots and root length. Data sets were analyzed by using analysis of variance F test at 5% level. If the variance has a significant effect, then a DMRT (Duncan Multiple Range Test) test was carried out at a level of 5% to determine the difference among treatments.

3. RESULTS AND DISCUSSION

3.1. Percentage of living plantlets

The results showed that there was no interaction between IAA media treatment and several kinds of organic supplements based on the percentage of live plantlets of Cavendish bananas. Single treatment of IAA and organic supplements had no significant effect on the percentage of live plantlets of Cavendish bananas either. Effects of IAA and organic supplements on percentage of live plantlets is presented in Table 1.

Table 1. Effects of IAA and organic supplements on percentage of live plantlets

Treatment	Percentage of live plantlets (%)
IAA (mg/L)	
0	90
0.50	97
1	94
1.50	97
Organic supplement	
No organic supplement	85
Coconut water	94
Potato Extract	100
Banana Extract	100

The combination and single treatment between IAA and organic supplements gave no significant effect on the percentage of surviving plantlets of Cavendish bananas. Table 1 shows that the addition of IAA and organic supplements was able to give a positive effect to the growth of Cavendish banana plantlets in the high range of 85% - 100% (regardless of insignificancy). The success of multiplication increases if the explants used are from young meristematic tissue. According to Zulkarnain (2009), young tissue (the explant material was derived from) is a tissue that is actively growing at the beginning of the growth period. Therefore; the high surviving explants were more likely to corespond to the use of young tissue rather, while the effect of IAA and organic supplements at that time were diminished.

3.2. Planlet height (cm)

The results of variance analysis showed that there was no interaction between IAA and various organic supplements in influencing the height of Cavendish banana plantlets. IAA single treatment had no effect on plantlet height of Cavendish bananas, while single treatment of several kinds of organic supplements had a significant effect on plantlet height of Cavendish bananas. The mean height of Cavendish banana plantlets in each treatment is presented in Table 2.

Table 2. Average plantlet height (cm) in response to IAA treatment and several types of organic supplements

Treatment	Planlet height (cm)
IAA (mg/L)	
0	10.20
0,50	12.75
1	12.76
1,50	11.55
Organic Supplement	
No organic supplement	11.17 ab
Coconut water	8.94 a
Potato Extract	13.13 b
Banana Extract	14.01 b

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% DMRT test

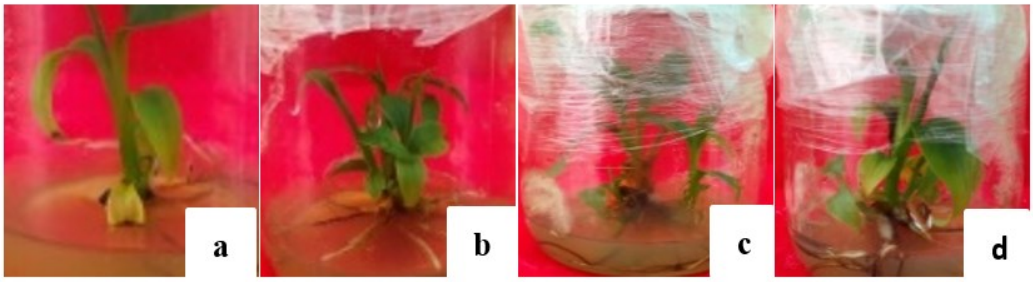

Figure 1. Height of Cavendish Banana Plantlets 8 Weeks After Planting (WAP) at Treatment: a) No organic Supplements; b) Coconut water 50 mL/L; c) Potato extract 50 g/L; d) Banana extract 100 g/L

Table 2 shows that all IAA concentration treatments added to the media produced plantlets with no different heights, which ranged from 10.20 cm to 12.76 cm. Table 2 also shows that supplementation with potato extract and plantain extract resulted in higher mean plantlets than planlets with coconut water supplementation.

The addition of 100 g/L banana extract resulted in the best plantlets which can be seen in Figure 1.d, where it can be seen that the plantlets had the highest number of shoots, leaves, and plantlet heights when compared to other treatments. This is because banana extract has essential elements that increase shoot growth (Kaur & Bhutani, 2012). Results of The research by Rahayu *et al.* (2021) revealed that the results of measuring shoot height showed that a banana concentration of 100 g/l was sufficient for shoot growth. Santi *et al.* (2011) added that stem elongation can occur due to the process of division, enlargement, and cell elongation in the stem tip meristems which causes the plant to grow taller.

The addition of 100 g/l banana extract was also not significantly different from the 50 g/l potato extract in producing the best plantlets. It was stated by Ambarwati *et al.* (2021) that the carbohydrate content in potatoes which serves as a source of energy-producing basic materials for growth and development and if it is present in culture media is also a major factor to support the primordial development of shoots.

Table 2 also shows that 50 ml/L of coconut water gave the lowest plantlet height yield. This is thought to be due to an imbalance between exogenous and endogenous hormones found in Cavendish banana plantlets. According to Alitalia (2008), inappropriate addition of exogenous growth regulators could be because the parent plant used as an explant has a high accumulation of endogenous cytokinins and auxins so it can inhibit the growth of explants.

3.3. Time of Shoots Emergence (days)

The analysis of variance showed that there was no interaction between IAA and several kinds of organic supplements in influencing the timing of the emergence of Cavendish banana shoots. The single treatment of IAA concentration and several kinds of organic supplements also had an insignificant effect on the emergence of Cavendish banana plantlet shoots either. The results of the average time of emergence of Cavendish banana plantlet shoots in each treatment are presented in Table 3.

Based on the results of the study, all treatments were not significantly different on the time of emergence of Cavendish banana plantlet shoots. The average time for Cavendish banana plantlet shoots to appear in all treatments ranged from 4.00 – 5.93 DAP. Shoots that appear on explants indicate the success of the multiplication stage in

tissue culture. According to Yulia *et al*. (2020), the rate of shoot emergence is determined by the conditions of the explants and the use of growth regulators with appropriate concentrations. Cytokinins are growth regulators that can stimulate cell division and development, encourage the process of morphogenesis and help the formation of chloroplasts.

Table 3. Average time of shoots emergence (days) treatment of IAA and several kinds of organic supplements

Treatment	Time of shoots emergence (days)
IAA (mg/L)	
0	4.69
0.50	4.97
1	4.18
1.50	5.36
Organic Supplement	
No organic supplement	4.28
Coconut water	5.93
Potato Extract	4.00
Banana Extract	5.00

3.4. Number of Shoots

The analysis of variance showed that there was an interaction effect between IAA and organic supplements on the number of shoots of Cavendish bananas. IAA single treatment and organic supplement had no significant effect on the average number of shoots per Cavendish banana explant. The results of the average number of shoots per Cavendish banana explant in each treatment are presented in Table 4.

Table 4. Average number of shoots with IAA treatment and several kinds of organic supplements

IAA (mg/L)	Number of Shoots Per Explant			
	No organic supplement	Coconut water	Potato extract	Banana extract
0	1.67 a	2.17 abc	3.72 cd	2.94 abcd
0.50	2.39 abcd	2.17 abc	2.67 abcd	3.22 abcd
1	3.11 abcd	3.83 d	2.56 abcd	3.33 bcd
1.50	2.11 ab	2.72 abcd	3.83 d	2.11 ab

Note: Numbers followed by the same letter in the same column and row are not significantly different in the 5% DMRT test.

There was a significant interaction between the administration of IAA and several organic supplements in influencing the number of shoots per explant. Table 4 shows that the treatment that produced the highest number of shoots was the combination of IAA 1 mg/L + coconut water 50 mL/L and IAA 1.5 mg/L + potato extract 50 g/L, which resulted in 3.83 shoots per explant. The complex content of coconut water, especially the content of the hormone auxin and cytokinin, has a major influence on the growth of in vitro explants. Kristina & Syahid (2012) stated that the chemical content of

coconut water showed the composition of ZPT kinetin (cytokinins) of 273.62 mg/L and zeatin 290.47 mg/L. The results of research from Ubaidah *et al*. (2019), that the treatment with 50 mL/L coconut water and 1 mg/L IAA showed the highest number of shoots, namely 8 shoots on the growth of Raja Bulu banana shoots. Jainol & Jualang (2015) added that the addition of coconut water can stimulate the growth of new shoots. Another treatment that gave a positive response to shoot growth is a combination of 1.5 mg/L IAA + 50 g/L potato extract. Carbohydrate content in potatoes which serves as a source of energy-producing basic ingredients to grow and develop and if present in culture media is also a major factor to support the primordial development of shoots (Ambarwati *et al*., 2021).

Based on Table 4, the combination of IAA banana extract also resulted in the number of shoots which was not significantly different from IAA 1 mg/L + coconut water; IAA 1.5 mg/L + potato extract 50 g/L and IAA 0 mg/L + potato extract 50 g/L. This is because bananas contain hormone compounds auxin and gibberellins which play a role in the process of germination and growth of vegetative organs (Singh *et al*., 2016) and both are correlated in the process of cell elongation. The results of research by Rahayu *et al*. (2021) reveaed that the results of measuring shoot height showed that a banana concentration of 100 g/L was sufficient for shoot growth.

3.5. Number of Leaves

The results of the variance analysis showed that there was no interaction between the concentration of IAA and the type of organic supplements in influencing the number of leaves of Cavendish banana plantlets. The single treatment of IAA concentration and organic supplements had no effect on the number of Cavendish banana plantlet leaves either. The results of the average number of Cavendish banana plantlet leaves in each treatment are presented in Table 5.

Table 5. Effects of IAA Treatment and Several Kinds of Organic Supplements on Average Number of Leaves

Treatments	Number of leaves
IAA (mg/L)	
0	5.92
0.50	7.13
1	7.71
1.50	6.47
Organic supplements	
No organic supplement	6.43
Coconut water	6.35
Potato Extract	7.61
Banana Extract	6.83

Based on the results of the study, all treatments given were not significantly different on the number of leaves. The average number of Cavendish banana plantlet leaves in all treatments ranged from 4.00 – 5.93 DAP. Mahfudza *et al*. (2018) said that endogenous PGR in Cavendish banana shoot explants was able to interact to achieve the right balance with auxin in stimulating the induction of cell division and enlargement in primordial shoots and leaves.

3.6. Time of Root Appearance (days)

The results of variance analysis showed that there was no interaction in the treatment of IAA concentration media and several kinds of organic supplements in term of their effect on the time of emergence of Cavendish banana plantlet roots. The single treatments of the concentration of IAA and several kinds of natural hormones each had a significant effect on the time of emergence of Cavendish banana plantlet roots. The results of the average time of emergence of Cavendish banana plantlet roots in each treatment are presented in Table 6.

Table 6. Mean time of root emergence (days) at the treatment of IAA and several kinds of organic supplements

Treatments	Time of Root Appearance (days)
IAA (mg/L)	
0	9.35 a
0.50	12.40 a
1	12.89 a
1.50	17.00 b
Organic Supplement	
No organic supplement	10.75 a
Coconut water	16.50 b
Potato Extract	12.50 a
Banana Extract	11.89 a

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% DMRT test.

The single treatment of various concentrations of IAA and the addition of several kinds of organic supplements were each able to have a significant effect on the emergence time of Cavendish banana plantlet roots. Increasing the concentration of IAA can slow down the emergence of roots on Cavendish banana plantlets. It can be seen in Table 6 that without IAA the time for Cavendish banana plantlet root emergence was the fastest at 9.35 days, while the IAA concentration treatment which slowed down the time for Cavendish banana plantlet root emergence was at 1.5 ppm IAA concentration treatment at 17.00 days.

The cause of the inhibition of root growth is thought to be due to the inaccurate accumulation of endogenous hormones and exogenous hormones in explants. According to Alitalia (2008), inappropriate addition of exogenous growth regulators could be because the parent plant used as an explant has a high accumulation of endogenous cytokinins and auxins so it can inhibit the growth of explants. This is presumably because if the concentration of auxin is too high, it will synthesize ethylene hormone which can inhibit growth hormone. Schwart *et al*. (2005) added that auxin-induced root formation begins with the formation of meristematic loci of cell dedifferentiation and cell multiplication into a group of cells forming a root meristematic network and cell elongation at the base of the root meristem so that roots begin to emerge.

Single treatment of concentration of several kinds of organic supplements also affected the time of emergence of Cavendish banana plantlet roots. It can be seen in Table 6 that without organic supplements, the addition of potato and banana extracts resulted in root emergence time that was not different, and was faster than the

addition of coconut water. Tuhuteru *et al*. (2012) explained that it was suspected that coconut water with this concentration had a higher cytokinin content than auxin so that it stimulated shoot and leaf growth. In addition, other factors that cause inhibition of root growth are thought to be due to an unbalanced concentration of endogenous hormones in plantlets and exogenous hormones given (coconut water) because according to Ambarwati *et al*. (2021) each plant also has phytohormones including endogenous auxins and cytokinins that influence plant growth responses.

3.7. Number of Roots

The results of variance analysis showed that both IAA and organic supplementation as a single treatment had a significant effect on the average number of Cavendish banana plantlet roots. There was no interaction between IAA and organic supplements in their effect on the number of Cavendish banana plantlet roots. The results of the average number of Cavendish banana plantlet roots in each treatment are presented in Table 7.

Table 7. Average number of roots at the treatments of IAA and several kinds of organic supplements

Treatment	Number of roots
IAA (mg/L)	
0	9.68 a
0.50	9.89 a
1	15.68 b
1.50	13.26 ab
Organic Suplements	
No organic supplement	11.22 ab
Coconut water	10.04 a
Potato Extract	14.38 b
Banana Extract	12.88 ab

Note: Numbers followed by the same letter in the same column are not significantly different in the 5% DMRT test.

The addition of IAA at a concentration of 1 mg/L resulted in the highest average number of roots, namely 15.68 strands (Table 7). Based on the results of the study, IAA 1 mg/L was the appropriate concentration for root formation in Cavendish banana plantlets. This is presumably because the more the concentration is added, the number of Cavendish banana plantlet roots decreases. Louw *et al*. (2018) explained that explants already contained sufficient endogenous auxin content for root growth, if high exogenous auxin was given it would also inhibit root growth. Widiastoety (2014) also added that low light intensity can stimulate endogenous growth regulators to work more actively to carry out the process of root growth and development.

Addition of 50 g/L potato extract resulted in the highest number of roots as many as 14.38 strands. The number of roots was higher than that of the coconut water treatment, but not different from the control and banana extract treatment (Table 7). According to Marpaung (2019), potatoes contain high-quality protein, essential amino acids, minerals, and microelements, as well as being a source of vitamin C (ascorbic acid), several B vitamins (thiamine, niacin, vitamin B6) and mineral P, Mg and K, so it is very suitable to be used as a medium in tissue culture and also enriches the nutrients in the media. Nurhayati (2006) explained that the addition of potato extract in Vacin & Went media had a significant effect on the number of moon orchid plantlet roots.

The provision of 50 mL/L coconut water resulted in the lowest number of roots, which was 10.04 strands. This is presumably because coconut water has a higher cytokinin content than auxin content, so root formation is also inhibited. The results of the analysis of Kristina & Syahid (2012) stated that the chemical content of young coconut water showed the composition of ZPT kinetin (cytokinins) of 273.62 mg/L and zeatin 290.47 mg/L, while the content of IAA (auxin) was 198.55 mg/L.

3.8. Root Length (cm)

The results of variance analysis showed that there was an interaction between IAA and several kinds of organic supplements in influencing the root length of Cavendish banana plantlets. The addition of IAA as a single treatment had no effect on the average root length, but the type of organic supplement that gave a significant effect on the root lenght. The results of DMRT tests on the effect of IAA and several kinds of organic supplements on the average root length of Cavendish banana plantlets at the age of 8 WAT are presented in Table 8.

Table 8. Average root length (cm) at the treatment of IAA and several kinds of organic supplements

IAA (mg/L)	Organic Suplements				Average
	No Organic Suplement	Coconut water	Potato Extract	Banana Extract	
0	6.75 abcd	3.28 a	5.03 ab	7.94 bcd	5.75
0,50	6.94 abcd	5.22 ab	6.50 abc	10.39 d	7.26
1	5.89 abc	7.08 abcd	9.56 cd	5.22 ab	6.94
1,50	5.11 ab	4.56 ab	6.86 abcd	6.83 abcd	5.84
Average	6.17 ab	5.03 a	6.99 ab	7.60 b	

Note: Numbers followed by the same letter in the same column and row are not significantly different in the 5% DMRT test.

There was a significant interaction between the addition of IAA and some organic supplements in influencing the average root length. The treatment that produced the longest root mean was the combination of IAA 0.5 ppm + banana extract 100 g/L which was 10.39 cm which was not significantly different from the combination of IAA treatment 1 mg/L + potato extract 50 g/L which was 9.56 cm (Table 8).). According to Bermawie *et al*. (2000) plantlets with longer roots are expected to have a better absorption area, which will help the plantlets during the acclimatization process of the plant.

The exogenous administration of IAA is thought to assist endogenous auxin activity in stimulating root formation. IAA at low concentrations causes elongation of both shoots and roots. If the IAA is higher, it has the opposite effect, namely inhibiting shoot and root elongation (Aryantha *et al*., 2004). Apensa (2017) stated that bananas contain thiamin which functions to accelerate cell division in root meristems and bananas also contain calcium (Ca) which plays a role in the formation of root hairs and root elongation.

The addition of IAA 1 mg/L and potato extract 50 g/L were also able to interact in affecting the root length of Cavendish banana plantlets. It was suspected that 1 mg/l IAA combined with 50 g/l potato extract was sufficient for the formation of Cavendish banana plantlet roots. Marpaung (2019), said that potatoes contain high quality

protein, essential amino acids, minerals, and microelements, besides being a source of vitamin C (ascorbic acid), several B vitamins (thiamine, niacin, vitamin B6) and mineral P, Mg and K, so it is very suitable to be used as a medium in tissue culture and also enriches the nutrients in the media.

Single treatment of organic supplements affected the root length of Cavendish banana plantlets. Table 8 shows that the addition of 100 g/L banana extract resulted in the longest root mean, which was 7.60 cm. Singh *et al*. (2016) stated that bananas contain elements of calcium (Ca) which play a role in the formation of root hairs and root elongation. This is confirmed by Santi *et al*. (2011) that bananas also contain thiamine and riboblavin which are able to accelerate cell division under culture conditions, and can increase the growth of shoots and roots.

4. CONCLUSIONS AND RECOMMENDATION

The results of this study showed that the addition of IAA had no effect on shoot height, but supplementation with potato and banana extracts produced higher plantlets than that at coconut water supplements. The highest number of shoots was produced in the treatment of IAA 1 mg/L with coconut water supplementation and IAA 1.5 mg/L with potato extract supplementation. The addition of IAA 1 mg/L and potato extract produced the highest number of roots. The average of the longest roots was produced in 0.5 ppm IAA treatment with banana supplements. There was an interaction between IAA and several kinds of organic supplements that affected the number of shoots and root length. The combination of IAA 1 ppm + coconut water 50 ml/L and IAA 1.5 ppm + potato extract 50 g/L resulted in the highest number of Cavendish banana shoots. The combination of 0.5 ppm IAA + banana extract 100 g/L increased root length. The 1.5 ppm IAA concentration treatment gave the longest root emergence time, while the 1 ppm IAA treatment produced the highest number of roots. The supplementation of 100 g/L banana extract and 50 g/L potato extract into the media resulted in higher Cavendish banana shoot length than 50 mL/L coconut water.

It is recommended for further researchers if they want to reduce the use of PGR or synthetic hormones, they can use an organic supplement treatment of banana extract with an increased concentration as a growth medium for Cavendish banana plantlets (*Musa acuminata*) in order to obtain optimal plantlet results.

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