The effect of cutting origin and organic plant growth regulator on the growth of Daun Ungu (*Graptophyllum pictum*) through stem cutting method

S P Pratama¹, A Yunus², E Purwanto² and Y Widyastuti³

¹Student of Agrotechnology Studi Program, Agriculture Faculty, Universitas Sebelas Maret, Surakarta, Indonesia
²Lecturer of Agrotechnology Studi Program, Agriculture Faculty, Universitas Sebelas Maret, Surakarta, Indonesia
³Research center for Medicinal Plant and Traditional Drug, Tawangmangu, Indonesia

E-mail: yunus.uns7@yahoo.com

**Abstract.** *Graptophyllum pictum* is one of medical plants which has important chemical content to treat diseases. Leaf, bark and flower can be used to facilitate menstruation, treat hemorrhoid, constipation, ulcers, ulcers, swelling, and earache. *G. pictum* is difficult to propagated by seedling due to the long duration of seed formation, thusvegetative propagation is done by stem cutting. The aims of this study are to obtain optimum combination of cutting origin and organic plant growth regulator in various concentration for the growth of Daun Ungu through stem cutting method. This research was conducted at Research center for Medicinal Plant and Traditional Drug Tanjungsari, Tegal Gede, Karanganyar in June to August 2016. Origin of cuttings and organic plant growth regulator were used as treatments factor. A completely randomized design (RAL) is used and data were analyzed by F test (ANOVA) with a confidence level of 95%. Any significant differences among treatment followed with Duncan test at $\alpha = 5\%$. The research indicates that longest root was resulted from the treatment of 0,5 ml/l of organic plant growth regulator. The treatment of 1 ml/l is able to increase the fresh and dry weight of root, treatment of 1,5 ml/l of organic plant growth regulator was able to increase the percentage of growing shoots. Treatment of base part as origin of cuttings increases the length, fresh weight and and dry weight of shoot, increase the number of leaves. Interaction treatment between 1 ml/l concentration of organic plant growth regulator and central part origin of cuttings is capable of increasing the leaf area, whereas treatment without organic plant growth regulator and base part as planting material affects the smallest leaf area.

1. Introduction

Indonesia has many plant species that contain high efficacy for natural medicines that can be use to heal various diseases that are free from side effects. Pharmacological studies on crude extracts of Daun Ungu plant are reported for anti-inflammatory, oxytocic and anti implantation activities [1]. Medicinal plants have important benefits in the world of health and have been used by humans since ancient times, one of them is Daun Ungu (*G. Pictum*). Daun Ungu is one of the traditional herbs that usually grows in Indonesia as a bush that has a chemical and nutritious content to treat the disease [2]. Leaves
can be used to treat wounds, swelling, ulcers, skin diseases, liver and ears [3]. Daun Ungu containing saponins, tannins, and flavonoids glycosides [4]. The presence of flavonoid extract cause a decrease in blood sugar levels [5].

Daun Ungu is difficult to propagate with seeds because no seeds formation and require long time to obtain the seed, therefore it is done by vegetative propagation using stem cutting. The cutting is important because of the ease of reproduction [6]. Vegetative propagation is generally chosen due to the difficulty of obtaining seeds in continuity according to irregular season and seed keeping period. The benefits of propagation using cutting methods are capable of produce similar plant to its parent in a relatively short time and simple [7]. The origin of cuttings were taken from the shoots, middle and the base. Those origin have a different C/N ratio and chance of growing cuttings as well. The origin of cuttings for multiply vegetatively should come from the parent tree which its growth rate has been known, as well as the quality and quantity of its production.

Plant growth regulator called ZPT, are the organic non-nutrient compounds that affect to the physiological processes of a plant. Organic ZPT is more environmental friendly, easy to obtain, safe to use and cheaper. In this study organic ZPT containing cytokines (zeatin and kinetin), auxin (IAA), and gibberellins was used. Cytokinin works for the growth of side shoots, auxin serves to trigger cell elongation in the end meristem and roots. Moreover, Gibberelin trigger the elongation of stems and accelerate cell division.

2. Methods
The research was conducted in garden of medicinal plants B2P2TOOT, Tanjungsari, Tegal Gede, Karanganyar. Research in the field was done for three months in June until August 2016. The geographic location of the research location is at -7 0 36.687 'S and 110 0 57.766' E. The altitude of this research location is about 215 meters above sea level. Temperature is ranging from 27°C - 30°C.

Factorial experimental design with combination of 2 factors of treatments that are organic plant growth regulator and origin of cuttings treatments. The first factor is organic ZPT (S) consisting of four levels S0 (Without organic ZPT), S1 (organic ZPT 0.5 ml / L), S2 (organic ZPT 1 ml / L) and S3 (organic ZPT1.5ml / L). The second factor is the origin of cuttings (B) consisting of three levels that are B1 (Shoots) B2 (Middle Section) B3 (The base). The origin of this cuttings comes from the parent plants of Daun Ungu that have a lifespan of approximately 3 years. The origin of this cuttings each section has a number of different nodes. The top part has 8 nodes, the middle has 6 nodes, and the base has 4 nodes. Observed data will be analyzed based on F (ANOVA) test with 95% confidence level. Any significant different will be proceed to DMRT test at 5%.

3. Results and Discussion
3.1. Shoot Length
Shoots are newly grown part of plants to form a new part that can be stems, juvenile leaves, prospective flowers and fruit candidates. Length of shoot is used as parameter to determine whether the plant is growing or not. Calculations are done from the base to the tip of the shoot. Observation of shoot length is done in the last week which is the 8th week or when cuttings are ready to be moved. The treatment of cuttings origin gives a significantly different result to shoot length variables. The top of the shoot has the lowest average shoot length than the other parts, which is 2.05 cm. Secondly, the middle section has an average shoot length of 6.61 cm and the base has the highest average shoot length with a value of 9.35 cm (Figure 1).
Based on these results then the best origin of cutting to support the long shoots is the base of shoot. This happens because the base has larger diameter of the stem than the tip and the center of shoot. Large trunk diameter has food storage more than the smaller diameter [8]. The diameter of the base of the stem has the largest size so the food or energy reserves to support the growth of shoot length is greater so that the cells in the area of elongation will grow longer. In Figure 1 the length is smaller as the stem goes to upper part, this is due to the food storage in upper part is getting smaller so that the growth of shoot is low as well.

3.2. Percentage of Growing Shoots

The lowest percentage of shoot growth occurred without organic ZPT treatment as indicated by the mean of 49.17%. The percentage of growing shoots that appear to be low in the treatment without organic ZPT is due to unavailability of growth hormone, thus, stem cuttings become less able to trigger the emergence of new shoot buds. The organic ZPT treatment of 1.5 ml/l has the highest percentage of shoots with an average value of 70.28% because the amount of organic ZPT given is suitable to trigger shoot growth, whereas in the organic ZPT treatment of 1 ml/l the shoot growth percentage tends to decrease with average score of 64.17%. The decrease of shoot percentage growth in organic ZPT treatment 1 ml/l is suspected because the amount of hormone given not enough so
buds grow less optimal. Applying plant growth regulators needs to consider the accuracy of the dosage, because if the dose applied is too high or too low it will not trigger growth but inhibit the growth of plants instead and cause toxicity in all plant tissues.

3.3 Shoots Weight

The appearance of shoots is an important part in determining the success of cuttings. The presence of shoots on cuttings will help the process of formation of natural growth regulator which is then circulated to the bottom or basal to form the roots [9]. The weight of these shoots was measured in the last week of observation measured in terms of fresh weight buds and dry weight of buds. The treatment of shoot part has the lowest fresh weight of shoots compared to the center and the base. This is assumed because the shoots only produce buds that have a small size and length. Treatment of the base has the highest fresh weight of shoots because it has a larger shoot length value than other parts so that the average value of fresh weight shoots are larger as well. Another factor that affects the fresh weight of buds is the presence of water content in the bud. Wet or fresh weight is strongly influenced by water content in plant tissue. Treatment of the base has a larger size and longer shoot length so it can store more water which can affect the fresh weight of the shoots.

Based on the 5% duncan test the shoots treatment has the lowest dry shoot weight value compared to the middle and the base part. This is directly proportional to the fresh weight of buds, the greater the
value of fresh weight the dry weight of the buds is also greater. The shoot part treatment has the lowest
dry shoot weight is assumed because the shoots have only a small amount of food or energy reserve to
form the shoot so it only produces shoots that have small size and length. The treatment of the base
has the highest dry weight of the shoots because it has enough food or energy reserves to trigger the
growth of the size and length of the larger shoots so that it affects the shoot dry weight compared to
other parts. Another factor is the impact of the photosynthesis process. Photosynthesis results in
increased dry weight of plants due to CO₂ retrieval, whereas the process of catabolism of respiration
causes CO₂ exposure and reduces dry weight [10].

3.4 Root Length
Based on the analysis of the variety of zeatin treatment and the origin of cuttings gives no significant
difference on root length variables. Treatment without zeatin has a root length with an average of
24.19 cm. The zeatin treatment of 0.5 ml/l has an average root length of 30.24 cm. Zeatin treatment of
1 ml/l has an average root length value of 25.97 cm. Treatment of 1.5 ml/l has an average value of root
length of 27.27 cm. This suggests that with the little addition of zeatin may affect root growth but with
a certain amount. Cytokinin has the ability to encourage the occurrence of cell division and tissue
differentiation on certain shoot bud formation and root growth [11]. The shoot treatment has the
highest root length with an average value of 27.95 cm. The middle part has the second longest root
length value after the shoot, which is 27.33 cm while the base has the lowest root length with an
average value of 25.48 cm. It is suspected that the base of the stem has hardened so that the root is
difficult to grow. The cutting material with high C/N ratio will be easier and faster to form the root but
because the cell wall begins to harden so the root primordia is difficult to penetrate, thus, the roots are
rather difficult to form [12].

3.5 Root Weight
The cutting position and age of origin cuttings important role in rooting and plant growth [13]. Root
weight is one indicator of success in the cuttings. The weight of the roots is closely related to the
number of roots in which the greater the number of roots, the greater the weight of the roots. The
occurrence of roots on the multiplication of stem cuttings is very important because at the time the
roots have not appeared then the cuttings grow with the food or energy reserves that exist at the origin
of the cuttings itself.

![Figure 5. Histogram of the Effect of Organic ZPT towards Fresh Weight Roots](image)

Growth can be shown by increasing plant height, length, width, and leaf area, as well as the dry
weight of each organ including roots, stems, leaves and fruits. The organic ZPT treatment has the
lowest fresh root weight compared to the others, whereas the 1.5 ml/l organic ZPT treatment gave the
highest yield of fresh root weight. Treatment of organic ZPT 1.5 ml/l gives the most effective effect to
increase root weight. Cytokinins is a plant hormone that affects many developmental processes, one of which is able to increase the shoots of plants, such as buds [14]. Shoots and roots have a close relationship in plants. The good growth of shoots will lead to the good formation of the leaves, so the process of photosynthesis increases, thus resulting more carbohydrates and may be used to form roots [15].

Figure 6. Histogram of the Effect of Organic ZPT towards Dry Weight Roots

The organic ZPT treatment of 1.5 ml / l has the highest dry weight value. This is directly proportional to the fresh weight of the roots, which organic ZPT 1.5 ml / l has the highest dry weight of plant roots that is affected by the administration of organic ZPT. Good root growth allows plants to produce a lot of energy for the purposes of metabolic processes and for further growth process, so indirectly dry weight also increases [15].

3.6 Leaf Amount
Leaves are one of the most important plant organs [16]. The leaves become the site of the process of photosynthesis that will produce food for plants and make up the dry matter of plants. Food products from this photosynthesis process will be distributed to all parts of plant body

Figure 7. Histogram of the effect of origin cuttings on the number of leaves

According to the analysis, the variety treatment of origin of cuttings gives significantly different result to the variable of the number of leaves. The top of the shoot has the greatest number of leaves compared to the center and the base, while the middle and the base part has the same effect. The top of
the shoot has the largest number of leaves with an average value of 5.86 pieces. The middle has the second greatest number of leaves with an average value of 8.40 strands. The base has an average number of shoots of 8.91 strands (Figure 5). This is directly proportional to the percentage of growing shoots, the higher the percentage of shoots growth, the more the average leaves grow in each cut.

3.7 Leaf Area
Leaf is the place where the process of photosynthesis to construct the plant dry matter is occur. Leaf area is the result of leaf length, leaf width and leaf constant multiplication [10]. Leaf area on a plant is important to be counted because it can affect the process photosynthesis in plants. An important factor to note in measuring leaf area is the accuracy of measurement results and measurement speed [16].

Table 1. Effect of organic PGR and origin of cuttings towards Leaf area (sheets) on Daun Ungu done by Stem cuttings (G. pictum)

| Organic ZPT     | The Origin of Cuttings | Average |
|----------------|------------------------|---------|
|                | Shoot Part  | Middle Part | Base Part |         |
| Without Organic ZPT | 13,94 ± a  | 16,86 ± a   | 13,08 ± a | 14,63 ±  |
| 0,5 ml/l        | 27,20 ± c   | 22,88 ± b   | 23,18 ± b | 24,42 ±  |
| 1 ml/l          | 27,76 ± c   | 29,76 ± c   | 21,54 ± b | 26,35 ±  |
| 1,5 ml/l        | 27,20 ± c   | 28,08 ± c   | 20,94 ± b | 25,41 ±  |
| Average         | 24,03 ±  | 24,40 ±     | 19,69 ± b | 22,70 ±  |

The combination of treatment of cuttings with organic ZPT on the wide varieties of these leaves gives significantly different results. The treatment of the origin of the central cuttings with organic ZPT 1 ml / L has the largest average leaf width, which is 29.76 cm², whereas the lowest average value is on the treatment of origin of the base cuttings with no organic ZPT, which is 13.08 cm². This is presumably because the middle treatment of 1 ml / L has an active cell that still divides and has enough food reserves to enlarge the leaf area, other than that, addition of organic ZPT 1 ml/l can trigger the leaf area growth to become more optimal. Treatment of the base without organic ZPT only has the smallest average value of the leaf area, because this section is old so that there is only a few cells that divide, but in the absence of application of organic ZPT make the leaf area only grow small. The use of exogenous cytokines through the leaves can increase the growth of leaf area and delayed leaf senescence [17].

4. Conclusion
Treatment of organic ZPT of 0.5 ml / L is able to increase root length; 1 ml / L treatment is able to increase fresh and dry root weight and treatment of 1.5 ml / L is able to increase the percentage of growing shoots. Treatment of the origin of the base cuttings can increase the length of shoots, fresh weight, dried buds, and the number of leaves. The combination of treatments between organic ZPT 1 ml / L and the central cuttings were able to increase the leaf area, whereas the treatment without organic ZPT and the origin of the cuttings gives the smallest leaf area effect.

Acknowledgement
This research was supported by the Medicinal Plant and Traditional Drug, Tawangmangu, Indonesia.

References
[1] Keloth K S, Jessy E M, Kerryn J 2011 Effect of ethanol extract of Graptophyllum pictum (L) Griff on cisplatin induced nephrotoxicity in rats J Department of Pharmaceutical Chemistry 57 (2) : 52-65
[2] Wahyuningtyas E 2005 The Graptophyllum pictum extract effect on acrylic resin complete denture plaque growth *Dentist Journal* **38** 201–204

[3] Lestari P, Khumaida N, Sartiami D and Mardiningsih TL 2015 Selection criteria of Graptophyllum pictum resistance to doleschallia bisaltide cramer (lep: nymphalidae) attack based on insect feeding preference *Sabrao Journal of Breeding and Genetics* **47** 172-184

[4] Olagbende-Dada SO, Ogbonnia SO, Coker HAB and Ukpo GE 2010 Blood glucose lowering effect of aqueous extract of Graptophyllum pictum (linn) griff on alloxan-induced diabetic rats and its acute toxicity in mice *African Journal of Biotechnology* **10** 1039-1043 ISSN 1684–5315

[5] Aulia W, Rahmawati, Dessy S M 2015 Activity of ethanol extract of purpleleaves (Graptophyllum pictum(Linn)Griff) on alloxan-induced diabetes mice *International Journal of PharmTech Research* **3** 497-501

[6] Deng X, Bagping C C, Jian Wen D, MuLin C 2000 Cutting propagation techniques for Quisqualis indica *Journal of Zhejiang Forestry College* **17** 38-48

[7] Hartmann H T, Kester D E 1983 Plant Propagation Principles and Principles 4 th edition New York (US) : Pentec hall nine, Englewood

[8] Suwasono H 1989 Hormon tumbuhan Jakarta (ID): Rajawali

[9] Dwijoseputro 1980 Fisiologi tumbuhan Jakarta (ID) : PT Gramedia

[10] Gardner F P 1991 Fisiologi, Tanaman Budidaya Susilo Herawati (Translator) Jakarta (ID) Translating from: Physiology of crop plant

[11] Werner T, Motyka V, Strnad M, Schmulling T 2001 Regulation of plant growth by cytokinin USA

[12] Kastono D, Sawitri H, Siswando 2005 Pengaruh nomor ruas setek dan dosis pupuk urea terhadap pertumbuhan dan hasil kumis kucing *J Ilmu Pertanian* **12** 56 – 64

[13] Santoso B B, Parwata A 2014 Seedling growth from stem cutting with different physiological ages of jatropha curcas 1 of west nusa tenggara genotypes *International Journal of Applied Science and Technology* **4** 6-16

[14] Gajdošová S, Spíchal L, Kamínek M, Hoyerová K, Novák O, Droběv P I, Galuszka P, Klíma P, Gaudinová A, Žižková E, Hanus J, Dančák M, Trávníček B, Pešek B, Krupicka M, Vanková R, Strnad M and Motyka V 2011 Distribution, biological activities, metabolism, and the conceivable function of cis-zeatin-type cytokinins in plants *J of Experimental Botany* **8** 2827-2840

[15] Purwanto 2004 Pengaruh isomer sodium nitrofenol terhadap pertunasan dan pertumbuhan bibit tanaman pisang *Jurnal Penelitian UNIB* **10** 105-108 http://ejurnaltripodcom/dilp04html

[16] Haryanti S 2010 Pengaruh naungan yang berbeda terhadap jumlah stomata dan ukuran porus stomata daun Zephyranthes rosea Lindl *J Anatomi Fisiologi* **18** 100 - 130

[17] Januwati M 1992 Faktor-faktor ekologi yang mempengaruhi pertumbuhan tanaman sirih (Piper betle Linn) *Warta Tumbuhan Obat Indonesia*

[18] Beltrano J, Caldiz DO, Barreyro R, Vallduri GS and Besus R 1994 Effect of foliar applied gibberelic acid and benzyladenin upon yield component in sunflower (Helianthusannus L) *J Plant Growth Regulation* **15** 101-106

[19] Munarti, Kurniasih S 2014 Pengaruh konsentrasi IAA dan BAP terhadap pertumbuhan setek mikro kentang secara in vitro *J Pendidikan Biologi, FKIP, Universitas Pakuan* **1**(1) : April 2014