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**The effect of rootone-f concentrations and type of  
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(*Dendrocalamus asper* (Schult.) Backer ex Heyne cv. Black)**

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## 研究報告

### The effect of rootone-f concentrations and type of culm cuttings on growth of black *Petung* bamboo (*Dendrocalamus asper* (Schult.) Backer ex Heyne cv. Black)

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#### Abstract

Limited propagation material of black *petung* bamboo (*Dendrocalamus asper* (Schult.) Backer ex Heyne cv. Black) caused us to investigate bamboo culm cuttings as a propagation material. This bamboo variety is very limited particularly in Bali, where it was introduced from Java in 1998. The aims of this research are to understand the effect of Rootone-F concentration and the best culm cutting material for growth of black *petung* bamboo. This research used Randomized Factorial Design between Rootone-F concentrations and type of culm cuttings. The first factor is Rootone-F concentrations, consisting of 0 mg/l, 200 mg/l, 400 mg/l, 600 mg/l, and 800 mg/l. The second factor is culm cuttings, consisting of middle, and top. There are 10 combinations among two factors with 3 repetitions. Analysis variance revealed that the interaction between Rootone-F concentration and kind of culm cutting significantly influenced toward leaf width (sign. 5%) and root length (sign. 1%). In addition, type of culm cutting gave also significantly influence toward shoot number (sign. 1%), leaf number (sign. 5%), leaf width (sign. 5%), root number (sign. 5%), and root length (sign. 1%); while Rootone-F concentration was significantly influence toward shoot height (sign. 5%), leaf number (sign. 5%), leaf width (sign. 5%), and root length (sign. 1 %). The combination between 400 mg/l of Rootone-F and middle culm cutting revealed the first results ranking to leaf number (8.91), and root length (72.17 cm); second ranking to shoot height (38.6 cm), leaf width (61.44 cm<sup>2</sup>) and root number (34.33); third ranking to shoot number (2.78). According to those results, we concluded that 400 mg/l of Rootone-F and middle culm cutting was the best combination among nine other combinations. Rootone-F with concentration of 400 mg/l could be used to enhance growth of middle culm cutting of black *petung* bamboo.

**Keywords:** Rootone-F Concentrations, culm cuttings, *Dendrocalamus asper* cv. Black

## 1. Introduction

Black *petung* bamboo (*Dendrocalamus asper* (Schult.) Backer ex Heyne cv. Black) is one of the bamboos that has important function for Balinese people. There are a lot of functions of black *petung* bamboo, such as for building materials, crafting of home industry (desk, chair, bed, book rack, cupboard and kitchen equipment, etc.), vegetable materials (shoot), absorbing agent, conservation of water and soil and also still many other usages (Ardana 1996; Suradi *et al.* 2003).

For the past ten years, the home building industry that uses bamboo (including black *petung* bamboo) has grown rapidly in some villages in Bali. Therefore, the need of bamboo poles is in great number. Cutting of bamboo as raw material in some fields is increasing, productivity in the fields is steady and many fields are being converted to other uses such as villages for housing, tourism, food production, roads, etc. It is causing a worsening bottleneck in black *petung* bamboo cultivation. There is also a limited supply of seedling material. Generally bamboo farmers produce black *petung* bamboo using rhizome divisions; other seedling techniques like cuttings are still unknown to them. By using this technique they can produce a great many seedlings and doesn't require a long time (Sastrapradja, 1977). Therefore, we conducted research entitled the Effect of Rootone-F Concentrations and Kind of Culm Cuttings on Growth of Black *Petung* Bamboo.

In 2003, Gianyar District needed 17,059 bamboo poles including black *petung* bamboo (Suradi *et al.* 2003). That necessity could not be realized in Bali, thus they ordered from outside of Bali Island. The interest of Balinese to plant black *petung* bamboo is high enough, but their interest can't be realized because the supply of bamboo seedlings is very limited. To solve that problem, we conducted research for using culm cutting in order to improve productivity and efficiency.

The limited availability of black *petung* bamboo caused it to be chosen as an object of propagation research. Because the abundance of black *petung* bamboo is very limited particularly in Bali, where it was introduced in 1998, makes it very difficult to find. The origin of black *petung* bamboo is not certain, but is thought to be somewhere in Java especially Wonosobo areas, Central Java. Black *petung* bamboo is one of monocotyledon classes that commonly used as technique for vegetative propagation. The difficulty of vegetative propagation is that culm cuttings are very difficult to grow. It might be caused by some factors, such as the limitation of provisions at culm cutting, low capability of cell to reduplicate, genetic and other environmental factors (Sutyono, 1999).

Sutyono (1999) mentioned that using culm cutting as material for propagation is very difficult to grow compared to dividing the rhizome. Arinasa (2004) stated that Rootone-F with 400 mg/l concentration could increase the number of root, shoot, and dry oven weight is higher when compared to black *petung* bamboo control.

Using regulator growth, like Rootone-F can increase growth percentage. Rootone-F is compound which consists of the naftalen asetamida combinations, 2-metil-1-nataleasetamida,

2-metil-1-naftaleasetat, oyster and indole-3-butirat (Rismunandar 1994). Auxin of this compound has function as bisection division of cell, magnification of cell, lengthening of cell and formation of roots. This makes it very effective to stimulate bud and root growth (Pierik, 1987).

The aims of this research are to understand the effect of Rootone-F concentration and the best culm cutting on seedlings of black *petung* bamboo (*Dendrocalamus asper* (Schult.) Backer ex Heyne cv. Black).

## 2. Methodology

This research used Randomized Factorial Design between Rootone-F concentrations and type of culm cuttings. The first factor is Rootone-F concentrations, consisting of 0 mg/l(K0), 200 mg/l(K1), 400 mg/l(K2), 600 mg/l(K3), and 800 mg/l(K4). The second factor is culm cuttings, consisting of middle(S1), and top(S2). There are 10 combinations between two factors with 3 repetitions. Each combination is planted in sand media with spacing of 9 x 1 m in the nursery of Bali Botanic Garden (1250 m above sea level.). Data recording is conducted six months after planting. Selecting culms is focused on the existence of at least one internode, one bud or branch. In addition, culms are healthy enough and at least more than 2 - 3 years old. All cuttings have to be soaked one hour with Rootone-F. Measured parameters are shoot height (height of new culm), shoot number (new culm number), leaf number (on each culm), leaf width (on each culm), root number (on each culm), and root length (on each culm). Analysis variance is used for data analysis, if significantly difference, tested by HSD Tukey (Walpole 1995).

## 3. Results and discussions

Analysis variance revealed that the interaction between Rootone-F concentration and kind of culm cutting was significantly influence toward leaf width (sign. 5%) and root length (sign. 1%). In addition, type of culm cutting gave also significantly influence toward shoot number (sign. 1%), leaf number (sign. 5%), leaf width (sign. 5%), root number (sign. 5%), and root length (sign. 1%); while Rootone-F concentration was significantly influence toward shoot height (sign. 5%), leaf number (sign. 5%), leaf width (sign. 5%), and root length (sign. 1 %). Analysis variance of this research is presented as Table 1 - 6 below:

Table 1. Dependent Variable: Shoot Height

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	1192.942(a)	9	132.549	1.982	.097
Intercept	25959.620	1	25959.620	388.098	.000
Type of culm cuttings	233.356	1	233.356	3.489	.077
Rootone-F Concentrations	905.437	4	226.359	3.384	.029
cuttings * concentrations	54.149	4	13.537	.202	.934
Error	1337.785	20	66.889		
Total	28490.347	30			
Corrected Total	2530.727	29			

a R Squared = .471 (Adjusted R Squared = .234)

Table 2. Dependent Variable: Shoot Number

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	25.153(a)	9	2.795	5.074	.001
Intercept	100.211	1	100.211	181.935	.000
Type of culm cuttings	19.473	1	19.473	35.354	.000
Rootone-F Concentrations	5.279	4	1.320	2.396	.085
cuttings * concentrations	.401	4	.100	.182	.945
Error	11.016	20	.551		
Total	136.380	30			
Corrected Total	36.169	29			

a R Squared = .695 (Adjusted R Squared = .558)

Table 3. Dependent Variable: Leaf Number

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	103.826(a)	9	11.536	2.675	.032
Intercept	680.680	1	680.680	157.836	.000
Type of culm cuttings	19.554	1	19.554	4.534	.046
Rootone-F Concentrations	59.435	4	14.859	3.445	.027
cuttings * concentrations	24.838	4	6.209	1.440	.258
Error	86.252	20	4.313		
Total	870.758	30			
Corrected Total	190.077	29			

a R Squared = .546 (Adjusted R Squared = .342)

Table 4. Dependent Variable: Leaf Width

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	4129.452(a)	9	458.828	3.774	.006
Intercept	56062.393	1	56062.393	461.072	.000
Type of culm cuttings	768.412	1	768.412	6.320	.021
Rootone-F Concentrations	1875.154	4	468.788	3.855	.018
cuttings * concentrations	1485.886	4	371.472	3.055	.041
Error	2431.829	20	121.591		
Total	62623.674	30			
Corrected Total	6561.281	29			

a R Squared = .629 (Adjusted R Squared = .463)

Table 5. Dependent Variable: Root Number

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	2891.500(a)	9	321.278	1.293	.300
Intercept	14740.833	1	14740.833	59.335	.000
Type of culm cuttings	1628.033	1	1628.033	6.553	.019
Rootone-F Concentrations	958.000	4	239.500	.964	.449
cuttings * concentrations	305.467	4	76.367	.307	.870
Error	4968.667	20	248.433		
Total	22601.000	30			
Corrected Total	7860.167	29			

a R Squared = .368 (Adjusted R Squared = .083)

Table 6. Dependent Variable: Root Length

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	5974.533(a)	9	663.837	23.850	.000
Intercept	69408.300	1	69408.300	2493.711	.000
Type of culm cuttings	662.700	1	662.700	23.810	.000
Rootone-F Concentrations	3606.950	4	901.738	32.398	.000
cuttings * concentrations	1704.883	4	426.221	15.313	.000
Error	556.667	20	27.833		
Total	75939.500	30			
Corrected Total	6531.200	29			

a R Squared = .915 (Adjusted R Squared = .876)

The combination between 400 mg/l of Rootone-F and middle culm cutting revealed the best results ranking to leaf number (8.91), and root length (72.17 cm); second ranking to shoot height (38.6 cm), leaf width (61.44 cm<sup>2</sup>), and root number (34.33); third ranking to shoot number (2.78). According to those results, we concluded that 400 mg/l of Rootone-F and middle culm cutting was the best combination among nine other combinations (Table 7 Fig.1).

Table 7. The Effect of Rootone-F Concentrations and Kind of Culm Cuttings Toward Shoot Height, Shoot Number, Leaf Number, Leaf Width, Root Number, and Root Length.

Combinations	Shoot Height (cm)	Shoot Number	Leaf Number	Leaf Width (cm <sup>2</sup> )	Root Number	Root Length (cm)
S1K0	22.92	1.78	3.03	30.33	13.33	37.00
S1K1	30.54	2.58	7.71 <sup>2</sup>	64.00 <sup>1</sup>	32.67 <sup>3</sup>	44.17
S1K2	38.60 <sup>2</sup>	2.78 <sup>3</sup>	8.91 <sup>1</sup>	61.44 <sup>2</sup>	34.33 <sup>2</sup>	72.17 <sup>1</sup>
S1K3	28.98	3.11 <sup>1</sup>	4.20	45.01	29.00	59.00 <sup>3</sup>
S1K4	39.99 <sup>1</sup>	2.92 <sup>2</sup>	4.00	40.67	38.33 <sup>1</sup>	51.67
S2K0	18.00	0.50	3.33	28.67	10.00	31.33
S2K1	25.00	0.80	4.00	30.00	14.67	32.33
S2K2	31.31 <sup>3</sup>	0.98	4.98 <sup>3</sup>	43.42	19.67	36.67
S2K3	27.92	1.72	3.80	49.25 <sup>3</sup>	14.00	70.00 <sup>3</sup>
S2K4	30.91	1.11	3.67	39.50	15.67	46.67

Remarks: Rootone-F concentrations, consisting of 0 mg/l (K0), 200 mg/l (K1), 400 mg/l (K2), 600 mg/l (K3), and 800 mg/l (K4). Culm cuttings, consisting of middle (S1), and top (S2).

Remarks: 1,2,3 are quality ranking

Treatment with 400 mg/l Rootone-F concentration was the best concentration that could produce: a) shoot height of 38.6 cm, increased 68.41% compared to control (22.92 cm); b) shoot number of 2.78, increased 56.18% compared to control (1.78); c) leaf number of 8.91, increased 194.06% compared to control (3.03); d) leaf width of 61.44 cm<sup>2</sup>, increased 102.57% compared to control (30.33 cm<sup>2</sup>); e) root number of 34.33, increased 157.54% compared to control (13.33); and f) root length of 72.17 cm, increased 92.45% compared to control (37.00 cm).

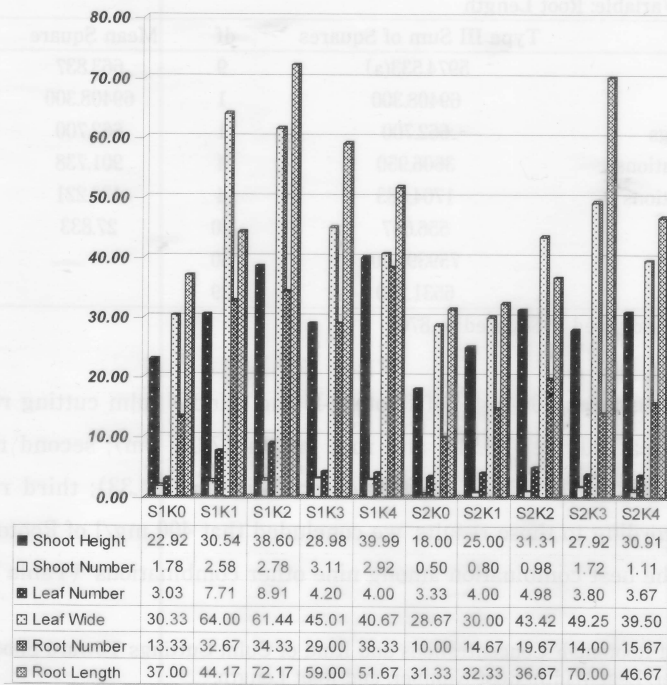


Fig.1. Comparison of the research results

The research results indicated that treatment by middle and top culm cuttings can grow shoots and roots. Middle culm cutting represents the best cutting and gave significantly effect to five measured parameters, such as shoot number, leaf number, leaf width, root number, and root length. Middle cutting with 0 mg/l(S1K0) produced 22.92 cm shoot height or higher than 27.33%, compared to top cutting(S2K0) (18.00 cm); 1.78 shoot number or more than 256%, compared to top cutting(S2K0) (0.5); 3.03 leaf number or less than 9.01%, compared to top cutting(S2K0) (3.33); 30.33 cm<sup>2</sup> leaf width or higher than 5.73%, compared to top cutting(S2K0) (28.67 cm<sup>2</sup>); 13.33 root number or more than 33.3%, compared to top cutting(S2K0) (10.00); and 37.00 root length or higher than 18.10%, compared to top cutting(S2K0) (31.11) respectively. Middle cutting gave better results than top cutting because there are nutrient reserves that exist inside cut culm. It might be caused culm cutting diameter at the middle is bigger than in top culm cutting. Besides that, middle cuttings are full of eye buds.

Statistical results indicated that treatment by Rootone-F at concentration of 400 mg/l gave significantly effects to four measured parameters that have been tested; those are shoot height, leaf number, leaf width, and root length as presented at Table 1, 3, 4, 6. Increasing concentration until 800 mg/l revealed decreased results or the same compared to 400 mg/l. Giving high concentration of Rootone-F means auxin will be higher than usual, and it might destroy (Rochiman and Harjadi, 1973).

Concentration treatment of 400 mg/l Rootone-F was the best propagation technique for black *petung* bamboo that using middle culm cutting. It is comparable with propagation results of



*Guadua (Guadua chacoensis)*, using branch cutting with 400 mg/l concentration (Arinasa 2004). It is also supported by Sumiasri *et al.* (2001) that giving 0.4% concentration of IAA and IBA gives the highest mean numbers to all measured parameters of bamboo branch cuttings.

#### 4. Conclusions

1. Analysis variance revealed that the interaction between Rootone-F concentration and kind of culm cutting was significantly influence toward leaf width (sign. 5%) and root length (sign. 1%). In addition, kind of culm cutting gave also significantly influence toward shoot number (sign. 1%), leaf number (sign. 5%), leaf width (sign. 5%), root number (sign. 5%), and root length (sign. 1%); while Rootone-F concentration was significantly influence toward shoot height (sign. 5%), leaf number (sign. 5%), leaf width (sign. 5%), and root length (sign. 1%).
2. The combination between 400 mg/l of Rootone-F and middle culm cutting revealed the best results ranking to leaf number (8.91), and root length (72.17 cm); second ranking to shoot height (38.6 cm), leaf width (61.44 cm<sup>2</sup>), and root number (34.33); third ranking to shoot number (2.78). According to those results, we concluded that 400 mg/l of Rootone-F and middle culm cutting was the best combination among nine other combinations.
3. Rootone-F with concentration of 400 mg/l could be used to enhance growth of middle culm cutting of black *petung* bamboo.

#### 5. Acknowledgement

We would like to thank Dr. Cliff Sussman of the American Bamboo Society who gave much information. He has also kindly and critically read this manuscript.

#### 6. References

- Ardana IB (1996) Data Bali Membangun. Bappeda Tingkat I, Bali.
- Arinasa IBK (2004) Pengaruh beberapa jenis dan konsentrasi zat pengatur tumbuh terhadap pertumbuhan stek cabang bambu *Guadua chacoensis* (Rojas) X. Londono & P.M. Peterson). Master's Tesis Udayana University, Bali.
- Pierik RLM (1987) In vitro culture of higher plants. Martinus Nijhoff Publishers, Dorlrect.
- Rismunandar (1994) Hormon tanaman dan ternak. Penebar Swadaya Press, Jakarta.
- Rochiman K, Harjadi SS (1973) Pembinaan vegetatif: bahan bacaan pengantar agronomi. Bogor Agricultural University, Bogor.
- Sastrapradja S (1977) Beberapa jenis bambu. Research Center for Biology, Indonesian Institute of Sciences, Bogor.
- Sumiasri N, Setyowati N, Indarto (2001) Tanggap stek bambu (*Dendrocalamus asper*) pada penggunaan berbagai dosis ZPT, IAA dan IBA. Jurnal Natur Indonesia 3(2).
- Suradi NM, Suarna IM, Hardana IM (2003) Laporan eksplorasi dan penelitian bambu untuk menunjang industri kerajinan rumah tangga di Kabupaten Gianyar - Bali. "Eka Karya" Bali

Botanic Garden, Indonesian Institute of Sciences, Bali.

Sutiyo (1999) Propagation techniques of important bamboos in Indonesia. Japan Bamboo Society, Bamboo Journal (16).

Walpole RE (1995) Pengantar statistika. Gramedia Pustaka Utama, Jakarta.

4. Conclusions

1. Analysis variance revealed that the interaction between Rootone-F concentration and kind of culm cutting was significantly influence toward leaf width (sign. 38%), and root length (sign. 18%). In addition, kind of culm cutting gave also significantly influence toward shoot number (sign. 19%), leaf number (sign. 32%), leaf width (sign. 52%), root number (sign. 32%), and root length (sign. 12%).

2. The combination between 400 mg/l of Rootone-F and middle culm cutting revealed the best results ranking to leaf number (830), and root length (73.11 cm), second ranking to shoot height (326 cm), leaf width (61.44 cm), and root number (34.73), third ranking to shoot number (2.18). According to these results we concluded that 400 mg/l of Rootone-F and middle culm cutting was the best combination among nine other combinations.

3. Rootone-F with concentration of 400 mg/l could be used to enhance growth of middle culm cutting of black bamboo.

5. Acknowledgements

We would like to thank Dr. Gill Sweeney of the American Bamboo Society who gave much information. He has also kindly and critically read this manuscript.

6. References

Arbani H (1988) Duga Bali Membangun Bangsa. Tingkat I Bali.

Arbani H (2001) Teknik budidaya bambu jenis dan konservasi sat pengantar tumbuh terhadap pertumbuhan serta ekspor bambu gundah (Gundah Cawokan) (Rajasa) X London & P.M. Petyon). Master's Thesis Victoria University, Ball.

Petrie K.M. (1987) In vitro culture of higher plants. Martinus Nijhoff Publishers, Dordrecht.

Ramunandar (1994) Honeen tanaman dan ternak. Penerbit Swagaya Press, Jakarta.

Rochman K. Hidayat SS (1997) Analisis vegetasi hutan bakau pesisiran agronomi Bogor Agricultural University, Bogor.

Santipradja S (1977) Laporan kerja babak Research Center for Biology, Indonesian Institute of Science, Bogor.

Sulistari N. Setyowati N. Indarto (2001) Tanggapan terhadap pertumbuhan aspal pada penggunaan berbagai dosis NPT-1AA dan IBA. Jurnal Natar Indonesia 3(2).

Suandi M. Soeris IM, Harbani IM (2003) Laporan eksplorasi dan penelitian bambu untuk menunjang industri kerajinan rumah tangga di Kabupaten Gianyar - Bali. Eka Karya, Bali.