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VEGETATIVE PROPAGATION OF PEAT FOREST TREE'S GERONGGANG (*Cratoxylon arborescens* (Vahl) Blume.) BY SHOOTS CUTTING

(Pembiakan Vegetatif Pohon Hutan Gambut Geronggang (*Cratoxylon arborescens* (Vahl) Blume.) *dengan Metode Stek Pucuk*)

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ABSTRACT

Cuttings system is a plant propagation system which relatively simple and produces good quality's plant material with the similar characteristics as its parent and takes less time. The aims of this research are to get the percentage of live cuttings of *Cratoxylon arborescens* and study the effect of growth regulator IBA 100 ppm, NAA 100 ppm and IBA 50 ppm+NAA 50 ppm against shoots cutting *Cratoxylon arborescens* growth. The material used are seedlings shoots of *Cratoxylon arborescens* with height <1–1,5 m, IBA 100 ppm, NAA 100 ppm, IBA 50 ppm+NAA 50 ppm, and alcohol 70% with media including cocopeat, husks and vermiculite. This research using Completely Randomized Design (CRD) with four treatments consist of IBA 100 ppm, NAA 100 ppm, IBA 50 ppm+NAA 50 ppm, and control. Every treatment consists of 3 repettition (each 50 cuttings). The study showed that growth percentage of live cuttings *Cratoxylon arborescens* was between 51.11–70.37%. The treatment not showed significant effect against five parameters i.e percentage of live cuttings, length of cuttings, root fresh weight, root dry weight, and shoots dry weight. However, significant effect showed on number of roots and shoot fresh weight. Duncan multiple range test was done for number of roots NAA 100 ppm, showed a better effect than control, while for weight wetness shoots IBA 100 ppm have similar effect with control. The conclusion of this research is percentage of live of *Cratoxylon arborescens* cuttings reach 70.37% and the use of NAA 100 ppm can increase the number of roots.

Keywords: *Cratoxylon arborescens* (Vahl) Blume.), cutting system, IBA, NAA, plant vegetative propagation

ABSTRAK

Sistem stek merupakan sistem perbanyakan tanaman yang relatif sederhana dan menghasilkan bahan tanaman yang berkualitas baik dengan karakteristik yang sama dengan induknya dan membutuhkan waktu yang lebih singkat. Penelitian ini bertujuan untuk mendapatkan persentase stek hidup Cratoxylon arborescens *dan mempelajari pengaruh zat pengatur tumbuh IBA 100 ppm, NAA 100 ppm dan IBA 50 ppm+NAA 50 ppm terhadap pertumbuhan stek pucuk* Cratoxylon arborescens. *Materi yang digunakan adalah pucuk bibit Cratoxylon arborescens dengan tinggi <1–1,5 m, IBA 100 ppm, NAA 100 ppm, IBA 50 ppm+NAA 50 ppm, dan alkohol 70% dengan media berupa cocopeat, sekam dan vermikulit. Penelitian ini menggunakan Rancangan Acak Lengkap (RAL) dengan empat perlakuan yaitu IBA 100 ppm, NAA 100 ppm, IBA 50 ppm+NAA 50 ppm, dan kontrol. Setiap perlakuan terdiri dari 3 ulangan (masing-masing 50 stek). Hasil penelitian menunjukkan bahwa persentase pertumbuhan stek hidup* Cratoxylon arborescens *berkisar antara 51,11–70,37%. Perlakuan tidak menunjukkan pengaruh yang nyata terhadap lima parameter yaitu persentase stek hidup, panjang stek, berat basah akar, berat kering akar, dan berat kering pucuk. Namun pengaruh nyata ditunjukkan pada jumlah akar dan berat basah pucuk. Uji jarak berganda Duncan yang dilakukan untuk jumlah akar dan NAA 100 ppm menunjukkan pengaruh yang lebih baik daripada kontrol, sedangkan untuk berat basah pucuk pada IBA 100 ppm memiliki pengaruh yang sama dengan kontrol. Kesimpulan dari penelitian ini adalah persentase hidup stek* Cratoxylon arborescens *mencapai 70,37% dan penggunaan NAA 100 ppm dapat meningkatkan jumlah akar.*

Kata kunci: Cratoxylon arborescens (Vahl) Blume.), IBA, NAA, *perbanyakan tanaman secara vegetative, sistem pemotongan*

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INTRODUCTION

Peat swamp forest has unique characteristics, one of them is being vulnerable to disturbance and difficult to recover if it has been disturbed. Theefore it is necessary to carry out rehabilitation activities on the disturb peatland. *Cratoxylon arborescens* or *Geronggang* is a local species that can be used for rehabilitation, especially for peat swamp forests in Sumatra and Kalimantan. In addition, this species is a pioneer species so that it can grow and stimulate other species to grow in the area.

In an effort to rehabilitate peatlands, large quantities of seeds are needed. This large quantity of seeds is difficult to obtain through generative seed production due to the flowering and fruiting seasons that did not always match the rehabilitation period and the uncertain ability of the seeds to germinate. Therefore, seedling production by using a cutting system should be done. One of the efforts that can be done to accelerate the percentage of rooted cuttings is by adding Growth Regulatory Substances (ZPT) such as the hormones IBA, IAA and NAA. However, it is not yet known how the response to ZPT was given to shoot cuttings of *C. arborescens* (Vahl) Blume. Therefore, it is necessary to conduct research on the effect of giving PGR on the growth of C. arborescens (Vahl) Blume shoot cuttings.

This study is aimed to obtain percent growth from shoot cuttings of *C. arborescens* and to observe the effect of the addition of Growth Regulatory Substances (PGR) in the form of IBA, NAA and a combination of IBA and NAA on the growth of *C. arborescens* shoot cuttings.

METHOD

Material and Equipment Used

The research was conducted in the nursery greenhouse of KOFFCO System, Silviculture Section of the Research and Development Center for Conservation and Rehabilitation (P3KR) Bogor, West Java in August-December 2010.

The material used was the shoots of *C. arborescens* (Vahl) Blume. derived from natural tillers with a height <1–1.5 m, 100 ppm IBA, 100 ppm NAA, 50 ppm IBA + 50 ppm NAA, and 70% alcohol. The media used was a mixture of coconut powder (*cocopeat*) with rice husks in a ratio of 2:1 and vermiculite as the basis of the media. The equipment used were 12 pairs of pot-tray lids, stationery, label paper, measuring cups, rulers, timers, digital scales and branch shears.

Research Design

The research design used in this study was a completely randomized design (CRD) with the following treatments: 1) IBA hormone dose of 100 ppm (A), 2) 100 ppm dose of NAA hormone (B), 3) 50 ppm dose of IBA hormone and 50 ppm dose of NAA hormone (C), and 4) Control (D).

Each treatment in this study had three replications, and in each replication contained 50 stems of shoot cuttings, so that the total unit of observation was 600 stems.

Seven parameters were observed and measured in this study, as follows: Percent life of cuttings, Number of roots, Root length, Roots fresh weight, Root dry weight, Shoot fresh weight, and Shoot dry weight.

Observational data is processed using Completely Randomized Design (CRD) with the following the design model:

$$Yij = \mu + \tau i + \varepsilon ij$$

Where:

Yij = Response value from observations in experimental units that are subjected to treatment level i repetitions to j
μ = General average score
τi = The value of the effect of treatment level i
εij = The error value of the experimental unit that is subjected to the treatment level i to j

The data taken was then further analyzed by using Microsoft Excel software, Minitab version 15 and SAS version 9.1. To distinguish between treatments, Duncan's test was carried out (Gasperz (1994) in Mattjik and Sumertajaya (2000).

Research Sequence

The sequence of research activities included collection and selection of tillers of *C. arborescens*, collection of cuttings material, preparation of media, preparation of hormones, immersion of cuttings material into hormones, planting of cuttings material into lids, watering, and maintenance. The cuttings used are from shoots that have good appearance, straight trunks, fresh leaves, healthy and without defects or wounds.

The shoots are cut with a length of 5-7 cm as many as 600 stems and pruning leaves leaving 2-3 leaves and cutting 2/3 parts. At the base of the cuttings, cut at an angle of ±45o. The cutting material is collected in the form of bundles with a total of 50 stems per bundle.

The media used were rice husk and coconut powder with a ratio of 1:2 as a sowing medium in a lid with a media base in the form of vermiculite. The prepared ZPT consisted of 100 ppm IBA, 100 ppm NAA, and 50 ppm IBA + 50 ppm NAA. The hormone is poured into a different measuring cup. Before the cuttings are soaked with hormones, the cuttings are soaked in water first. Soaking the cuttings into the hormone is done for 15 minutes. Each treatment had 150 replicates planted in three containment, 50 stems each. Activities are carried out in a shady place so that hormones are not damaged by the sun. Planting cuttings into the lid with a total of 50 stems per lid so that there are 12 observation hatches including controls. Watering after planting was carried out before the lid was closed to maintain the humidity of the media and as a treatment during the study.

Data Collection

Data collection was carried out by direct measurement, with the following procedures:

- Percentage of cutting survival : the number of rooted cuttings divided by the total number of cuttings planted for each treatment.

- Number of roots: live cuttings were removed and the number of roots that grew was counted.
- Root length: live cuttings were removed and the root length was measured.
- Root fresh weight : root samples were weighed in fresh (wet) conditions.
- Root dry weight: root samples were weighed after being oven-dried at 60 oC for 24 hours.
- Shoot fresh weight : shoots that grow from cuttings are cut and then weighed in fresh (wet) conditions.
- Shoot dry weight : shoot samples were weighed after being oven-dried at 60 oC for 24 hours.

RESULTS AND DISCUSSIONS

Results

The results of the variance of each parameter are summarized in Table 1. From Table 1, it was found that the treatment had a significant effect on the parameters of the number of roots and shppts fresh weight. There was no significant effect on the other five parameters, namely the percent live cuttings parameters, root length, root wet weight, root dry weight, and shoot dry weight.

Percent growth

Cuttings are considered alive if the condition of the cuttings is still having fresh stems, green leaves, and has a growing roots or shoots. The results of the measurement of the average percent life of cuttings can be seen in Figure 1.

Figure 1 shows that the percentage of cuttings life has various values in the range of 51.11–70.37%. From the results of the variance, it is known that the P-value (0.175) > (0.05) which means that the hormone treatment applied has no significant effect on the percentage of cuttings survival, which can be seen in Table 2.

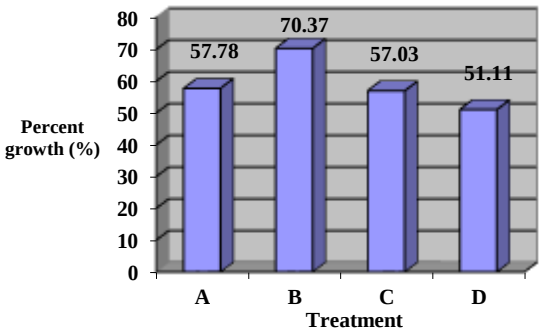
The results of observations on the percent of rooted cuttings with hormone treatment can be seen in Figure 2. In each treatment, 150 cuttings were planted.

Figure 2 shows that the percentage of rooted cuttings produced varied from 20.00% to 34.81%. From the results of the variance, it is known that the P-value (0.418) > (0.05) which means that the hormone treatment applied has no significant effect on the percentage of rooted cuttings, which can be seen in Table 3.

Table 1 Variance Recapitulation

No	Parameter	P-value
1	Percent life	0,418^{tn}
2	Numebr of roots	0,039*
3	Root length	0,050 ^{tn}
4	Root fresh weight	0,618 ^{tn}
5	Root dry weight	0,252 ^{tn}
6	Shoot fresh weight	0,029*
7	Shoot dry weight	0,108 ^{tn}

Note:
tn : Not significant difference(P-value ≥ α (0,05))
* : Significant difference (P-value < α (0,05))



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 1 Average of percent survival of cuttings of *C. arborescens*

Number of roots

The measurement of the number of roots was carried out by counting the number of roots growing.

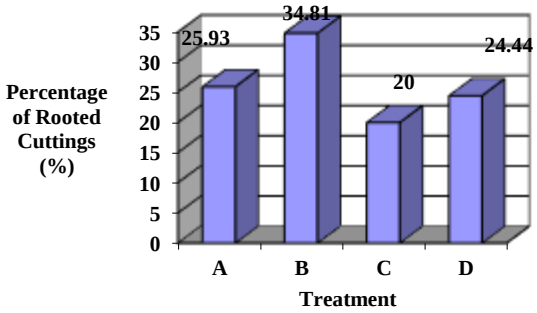
From the data on the number of roots on shoot cuttings of *C. arborescens* (Vahl) Blume. it can be seen that there is a variation in the average value of the number of roots, which is in the range of 2.78-5.12. The results of variance

Table 2 Results of the variance of the percent survival of *C. arborescens* cuttings

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	0,0723	0,0241	2,12	0,175
Error	8	0,0908	0,0114		
Total	11	0,1631			

Table 3 Results of the variance of the percentage life of cuttings

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	0.030	0.010	1.060	0.418
Error	8	0.076	0.009		
Total	11	0.106			



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 2 Percentage of rooted cuttings of *C. arborescens*

showed that P-value (0.039) > (0.05) which means that further tests are needed to determine the effect of each treatment. From the results of Duncan's test, it was seen that 100 ppm NAA had a better effect than the control, while 100 ppm IBA and 50 ppm NAA 50 ppm had a worse effect than the control. This means that the addition of 100 ppm NAA can increase the number of cutting roots, while the provision of 100 ppm IBA and 50 ppm IBA + 50 ppm NAA actually reduces the number of cutting roots. This can also be seen from Figure 4 below.

Root length

Measurement of root length parameters was carried out on each root growing on the base of the shoot cuttings of *C. arborescens* (Vahl) Blume which is presented in Figure 5.

Based on Figure 5, it was obtained that the root length data varied with a value range of 6.29-8.99 cm. From the results of the variance, it is known that the P-value (0.05) = (0.05) which means that hormone treatment does not have a significant effect on root length parameters. The results of the variance can be seen in Table 4.

Root fresh weight

The fresh weight of the roots analyzed by variance was the wet weight of the roots in one replication divided by the number of rooted cuttings. The data is shown in Figure 6.

Based on Figure 4, it is known that the data obtained varied between 0.13-0.26 grams. The results of the analysis of variance showed the P-value (0.618) > (0.05), which means that the treatment did not have a significant effect on the wet weight of the roots. The results of the variance can be seen in Table 5.

Root dry weight

The root dry weight value was obtained from the total root dry weight data in one replication divided by the number of rooted cuttings which can be seen in Figure 7 below.

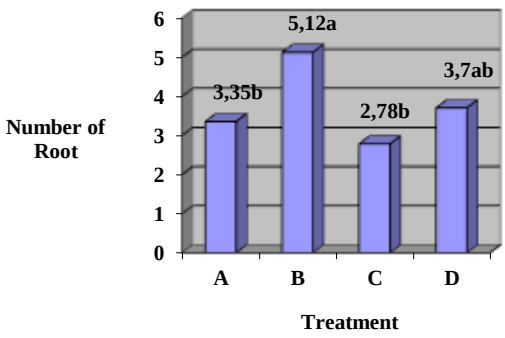
Based on the data from Figure 5, it is known that the results obtained from the treatment varied with a value range of 0.05-0.07 grams. Analysis of the variance of root dry weight showed that the P-value (0.252) > (0.05) which means that hormone treatment had no significant effect on root dry weight. The results of the variance can be seen in Table 6.

Shoot fresh weight

The data used from the wet weight of shoots in the analysis of variance came from the total fresh weight of shoots in one replication divided by the number of rooted cuttings. Can be seen in Figure 8.

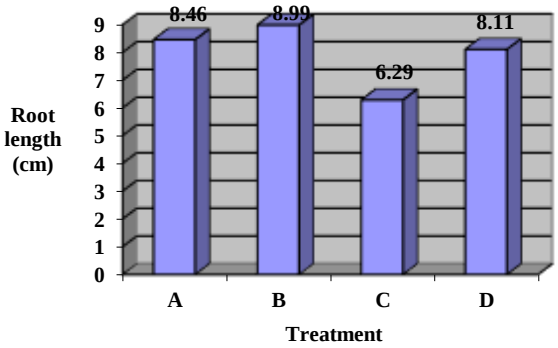
Table 4 Results of root length variance for each treatment

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	224.6	74.9	2.76	0.05
Error	56	1516.8	27.1		
Total	59	1741.4			



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 3 Average number of roots for each treatment



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 5 Average root lenght for each treatment

Figure 4 Arrangement of root cuttings for each treatment

Weighing results of shoots growing on shoot cuttings of C. arborescens (Vahl) Blume. obtained values that vary with the range of values between 0.07-0.12 grams. The results of the analysis of variance on the wet weight parameter of shoots showed that the P-value (0.029) < (0.05) which means that the treatment had a significant effect on the shoot wet weight. From the results of Duncan's follow-up test, it can be seen that the 100 ppm IBA treatment had the same effect as the control, while the 100 ppm NAA and 50 ppm IBA + 50 ppm NAA treatment had a lower effect than the control. This means that there is no better treatment in giving effect because the treatment has the same effect as the control.

Shoot dry weight

The shoot dry weight value was the total shoot dry weight in one replication. To get the shoot dry weight value per rooted cutting, you can divide the shoot dry weight value in one replication by the number of rooted cuttings which can be seen in Figure 7 below.

Based on Figure 9, it can be seen that the variation in the average treatment value is in the range of 0.0344-0.0582 grams. The results of the analysis of shoot dry weight variance showed the P-value (0.108) > (0.05) which means that the hormone treatment did not have a significant effect on.

Discussions

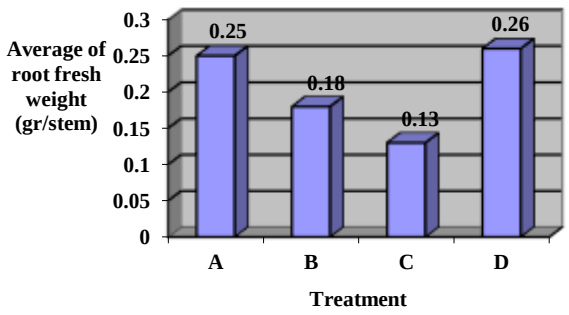
Research on vegetative propagation in general often uses the percentage of survival and the number of rooted cuttings as key indicators of research success. The results of the research showed that the treatment caused variations in the percentage of life with a range of percent values. Cutting life was 51.11–70.37% and the variation in the percentage of rooted cuttings was 20.00–34.81%.

In a vegetative plant propagation system such as using the cutting method, the dominant factor is the root because the root is the part of the plant that determines whether the plant lives or not. In the observation of cuttings, it is often found that cuttings have shoots but are not followed by root growth, seeing these conditions it is certain that these cuttings cannot survive for a long time because the cuttings will run out of food reserves and cannot absorb nutrients in the media.

If the opposite happens, the cuttings have roots but do not have shoots, the cuttings can still survive by absorbing

Table 5 Results of root wet weight variance

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	0.001	0.000	0.63	0.618
Error	56	0.005	0.000		
Total	59	0.006			

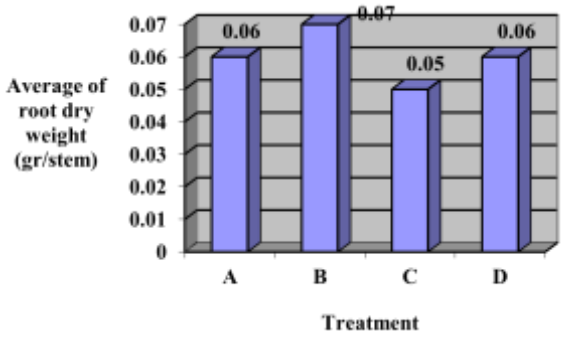


Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 6 Average fresh weight of roots for each treatment

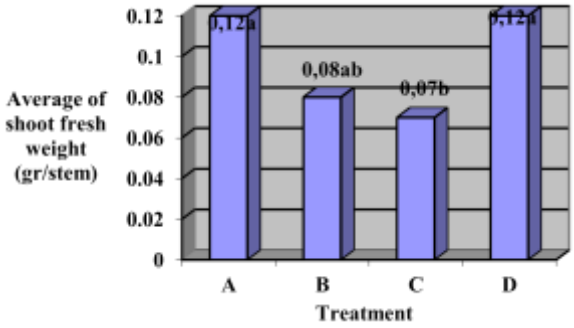
Table 6 Results of root dry weight variance

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	0.001	0.000	1.660	0.252
Error	56	0.002	0.000		
Total	59	0.003			



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 7 Average dry weight of roots for each treatment



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 8 Average wet weight of shoots per rooted cutting

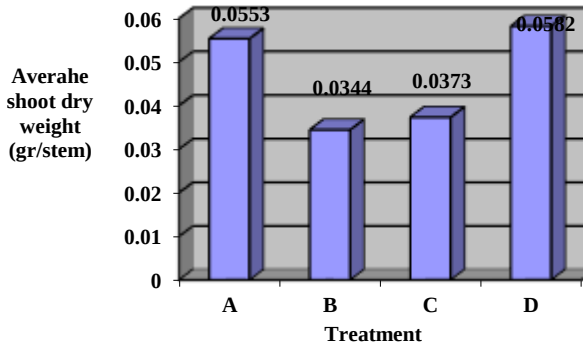
nutrients in the media. Auxin given exogenously (giving ZPT) did not affect the formation of shoots, because the formation of shoots was more influenced by the presence of endogenous cytokinins. Growth and development are controlled by the balance of hormones in the plant. The initiation and formation of shoots is controlled by the interaction between auxin and cytokinin.

The right ratio between auxin and cytokinin will increase cell division and cell differentiation. The content of cytokinins in cells that is higher than auxin will stimulate cells to divide rapidly and develop into shoots, stems, and leaves, while the amount of auxin which is higher than cytokinins will stimulate root growth. If the amount of cytokinin and auxin is balanced, it will stimulate the growth of roots and shoots (Pamungkas et al. 2009). In accordance with this statement, during observations it was seen that there were cuttings that grew only by shoots, only grew roots and grew shoots and roots. This is possible because the condition of the cutting material used has a different amount of auxin and cytokinin content so that the response is different.

In this study, the results showed that the treatment had no effect on five of the seven parameters observed, namely the percentage of live cuttings, root length, root fresh weight, root dry weight, and shoot dry weight. This is because the cutting material used in the study was cutting material derived from the young shoots of natural saplings of *C. arborescens* with a height of >1-1.5 m. The cuttings taken were shoots that had a good physiological condition, namely those that were young, had light-dark green leaves and greenish-brown stems. According to Hartmann et al. 1981 in Hariadi 2007, if the cutting material for woody plants is taken from a young plant, has not flowered and is several years old after the seeds germinate, rooting will be easier than cutting material taken from plants that are old, flowering mature and have fruited.

Table 7 Results of shoot dry weight variance

Source of Diversity	Db	Sum of Square	Middle Square	F-calculation	P-value
Treatment	3	0.002	0.001	2.800	0.108
Error	56	0.002	0.000		
Total	59	0.004			



Note:
A = 100 ppm IBA treatment
B = 100 ppm NAA treatment
C = 50 ppm IBA – 50 ppm NAA treatment
D = Control

Figure 9 Average shoot dry weight for each treatment

Cuttings material that is still young or juvenile does not require additional auxin because in the juvenile phase, cuttings from shoots contain sufficient auxin content to stimulate the formation of roots and shoots, so that if you do cuttings with materials with these properties, there is no need to add PGR because in the absence of The ZPT of the cuttings was also able to grow well, even if there was too much auxin in the cutting material, the cuttings did not grow well, but instead became stunted as the mechanism of ZPT worked. If the ZPT in the plant is in sufficient quantity, it will become a stimulant, but if there is too much it will become an inhibitor.

Based on the results of research of Budiman (2000) ZPT IBA dose had a very significant effect on the number of roots parameters on cuttings of *Shorea balangeran* Korth. In this study of cuttings of *C. arborescens*, the number of roots parameter had a significant effect with the P-value (0.039) < (0.05). To find out which of the treatments had an effect on the number of roots, Duncan's further test was carried out. In Duncan's test results, NAA 100 ppm had a better effect than the control, while giving IBA 100 ppm and IBA 50 ppm + NAA 50 ppm gave a worse effect than control. This means that for the number of roots, cuttings with 100 ppm NAA treatment had more roots than controls, while cuttings treated with 100 ppm IBA and 50 ppm IBA + 50 ppm NAA had fewer roots than the control. Based on these results, 100 ppm NAA could be used to increase the number of roots on shoot cuttings of *C. arborescens*.

In addition to the number of roots parameter, there is one more parameter that has a significant effect, namely the shoot fresh weight parameter which has a significant effect on the 100 ppm IBA treatment. The fresh weight parameter of this shoot had a significant effect with the P-value (0.029) < (0.05). To find out which of the treatments had an effect on the fresh weight of the shoots, Duncan's further test was carried out. Duncan's further test results stated that 100 ppm IBA had the same effect as the control, while the 100 ppm NAA and 50 ppm IBA + 50 ppm IBA had a worse effect than the control. This means that for the shoot fresh weight parameter it is not necessary to give ZPT because it has the same effect as the control.

The results of further tests on these two parameters indicated that the 100 ppm NAA treatment could provide a higher number of roots than the control but for the shoot fresh weight parameter there was no treatment that gave a better effect than the control. The treatment causes variations in the data that describe the optimum potential of the cutting material to grow. The existence of high value variations can cause high deviations so that it has an impact on the conclusion that the treatment does not have a significant effect. However, treatment can be used to increase the number of roots on cuttings by giving 100 ppm NAA. These results were may due to the cutting material used is not uniform, namely the age of the cutting material is unknown and the quality of the parent source is unknown because the cutting material is taken from natural tillers.

Based on the results of a study, we may stated that the combination of IBA and NAA gave more effective results. However, the results of this study on shoot cuttings of *C. arborescens* actually showed the opposite result, namely

the combination treatment between IBA and NAA was actually a treatment with a lower value than the control. This is possible because of the factors that affect the effectiveness of the ZPT work including the concentration used, the location of the ZPT administration activity, the plant growth stadia, amount, and speed of transportation, so further research needs to be done to prove this.

Hartmann et al. (1997) stated that the use of a combination of auxin consisting of IBA and NAA compounds gave a better effect than the use of it alone at the same concentration. This is also supported by the results of Puspitasari's (2008) research which stated that the combination of IBA and NAA gave the best results at the highest average root length value for *Jatropha curcas*. Another study stated that for *Cornus* spp., *Cryptomeria japonica*, *Diospyros* spp., *Eucalyptus* spp., *Euphorbia* spp., *Ginkgo biloba*, and *Hamamelis* spp. got a better effect from the combination of IBA and NAA in high concentrations >1000 ppm (Davies 2010).

The results of Ingle's (2008) research on the effect of the combination of IBA and NAA in various concentrations showed that the combination of 50 ppm IBA and 50 ppm NAA gave results that were not too different from the control, while the use of IBA and NAA alone gave better results. This is possible because of the factors that affect the effectiveness of the ZPT work, including the concentration used, the location of the ZPT administration activity, the plant growth stage, the amount, and the speed of transportation. In this regard, it is necessary to conduct further research to prove this for shoot cuttings of *C. arborescens*.

Based on the results presented for all the parameters observed in this study, it can be seen that the physiological conditions of the cuttings used are still in juvenile condition, so that growth does not require additional ZPT to stimulate root emergence. However, giving ZPT can give better results, although not significantly.

CONCLUSIONS AND SUGGESTIONS

Conclusions

Rooting percentage for shoot cuttings of *C. arborescens* ranged from 20.00–34.81%. The treatment had no significant effect on the percentage of cuttings survival, root length, root wet weight, root dry weight, and shoot dry weight. However, the treatment had a significant effect on two parameters, namely the number of roots and the wet weight of shoots. Duncan further test results stated that for the parameter number of roots the NAA treatment gave a better effect than the control so that 100 ppm NAA could be used to increase the number of roots on cuttings, while for the wet weight parameter of shoots it was known that IBA 100 ppm had the same effect as the control.

Suggestions

Further research is needed in the form of field tests on degraded peatlands for vegetative propagation of C. arborescens to determine the ability of seedlings in nature. In order to obtain a larger number of cuttings, it is advisable to take cuttings from growth rates that are abundant in nature, such as from the sapling or pole stages.

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