

## ***Artemisia annua* respon to various types of organic fertilizer and dose in lowland**

**A Yunus<sup>1</sup>, Samanhudi<sup>1</sup>, N Brahmanto<sup>2</sup> and Y Widyastuti<sup>3</sup>**

<sup>1</sup> Lecturer of Study Program of Agrotechnology, Faculty of Agriculture, Universitas Sebelas Maret Surakarta, Indonesia

<sup>2</sup> Student of Faculty of Agriculture, Universitas Sebelas Maret (UNS) Surakarta, Indonesia

<sup>3</sup> Research Center for Medicinal Plant and Traditional Drug, Tawangmangu, Indonesia

E-mail: yunus.uns7@yahoo.com

**Abstract.** *Artemisia annua* belongs to asteraceae genus which has many benefits in the medical field. Artemisia contains artemisinin which is used to cure malaria disease. The obstacle of artemisia development in Indonesia is low artemisinin content and the fact that artemisia only able to grow well in the highland area. For that this experiment aimed to increase the artemisinin content through enhancing artemisia biomass in the lowland using the application of organic fertilizer. Experiment was conducted in GreenhouseLab, Faculty of Agriculture, Sebelas Maret University, Surakarta from October 2015 to January 2016. Two factor of treatment and three replications was performed during experiment. The first factor is the organic fertilizer type and the second is the application dose. Result showed that Rabbit manure at 40% application dose give best influence on the plant height (172,62 cm), number of branches (68,3 branch), flowering time (102,67 day after planted), fresh weight (56,47 g) and dry weight (43,15 g), moreover Rabbit manure at 80% dose give the best influence on the root length (27,33 cm).

### **1. Introduction**

*Artemisia* (*Artemisia annua* L.) is asteraceae plant having distinctive aroma or unique taste and benefits in the medical field. Artemisia is a medicinal plant originated from China and generally cultivated in Asia, America, and Europe [1]. The main problem of artemisia development in Indonesia are low content of artemisinin and the fact that artemisia only grow well on highlands with altitude more than 1,000 m [2].

Many factors are influencing the artemisinin content and one of them is the biomass. Artemisia usually grown in the long day field. The flowering stage of artemisia will be faster when artemisia planted in the tropical field. The faster of flowering stage will affected the biomass and the biomass will decreased. In the tropical field, artemisia will be able to produce high content of artemisinin if planted in highlands or using artemisia variety with longer flowering stage [3].

According to [4], organic and inorganic fertilizers have a positive effect on the artemisias growth. Application of fertilizer positively effect to the vegetative growth and biomass. Moreover, biomass can increase the level of artemisinin content. In this regard, organic fertilizers are more preferable due to have sustain nutritional benefit.



## 2. Methods

### 2.1. Location and Time Research

This experiment was conducted at , Faculty of Agriculture, Universitas Sebelas Maret, Surakarta from October 2015 to January 2016. Analysis of the yield was conducted in Ecology Plant Production Physiology and Biotechnology Laboratory, Faculty of Agriculture, Universitas Sebelas Maret, Surakarta in February 2016.

### 2.2. Experimental Design and Data Analysis

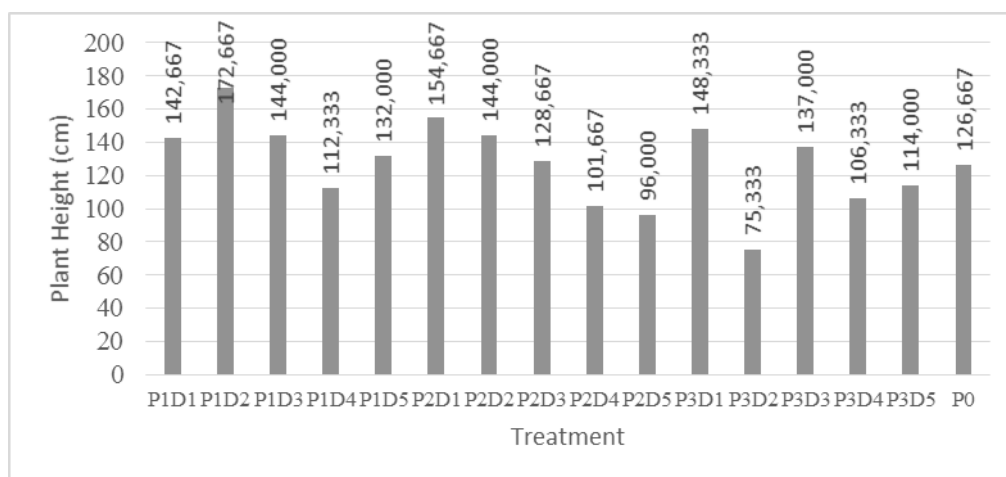
This research used two factors of treatment and three replications. The first factor is the type of fertilizer which consists of rabbit manure (P1), goat manure (P2), cow manure mixed with husk (P3) and without fertilizer treatment (P0). The second factor is the percentage of dose which consists of 20% dose (D1), 40% dose (D2), 60% dose (D3), 80% dose (D4), and 100% dose of fertilizer (D5). Growth data resulted from the experiment were analyzed using ANOVA and P value was set at 0.05.

## 3. Results and Discussion

### 3.1. Plant height

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the height. The average height is shown on Figure 1. The height is varies between 172.67 cm to 96 cm. The treatment resulted highest average of height is the rabbit manure with the 20% of dose (172,62 cm), while lowest average of height is the goat manure with 100% of dose (96 cm).

Figure 1 showed the fertilizer application with certain dose give positive effect to artemisia height. However, if organic fertilizeris applied in the excessive way, it will cause obstructed growth of artemisia. According to [5] and [6], excessive application of organic fertilizer affected to increment of soil acidity. For that, plants cannot utilize N, P, K and other nutrients needed. Moreover, in the acid soils, plants have high probability to be poisoned by Al. Thus right amount of organic fertilizer application must be done to obtain optimum results.

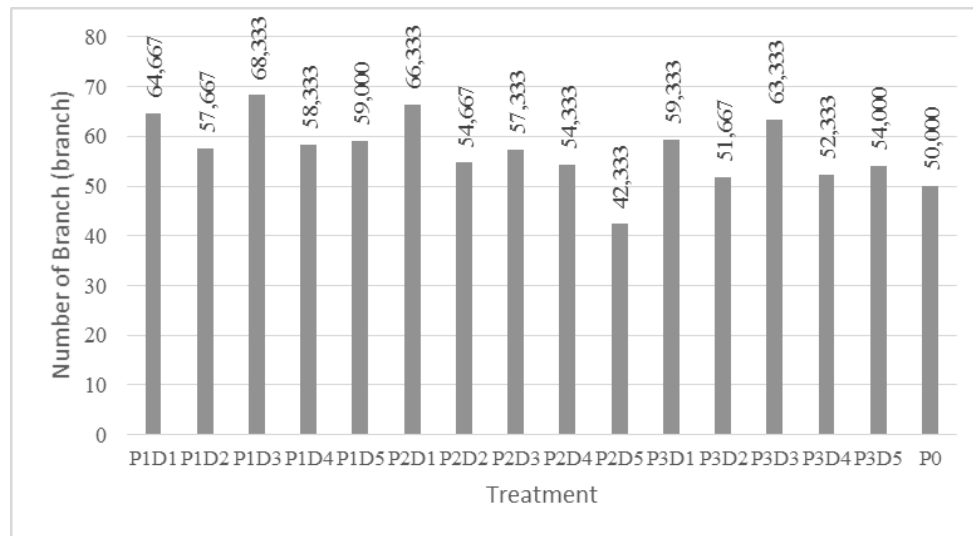


**Figure 1.** Effect the fertilizer type and percentage of dose to artemisia height

### 3.2. Number of Branch

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the artemisia branches. The average branches that can be seen in Figure 2 varies between 68.3 and 42.3. The treatment showed highest number of branches of plants is the rabbit manure with 40% percentage of dose (68.3), while lowest number of branches is the goat manure with 100% percentage

of dose (42.3). Increasing the doses can stimulate the lateral meristem activity and nutrient uptake, especially for N, because N is important for vegetative growth and form a new branch [7].



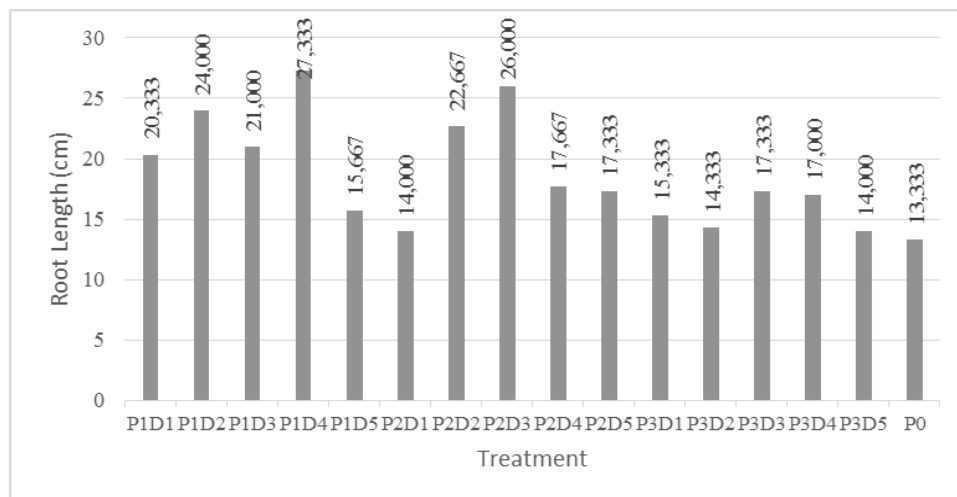
**Figure 2.** Effect the fertilizer type and percentage of dose to number of branch

Nitrogen is very important for the chlorophyll formation. Chlorophyll in sufficient quantities can increase the leaves ability to absorb sunlight, so the photosynthesis process will run smoothly. The product of the photosynthesis will be revamped through the respiration process and generate the energy that will be needed by the cell to perform activities such a cell division and enlargement. Phosphorus that contained in rabbit manure has a functions to develop the meristem tissue. Potassium is an activator for various essential enzymes, photosynthetic and respiratory reactions, and protein synthesis enzymes [8].

### 3.3. Root Length

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the root length. The average length of the roots shown in Figure 3 varies between 27.33 and 13.33 cm. The treatment showed highest average of the root length is rabbit manure with 80% dose (27,33 cm), while lowest average of is in the control treatment (13.33 cm).

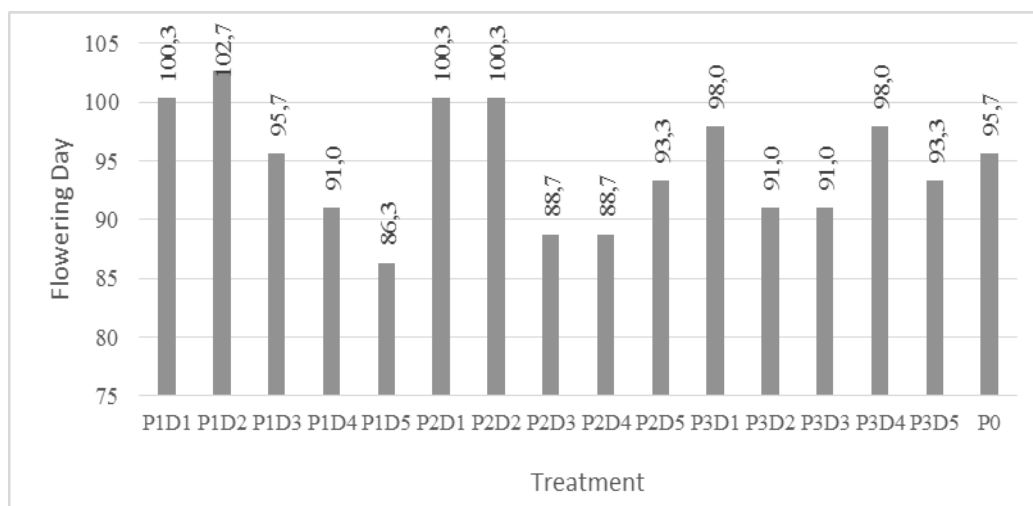
According to [9] application of organic fertilizers can increase the pH, affect the aggregates, and increase the porosity of soils. Soils that has a good porosity will have sufficient water availability. Rabbit manure can be used to improve soil physical properties. Crumbly soil can be easily penetrated by roots. P in the fertilizer also plays an important role for the growth and root branching. These factors will affect the absorption of roots for water or for nutrients in the soil [10].



**Figure 3.** Effect the fertilizer type and percentage of dose to root length

### 3.4. Flowering Day

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the flowering day. The average flowering day varies between 86.33 to 102.67 day after planted. The treatment that has highest average flowering day is the rabbit manure with 40% dose (102.67 day) after planted. The treatment that has the lowest average flowering day is the rabbit manure with 100% dose (86.33 day) after planted.

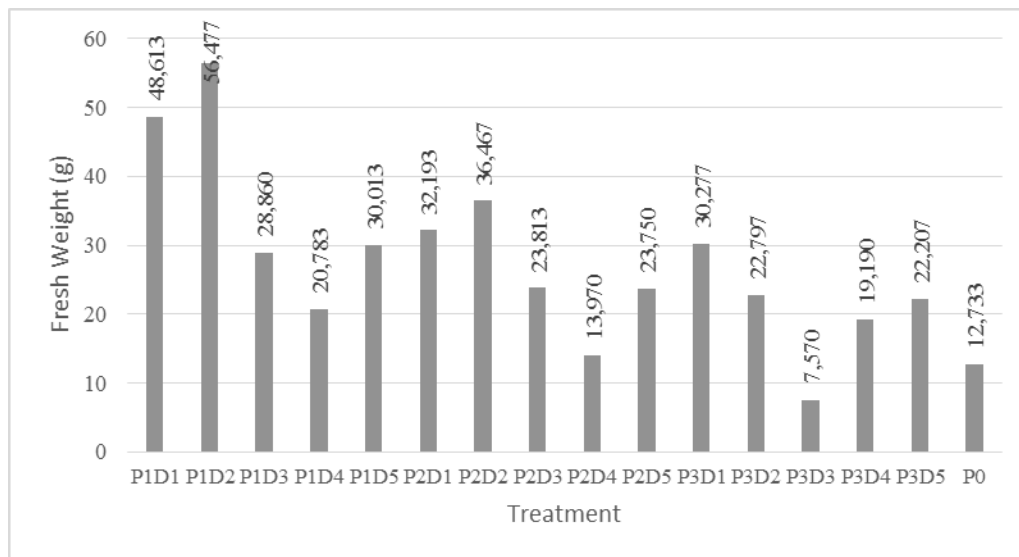


**Figure 4.** Effect the fertilizer type and percentage of dose to flowering day

Lack of the N will inhibit the vegetative growth and the flowering period will delay. The application of N fertilizer can accelerate the appearance of the first flowers when it compared with the control treatment. The application of N fertilizer in certain doses can also slowing the appearance of the first flowers. Increasing the dose of N fertilizer can stimulate the vegetative growth and multiply the number of flowers. The vegetatif growth can delay appearance of the first flower. If the appearance of the first flower is delay, the plants will maximize the vegetative growth so that the height, number of branches, the number of flowers, and the biomass of the plant will increase [11].

### 3.5. Fresh Weight

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the fresh weight. The average weight of fresh plant varies between 7.57 to 56.47 g. The treatment that has the highest average fresh weight is the treatment of rabbit manure with 40% dose (56.47 g). The treatment that has the lowest average fresh weight is the treatment of cow manure and husk with 60% dose (7.57 g).

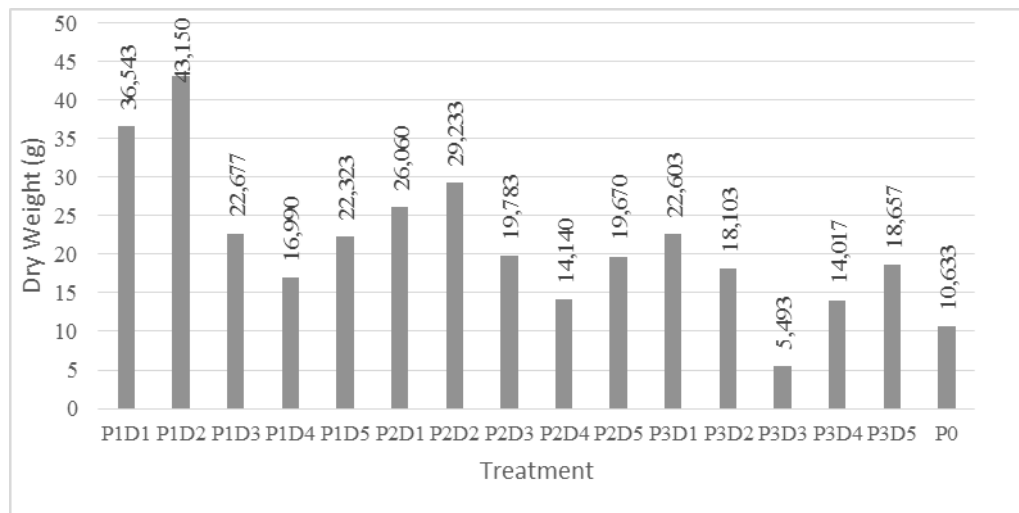


**Figure 5.** Effect the fertilizer type and percentage of dose to fresh weight

According to [12] the addition of organic fertilizer will increase the process of decomposition in the soil and the availability of nutrients. Organic fertilizers can also be used to improve soil physical properties. Treatment with rabbit manure have the best average fresh weight. Rabbit manure have sufficient nutrient and can be easily absorbed by plants.

### 3.6. Dry Weight

Interaction between fertilizer type and the percentage of dose have no significant effect ( $P > 0.05$ ) on the dry weight. The average weight of the dry plant varies between 14.01 and 43.15 g. The treatment that has the highest average dry weight is the rabbit manure with 40% dose (43.15 g). The treatment that has the lowest average of dry weight is the cow manure and husk with 60% dose (14.01 g). All the fertilizers that applied in this experiment able to increase the dry weight. According to [13], the provision of organic fertilizer can stimulate vegetative growth and increase dry weight of plants. The treatment showed best yield of dry weight has the best nutrient intake.



**Figure 6.** Effect the fertilizer type and percentage of dose to dry weight

#### 4. Conclusion

Rabbit manure with 40% of dose give best influence on the plant height (172,62 cm), number of branches (68,3 branch), flowering time (102,67 day after planted), fresh weight (56,47 g) and dry weight (43,15 g). Rabbit manure with 80% of dose give the best influence on the root length (27,33 cm).

#### Acknowledgement

This research was supported by the Ministry of Research Technology and Higher Education and Dr. Ir. Yuli Widyastuti as field from Research Center for Medicinal Plant and Traditional Drug, Tawangmangu, Indonesia. *Artemisia annua* seeds in this research were obtained from B2P2TOOT, Tawangmangu, Karanganyar.

#### References

- [1] Ozguven M, Sener B, Orhan I et al. 2008. *Ind Corps Prod.* **27** 60-64
- [2] Purnamaningsih R, Lestari E G, Syukur M, and Yunita R 2010 *J. Ilm. Apl. Iso. Rad.* **6**(2) 139-146
- [3] Ferreira J F S, Laughlin J C, Delabays, and Magalhaes P M 2005 *Plant Gen. Reso.* **3**(2) 206-229
- [4] Yeboah S, Akromah R, and Quansah C 2012 *Afri. J. Agr. Res.* **7**(2) 177-182.
- [5] Efendi 2010. *J. Floratek* **5** 65 -73
- [6] Patti P S, Kaya E and Silahooy C 2013 *J Agrologia* **2**(1) 51-58
- [7] Sukarman 2012 *J. Littri.* **18**(2) 81-87
- [8] Sitompul H F, Simanungkalit S, and Mawarni L 2014 *J. On Agroekotek.* **2**(3) 1064-1071
- [9] Masulili A 2010 *J. Agric. Sci.* **2** (1) 39-47
- [10] Kabir R, Yeasmin S, Mominul A K and Sarkar A R 2013 *Int. J. Bio-Sci Bio-Tech.* **5**(3) 51-60
- [11] Aminifard M H, Aroiee H, Nemati H, Azizi M and Khayyat M 2012 *J. Pln.t Nutri.* **35** 235–242
- [12] Tiamiyu R A, Ahmed H G, and Muhammad A S 2012 *Nig. J. Bas. Apl. Sci.* **20**(2) 213-216
- [13] Olaniyi J O and Ojetayo A E 2011 *J. Anim. Plnt. Sci.* **12**(2) 1573-1582