Dendrocalamus asper productivity after beginning thinning

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Abstract. Dendrocalamus asper is one of bamboo species that is highly required for industrial purposes and community. Beside as the construction materials, shoot of D. asper has a good taste. However, D. asper cultivation faces some obstacles because its big stem and clump disturb other species. Planting in agroforestry model and an appropriate D. asper clump management are the efforts to attract people to plant D. asper. Thinning is applied in D. asper management. This is expected to be able to reduce its canopy impact on the under plants and to improve D. asper productivity. Objective of this research is to find out the influence of beginning thinning on D. asper clump productivity. The research used complete random design with blocks with three treatments of thinning, i.e. a. thinning by eliminating first generation (J1), b. thinning by eliminating first and second generation (J2), c. without thinning (control/J3). The bamboo clump used in the research is two years old. 2 years old clumps. The planting spaces were 10 m x 10 m with a total of 100 clump. The research showed that J2 give the best height growth (5.18 m). It is better than control/J3 (4.5 m), and there were no differences on parameter of diameter and numbers of stem in a clump, although J2 treatment showed the highest average number of stem in a clump.

Keywords: Agroforestry, bamboo, Dendrocalamus asper, thinning

1. Introduction
Bambu betung (Dendrocalamus asper) is a species of bamboo that is highly required for industrial purposes and community. D. asper can be used as the construction material. It is potential in supporting food industry, such as flour, fiber, and starch extract [1]. D. asper’s shoots are known having a good taste. Therefore, many people like to consume it. However, nowadays its cultivation or utilization is not optimal. That makes D. asper is no more popular and people are less interesting in cultivation it [2].

Hani et al. [3] wrote bamboo canopy that is too lush makes it difficult to planting another species. Some efforts to attract people in planting D. asper are planting it by agroforestry model and using an appropriate bamboo clumps management. Besides that, bamboo can be cultivated on marginal lands in order improving farmer’s income, while improving soil fertility [3].

Bamboo has growth characteristic, such as the forming of bamboo clumps. New shoots of bamboo will grow during the rainy season until the season changed. Next, it will become old without the growing of height and diameter. In the next rainy season, the new bamboo shoots will grow. It cause the bamboo clump is consisted of many generations [4]. In the beginning of planting stage, people can plant various seasonal plants. It is expected to attract people in planting bamboo and improve the land economic value as well [5]. However, more age of bamboo, non-cultivated bamboo will produce dense
bamboo clump with thick canopy. That makes the farmer difficult in exploiting land (planting other species on it) under the bamboo tree.

One of bamboo clump management is thinning around the bamboo clump. This is expected can reduce the competition among the clumps and reduce the canopy for under plants. Thinning on 3 years old bamboo which has only 4 stem in one clump will improve its productivity by increasing the number of stems in a clump and increasing the size of bamboo stem [6]. In general, people harvest the D. asper after it has big stem and thick clump. Thinning on young bamboo is rarely applied. This research is aimed to find out the influence of beginning thinning on D. asper clump productivity.

2. Methods

2.1 Location and Time
The research was conducted in Sukaharja Village of Ciamis District. The research site is on 450 m above sea level. The research site belongs to Sukaharja Village and is cultivated by local people. D. asper was planted in December 2015 and in 2017, thinning was applied.

2.2 Materials and Tools
The research used 3 years old bamboo betung (D. asper) clump as the material. Meanwhile, the chopping knife, calliper, roll meter, and stationer were required tools.

2.3 Experimental Design
A hundred bamboos were planted by using 10 m x 10 m of planting space. D. asper were taken care intensively by applying compost on it once a year, pruning, sowing, and land clearing. Thinning was applied when bamboo were 3 years old. The research used complete random design with blocks with three treatments of thinning, i.e. a. thinning by eliminating first generation (J1), b. thinning by eliminating first and second generation (J2), c. without thinning (control/ J3). Each treatment was consisted of 10 bamboo clumps and it required three iterations. The growth of parameter were height, diameter, and number of stem in a clump.

2.4 Data Analysis
The data of bamboo growth was analysed by using variety analysis. If there were differences among treatments, it would be continued by Duncan test. Data processing used SPSS 23.

3. Results and Discussion
Beginning thinning on D. asper is aimed to manage bamboo stem solidity of low economic value bamboo stem and to stimulate the growth of young shoots of bamboo. The influence of thinning on D asper growth are shown in Table 1.
**Table 1.** The analysis variances of the effect of thinning on *betung* bamboo (*D. asper*) productivity

| Sources of variation | Sum of Squares | df  | Mean Square | F      | Sig.  |
|----------------------|----------------|-----|-------------|--------|-------|
| Height Treatment     | 353728.63      | 2   | 176864.31   | 4.97   | 0.007 |
| blok                 | 208625.09      | 2   | 104312.55   | 2.93   | 0.055 |
| Diameter Treatment   | 201655.48      | 2   | 100827.74   | 1.27   | 0.283 |
| blok                 | 93048.09       | 2   | 46524.05    | 0.58   | 0.558 |
| Number of stem       | 20.33          | 2   | 10.16       | 1.03   | 0.362 |
| blok                 | 68.51          | 2   | 34.25       | 3.47   | 0.036 |

The result shows that J2 treatment produces the best height (5.18 m) than control/J3 (4.5 m). Meanwhile, the parameter of diameter and number of stem in each clump have no significant differences, although J2 treatment shows the highest average number of stem in a clump.

**Table 2.** Duncan test effect of initial thinning of young shoots of bamboo to height parameter

| Treatment | Height (cm) |
|-----------|-------------|
| J2        | 518.44      |
| J1        | 492.37      |
| Control (J3) | 450.68    |

Advance Duncan Test (Table 2) shows that J2 treatment produces high bamboo. It is because the J2 treatment keep less old stem of bamboo than the other treatments. This old stem of bamboo in a clump will stimulate the higher competition in gaining a space for growing. Moreover, dense bamboo clump will increase the competition level in gaining water, nutrition, and lights. Bamboo’s nutrition searching zone is in 50 cm of radius [7]. In general, space of stems in a clump is so closes because *D. asper* is sympodial bamboo. Therefore, if there is a cut stem in a clump, then the competition level will decrease. Moreover, in general, the first generation stems have small size and less economic value. Therefore, it will give less economic value if the farmer keep it. In the contrary, it will decrease the height of young bamboo. Bamboo clump management by 50% cutting of stem in a clump and giving organic fertilizer will increase bamboo productivity than no cutting and no fertilizing [8].
The growth of bamboo stem among treatments in one year after thinning does not show any significant differences. However, J2 treatment has a tendency that number of stems in a clump is more than other treatments. Inoue et al. [9] wrote that one of natural character of bamboo growth was bamboo clump density will increase until reach its climax because when there were a died bamboo stem. It will be soon replaced by new bamboo shoots and make a dense clump.

One of many factors that influencing bamboo growth is the soil fertility. The analysis show that the soil in the research site has less chemical fertility (Table 3).

Table 3 shows that soil fertility in research site is in low category. It should be improve through the improvement of physical and chemical soil characteristic. Soil organic carbon becomes one of determination factors for soil fertility. Bamboo roots growth will be focused on land with high organic carbon. Meanwhile, on land with sour pH, the growth of bamboo root will be threat [10]. That will cause non-optimal growth for bamboo. Wang et al. [11] explained that intensive bamboo cultivation could improve organic humification fertility. It will improve the soil fertility. One of efforts for improving soil fertility around bamboo tree is the management of bamboo leaves litter, so it can be a source of organic materials for improving microorganism activity and the efficiency of soil nutrition utilization [12]. Types of fertilizer for bamboo should appropriate with the soil condition for the bamboo growth [13].
4. Conclusion
Thinning by eliminating first and second generation bamboo (J2) produces the best height (5.18 m) than control/J3 (4.5 m). Meanwhile, parameter of diameter and number of bamboo stem in each clump has no differences, although J2 treatment shows the highest average of number of stem in each clump among other treatment.

References
[1] Felisberto M H F Miyake P S E Beraldo A L and Clerici M T P S, 2017 Young bamboo culm: Potential food as source of fiber and starch Food Res. Int. 101, August p. 96–102.
[2] Fahrina R, 2014 Pemanfaatan bambu betung bangka sebagai pengganti tulangan balok beton bertiulangan bambu J. Fropil 2, 1 p. 56–68.
[3] Kumar A Kumar A Baredar P and Prakash O, 2019 Forest Policy and Economics Bamboo as a complementary crop to address climate change and livelihoods – Insights from India 102, February p. 66–74.
[4] Sutiyono and Wardani M, 2015 Karakteristik tanaman bambu petung (Dendrocalamus asper Back.) di dataran rendah di daerah Subang, Jawa Barat Pros. Semin. Nas. Biol. 2015. Univ. Sebel. Maret p. 51–62.
[5] Lu H Cai C Zeng X Campbell D E Fan S and Liu G, 2018 Bamboo vs . crops : An integrated energy and economic evaluation of using bamboo to replace crops in Sichuan Province , China 177 p. 464–473.
[6] Hani A, 2019 Pengelolaan bambu ampel (Bambusa vulgaris) melalui perlakuan penjarangan pada pola agroforestry J. Penelit. Hutan dan Konserv. Alam 16, 1 p. 91–100.
[7] Kittur B H Sudhakara K Kumar B M Kunhamu T K and Sureshkumar P, 2017 Effects of clump spacing on nutrient distribution and root activity of Dendrocalamus strictus in the humid region of Kerala, peninsular India J. For. Res. 28, 6 p. 1135–1146.
[8] Li C et al., 2018 Effects of different management approaches on soil carbon dynamics in Moso bamboo forest ecosystems Catena 169, Oktober 2018 p. 59–68.
[9] Inoue A Sato M and Shima H, 2018 Maximum size-density relationship in bamboo forests: Case study of Phyllostachys pubescens forests in Japan For. Ecol. Manage. 425, May p. 138–144.
[10] Xu M Zhuang S and Gui R, 2017 Soil hypoxia induced by an organic-material mulching technique stimulates the bamboo rhizome up-floating of Phyllostachys praecox Sci. Reports (Nature Publ. Group) 7 p. 1–6.
[11] Wang H Tian G and Chiu S, 2016 Invasion of moso bamboo into a Japanese cedar plantation affects the chemical composition and humification of soil organic matte Sci. Reports (Nature Publ. Group) 6 p. 32211.
[12] Zhang X Zhng Z Bian F and Yang C, 2019 Effects of composted bamboo residue amendments on soil microbial communities in an intensively managed bamboo (Phyllostachys praecox) plantation Appl. Soil Ecol. Short comm, 136 p. 178–183.
[13] Zhang J Jiang J and Tian G, 2016 The potential of fertilizer management for reducing nitrous oxide emissions in the cleaner production of bamboo in China J. Clean. Prod. 112, 4 p. 2536–2544.

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