

Enhancing the growth and yield of Ramie (*Boehmeria nivea* L.) by ramie biomass waste in liquid form and gibberellic acid

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Abstract. Ramie (*Boehmeria nivea* L.) is one of the most important sources of natural fibre, a sustainable biomass. The growth and yield of ramie are affected by mineral nutrients. In the present study, we used fertilizers from waste of ramie biomass in liquid form (liquid organic fertilizer, LOF) and the other treatment is by gibberellic acid (GA3). This study was to obtain the effect of treatments on enhance the growth and yield of ramie. Hence, we measure the character that related to the important parameter for biomass product of ramie. Such plant height, stem diameter, dry plant weight, and ramie fresh stem weight of ramie clone Pujon 13. This research was conducted from January 2016 to March 2016 at Research Field Ciparanje, Faculty of Agriculture, Padjadjaran University, Jatinangor, Sumedang, West Java with an altitude of about ± 750 m above sea level. The type of Soil in this area is Inceptisol soil order and the type of rainfall according to Schmidt and Fergusson Classification is C type. The experiment used Randomized Block Design (RBD) which consisted of eight treatments (GA and LOF) and four replications. The concentration of GA from 0, 50, 100 and 150 ppm and for concentration of LOF is 40 mL⁻¹. We suggested the treatment of GA 150 ppm with 40 mL⁻¹ LOF was the best treatment on enhancing plant height and stem fresh weight of ramie clone Pujon 13.

1. Introduction

A sustainable biomass could be produced through agricultural product due to the agricultural crops is the cellulose resources. This could be a substitute material to produce the product based on petroleum resources to decrease the fossil fuel which the fossil fuel is non-renewable resources. The product from biomass is used in various field such textile, cosmetic, medical, automotive and electronic [1] and as bioethanol [2].

One of the important crops could be used in various field is ramie (*Boehmeria nivea* L.), this crop is a herbaceous perennial plant that belongs to the family Urticaceae. Generally ramie is can adapt and grown most of the tropics and subtropics regions such in China and some other Asian Countries including the Philippines and India [3]. As a crop mineral content of soil and fertilization practices in cultivation of this crop is important to reach high yield. Due to the rapid growth of ramie could rapidly reduce soil nutrients for normal growth and sustainable yield, therefore the supply of nutrition to for



this crop to soil is very important [4,5]. Besides, the plant growth regulator (PGR) such gibberellic acid (GA) is very important in affected yield and fibre quality in ramie [3].

Information concerning the effects of nutrient management, particularly from waste of ramie biomass and the plant regulator (PGR) on the morphological traits and yield is nevertheless limited. In the present study, we accordingly aimed to assess the effects of the single or the combination use of liquid organic fertilizer (LOF) from ramie waste and GA3 on the growth and yield of ramie.

2. Materials and Methods

This research was conducted from January 2016 to March 2016 at Research Field Ciparanje, Faculty of Agriculture, University of Padjadjaran, Jatinangor, Sumedang, West Java with an altitude of about ± 750 m above sea level. The type of Soil in this area is Inceptisol soil order and the type of rainfall according to Schmidt and Fergusson Classification is C type. The experiment used Randomized Block Design (RBD) which consisted of eight treatments (GA and LOF) and four replications. The concentration of GA from 0, 50, 100 and 150 ppm and for concentration of LOF is 0 and 40 mL⁻¹. In each treatment consisting 3 plant of ramie of Pujon 13 clone, hence we used 96 plants in total. The treatments in this study are A = GA 0 ppm + 0 mL⁻¹LOF, B = GA 50 ppm + 0 mL⁻¹LOF, C = GA 100 ppm + 0 mL⁻¹LOF, D = GA 150 ppm + 0 mL⁻¹LOF, E = GA 0 ppm + 40 mL⁻¹LOF, F = GA 50 ppm + 40 mL⁻¹LOF, G = GA 100 ppm + 40 mL⁻¹LOF, H = GA 150 ppm + 40 mL⁻¹LOF.

3. Results

According to the result of the analyzed of LOF (Table 1), the characteristic of LOF is alkali and contains the essential nutrients such a few nitrogen (N), phosphate (P) and potassium (K), (0,01;0,10;0,41 %). The plant height of ramie was affected by combination LOF and GA3, particularly in H treatment (GA 150 ppm + 40 mL⁻¹LOF), in which the plant height of rami Pujon 13 clone showed the highest in 6, 10 and 12 week after sowing (Table 1). However, the statistically result showed that the diameter of stem was not different in all treatments. Although, it seems the value of stem diameter is increase in several treatments (Table 2).

In this study showed that increasing the fresh weight of ramie could be affected by GA3 as single treatment or combination of GA3 at the level D (150 ppm) and LOF at the level H (GA 150 ppm + 40 mL⁻¹) as seen at Table 3.

Table 1. Content and characteristics of ramie liquid of fertilizer (LoF)

No	Parameter	unit	value
1	pH	-	8,71
2	C-Organik	%	0,67
3	N-Total	%	0,01
4	P ₂ O ₅	%	0,10
5	K ₂ O	%	0,41

Note: the liquid of fertilizer was analyzed by lab. Crop nutrition of Agriculture Faculty UNPAD.

Table 2. Plant height of rami Pujon 13 clone

Perlakuan	Plant height (cm)			
	6 week	8 week	10 week	12 week
A	49.63 c	79.21 a	115.92 b	125.92 c
B	68.49 ab	115.88 b	160.54 a	170.54 b
C	79.75 a	128.17 b	174.38 a	184.38 ab
D	83.75 a	132.08 b	180.21 a	190.79 ab
E	61.75 bc	94.13 a	135.42 b	136.08 c
F	82.88 a	120.00 b	160.21 a	171.63 ab
G	83.42 a	131.25 b	180.17 a	190.75 ab
H	85.67 a	132.38 b	180.83 a	201.13 a

Note : The numbers followed by the same letter at the same treatment were not significantly different at the Duncan test significance level of 5%

Table 3. Stem diameter of ramie Pujon 13 clone

Treatment	Stem diameter (mm)			
	6 week	8 week	10 week	12 week
A	22.15 a	27.95 a	33.88 a	37.68 a
B	24.33 a	30.78 a	35.98 a	40.63 a
C	25.35 a	32.23 a	37.58 a	42.33 a
D	25.40 a	32.63 a	38.15 a	43.00 a
E	22.55 a	28.25 a	33.63 a	37.88 a
F	25.13 a	31.53 a	37.55 a	42.25 a
G	26.03 a	32.85 a	38.48 a	42.68 a
H	26.95 a	33.58 a	47.58 a	43.35 a

Note: The numbers followed by the same letter at the same treatment were not significantly different at the Duncan test significance level of 5%

Table 4. Fresh weight of stem and Dry weight per plant of ramie Pujon 13 clone

Treatment	Stem fresh weight (g)	Plant dry weight (g)
A	270.00 b	225.0 a
B	323.75 b	226.3 a
C	278.75 b	192.7 a
D	330.00 ab	182.9 a
E	271.25 b	225.5 a
F	277.50 b	194.4 a
G	286.25 b	181.1 a
H	390.00 a	260.4 a

Note : The numbers followed by the same letter at the same treatment were not significantly different at the Duncan test significance level of 5%

4. Discussion

In our study, although LOF of ramie contains few amounts of essentials nutrient and low level of alkali suggests that the combination of treatment is effective to increase the plant height in ramie. According to Salisbury and Ross, the physiological effects typical application results GA3 is the lengthening of the stem, as a result of their activities in internodes cambium, so plants that are treated to be higher than normal plants [6]. Results of research conducted by Nasaruddin et al., showed that

the liquid organic fertilizer concentration of 15 ml/L of water and 30 ml/L of water, increased height of cocoa seedlings [7]. However, in this study showed that the increasing of plant height was not accompanied with the widening of stem. This result suggests that each treatment and combination of treatment is not affect to stem diameter (Table 2). Our result was corresponded well with Dantas et al., in which their study showed the combination and the single effect of gibberellin and bio-stimulant to the growth of tamarind was affect to the stem elongation but not affect to the stem diameter [8]. In the level 150 ppm for GA3 is the best treatment in increasing the stem fresh weight. However, the increasing fresh weight at this level was no cause the increasing of plant dry weight.

Gibberellic acid (GA) is very important in affected yield and fibre quality in ramie [3]. According Mudyantini, GA can increase the amount of phloem, cellulose and lignin [9]. Cellulose and lignin is a determining factor for the quality of Ramie fiber. The results of the study Supriyadi et al., showed that the liquid organic fertilizer with a concentration of 150 ml/l of water, increased plant height, stem diameter, number of leaves, fresh weight of shoots and dry weight of shoots in nursery plants Jabon Red {*Anthocephalus macrophyllus* (Roxb.)} [10]. As well as the results of research conducted by Maruapey on the sugar cane plant cuttings, gibberellin with a concentration of 75 ppm can increase sugar cane plant height, leaf number, the number of segments of plants, stem diameter, number of roots of plants, and weight of cane biomass [11].

5. Conclusions

According to the result we conclude that the GA3at the level 150 ppm could increase the fresh weight of ramie and the combination of GA3 150 ppm and 40 ml.L-1 could increase the plant height. However, the stem diameter and dry weight per plant were not affected by single treatment or combination treatment.

The increasing of plant height will affect to the how long ramie fibers produced. We suggested the treatment of GA 150 ppm with 40 mlL-1 LOF was the best treatment on enhancing plant height and stem fresh weight of ramie clone Pujon 13.

References

- [1] Siti A M, Abdul K H P S, Asniza M, Suhaily S S, Nur A A S and Jawaidd M 2014 Agricultural biomass raw materials: the current state and future potentialities In Hakeem K R, Jawaidd M and Rashid U ed. *Biomass and Bioenergy* (New York: Springer)
- [2] Goh C S I, Tan K T, Lee K T, Bhatia S. 2010 Bio-ethanol from lignocellulose: Status, perspectives and challenges in Malaysia *Bioresour Technol.* **101** 34-41
- [3] Liu F, X Liang, N Zhang, Y Huang and S Zhang 2001 Effect of growth regulators on yield and fibre quality in ramie (*Boemherianivea* L. Gaud.) China grass *Field Crops Res.* **69** 41-46
- [4] Subandi M 2012 The effect of fertilizers on the growth and the yield of ramie (*Boehmeria nivea* L. Gaud) *Asian J. Agric. Rural Dev.* **2** 126-135.
- [5] Huang C, Wei G, Luo Z, Xu J, Zhao S, Wang L, Jie Y 2014 Effects of nitrogen on ramie (*Boehmeria nivea*) hybrid and its parents grown under field conditions *J. Agric. Sci.* **6** 230-243.
- [6] Salisbury F B, and Ross C W 1995 Plant Physiology Bandung: Institut Teknologi Bandung) **1**
- [7] Nasaruddin dan Rosmawati 2011 Pengaruh pupuk organik cair (POC) hasil fermentasi daun gamal, batang pisang dan sabut kelapa terhadap pertumbuhan bibit kakao (<http://isjd.pdii.lipi.go.id/index.php/>) March 20th 2016.
- [8] Dantas A C V L, Queiroz J M de O, Vieira E L, and Almeida V de O 2012 Effect of gibberellic acid and the biostimulant stimulate® on the initial growth of tamarind *Revista Brasileira de Fruticultura* **34** 8-14
- [9] Mudyantini W 2008 Pertumbuhan kandungan selulosa, dan lignin pada rami (*boehmeria nivea* l. gaudich) dengan pemberian asam giberelat (GA) (<http://biodiversitas.mipa.uns.ac.id/>) September 10th 2015

- [10] Supriadi D A and Setyorini D 2001 Bahan baku mutu pupuk organik (<http://syekhfanismd.lecture.ub.ac.id/>) September 21st 2015
- [11] Marupaey A 2013 Efek berbagai konsentrasi zat pengatur tumbuh GA₃ terhadap dinamika pertumbuhan setek tebu (<http://www.jurnal.lipi.go.id/data/1330473786/data/1377780020.doc>) March 20th 2016