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Research Article

The effect planting hole size and manure on vegetative growth of golden teak (*Tectona grandis* L.)

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Abstract: Cultivation of the golden teak (*Tectona grandis* L.) requires the planting hole size and appropriate use of manure. The size of planting hole provides plant growth, so that the plant can grow with optimum and appropriate use of manure to provide nutrients for the plants. . The aims of the study was to obtain an interaction between planting hole size and manure on vegetative growth phase of golden teak. Treatments tested in this study were with 4 treatment of planting hole size as the first factor and 3 levels of manure as the second factor. The twelve treatments were arranged in a factorial randomized block desiagn with three replicates. Variable measured plant height, number of leaves, and the flush changes to mature. The results showed that there were no interactions between the planting hole size and goat manure on early vegetative growth of golden teak plants. The planting hole size treatment showed significant effects on some variables height of plant, number of leaves and flush change to mature leaves. Manure treatment showed no significant effect for all variables. The observation variables that showed no significant differences height of plant, number of leaves and flush change to mature leaves.

Keywords*: goat manure, golden teak, planting hole size, stagnation*

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Introduction

Teak (*Tectona grandis* L.) is a plant cultivated for the use of wood as raw materials of furniture and buildings. Teak is also one of the forest plants that is able to keep the concentration of CO_2 in the atmosphere remains stable (Junaedi, 2008). Initially teak cultivation has a long harvest period, which is about 40-60 years in one harvest. However, since the last 5 years in Indonesia has started to develop various approaches to shorten the harvest time of teak. The development of bio technologies has resulted in a superior teak variety. Age of the harvest of the superior teak only ranges approximately 15 years (Effendi and Iqbal, 2012). A key factor in accelerating the growth of teak plant is fertilizer. The fertilizer provides nutrients for golded teak plant. The use of organic fertilizer aims to improve the physical, biological and chemical properties of soil to grow roots quickly and freely move in the soil (Rahim, 2000). Uwah and Eyo (2014) also stated that the provision of manure gives a significant effect on maize in parameter plant height, number of leaves and stem diameter. The response is related to the nutrient content of manure hat can increase the soil absorption of the soil to water and helps the nutrient uptake of chemical fertilizers provided. The factor of planting hole size will affect rate of plant growth. When planting hole sizes are not suitable, then the growth of a plant becomes disturbed. Mechanism of the planting hole is intended to facilitate the roots of the plant through the soil, the roots grow well, and continue to elongated grow to a deeper place in the soil to facilitate the roots to take up the nutrients and water, thus increasing the growth and percentage of plant life (Komang, 2009). Planting hole in each plant species requires different size. Planting hole size on soil with heavy texture and rocks

requires a larger size than normal soil conditions for rooting of seedlings having time to adapt to the environment in the roots of plants (Schuch et al., 2004). Addition of goat manure can increase soil absorption to water and assist nutrient absorption (Ano and Ubochi, 2007). Therefore this study was conducted to find out influence of planting hole size and goat manure treatment to early vegetative growth of golden teak plant.

Materials and Methods

This research was conducted from May to September 2016 at the academic business unit of Agro Techno Park Universitas Brawijaya located at Jatikerto, Kromengan District, Malang Regency, East Java. The type of soil is Alfisol with a pH about 6.0, total of N 0.20%, water content 8.5% and C-Organic 1.65%. Altitute of the study area is about 303 meters above sea level. The average recorded temperature ranges from 23 to 26 ^{0}C, rainfall is about 100 mm/ month, and relative of humidity ranges from 70 to 90% .The research materials used were gold teak seedlings with an average height of 50 cm. The experiment used factorial which was arranged in a randomized block design with planting hole size as the first factor that consisted of three levels: L1 = Hole Size (30 x 30 x 30) cm^3; L2 = Hole Size (50 x 50 x 50) cm^3; L3 = Hole Size (70 x 70 x 70) cm^3; and L4= Hole Size (90 x 90 x 90) cm^3. Manure as a second factor consisted of 3 levels, namely: P1 = 5 kg goat manure; P2 = goat manure 7.5 kg; P3 = goat manure 10 kg. Based on the results of chemical analysis of goat manure got result pH 7.8, C-Organic 8.93%, total N 0.72%, C/N 12, P 0,46 mg/kg and K 0.77 me/100g. Observations were performed at ages of 2 to 14 weeks after planting. The variables measured were plant height, number of leaves, and the flush changes to mature. Data obtained were analyzed by variance analysis (ANOVA). Further analysis of the least honestly difference (HSD) was performed at the level of 5%.

Results and Discussion

Based on the analysis of variance, there was no interaction between planting hole size and goat manure to the variable of plant height at 2 to 14 weeks after planting (WAP). The treatment of planting hole size significantly affected height of teak plants, but no significant effect on the application of manure (Table 1). Table 1 shows that there were significant differences in planting hole treatments at the analysis of hsd advanced test at 5% level.

Table 1. Average plant height at 2 to 14 weeks after planting

Treatment	**Height of Plant (cm) (WAP)**				
Planting Hole Size	**2**	**5**	**8**	**11**	**14**
L1 (30 x 30 x 30) cm^3	35.57a	36.57a	37.82a	39.49a	42.06a
L2 (50 x 50 x 50) cm^3	36.11ab	37.17ab	38.38ab	40.11a	42.67a
L3 (70 x 70 x 70) cm^3	37.78b	38.94b	40.22b	41.67ab	44.49ab
L4 (90 x 90 x 90) cm^3	39.46b	40.54b	41.86b	43.63b	46.81b
HSD 5%	1.84	1.92	2.00	2.33	2.65
CV	6.19	6.29	6.33	7.08	7.53
Goat Manure	**2**	**5**	**8**	**11**	**14**
P1 (5 kg)	49.24	50.67	52.46	54.57	58.25
P2 (7.5 kg)	48.98	50.42	52.00	54.08	57.75
P3 (10 kg)	50.69	52.14	53.82	56.24	60.01
HSD 5%	ns	ns	ns	ns	ns
CV	6.19	6.29	6.33	7.08	7.53

Note: Within a column for each site, means followed by the same letters are not significantly different according to HSD (0.05). ns: not significantly different WAP: week after planting.

The average plant height at 2 wap observation was not significantly different in all treatments except the planting hole size treatment of 30 x 30 x 30 cm^3 and planting hole treatment of 90 x 90 x 90 cm^3. In observation at 5 and 8 wap, plant height in planting hole treatment of (30 x 30 x 30) cm^3 was significantly with that of treatment of 70 x 70 x 70 cm^3. In observation at11 and 14 wap significant different in plant height was observed for treatments of 30 x 30 x 30 cm^3 and 90 x 90 x 90 cm^3. At 14 WAP observations, planting hole size treatment L1 and L2 did not give a significant

effect to each other. However, in treatment L2 and L3 gave a significant effect after HSD test with 5% level. Significant effects occurred in treatment L2 with L4 with average yield of plant height of 42.67 a and 46.81 b, HSD yield 5% level of 2.65. Komang (2009) stated that larger planting holes could improve soil aeration, root development, and infiltration rate. Results of analysis of variance showed that there was no interaction effect between the planting hole size and manure on the number of leaves at age 2 to 14 WAP. Planting hole size treatment significantly affected the number of leaves at the age of 11 until 14 WAP, but did not occur on manure treatment (Table 2).

Data presented in table 2 show that the average number of leaves produced at age 2 until 8 wap was not significantly different in all planting hole treatments except in at 11 and 14 wap. At 11 wap, the average number of leaves produced showed significantly different in 30 x 30 x 30 cm^3 and 70 x 70 x 70 cm^3 treatments. The average number of leaves produced at 11 wap showed that the (30 x 30 x 30) cm^3 treatment was significantly different with that of (50 x 50 x 50) cm^3 and treatment (90 x 90 x 90) cm^3 treatments. At all age of observation, the highest yield was obtained on planting hole treatment of (90 x 90 x 90) $cm^{3.}$, the highest yield of plant height was observed in the treatment of planting hole size of (30 x 30 x 30) cm^3. Differences in the planting holes size affected the number of teak leaves. The deeper the planting hole size was made, the deeper roots of the teak plants grew, thus affecting the uptake of nutrients by plants to perform the process of photosynthesis. The effect of this significant difference that caused the number of teak leaves increased, although the effect of fertilizer was not significant. This significant effect caused the increase of number of teak leaves, although the manure did not have an effect. According to Alridiwirsah (2010), planting hole size depends on the root pattern of a plant. the recommended planting hole size should be match to the formation of teak plant root pattern, so that subsequently it is not expected to make the plant stagnant.

Table 2. Average number of leaves

Treatment	**Number of Leaves (Sheet) (WAP)**				
Planting Hole Size	**2**	**5**	**8**	**11**	**14**
L1 (30 x 30 x 30) cm^3	7.22	7.82	8.11	8.89 a	10.08 a
L2 (50 x 50 x 50) cm^3	7.81	8.67	9.03	10.26 ab	11.58 b
L3 (70 x 70 x 70) cm^3	8.47	8.94	9.49	10.97 b	12.33 bc
L4 (90 x 90 x 90) cm^3	8.56	9.04	9.97	11.51 b	13.55 c
HSD 5%	ns	ns	ns	1.50	1.39
CV	24.65	25.31	22.73	18.11	14.68
Goat Manure	**2**	**5**	**8**	**11**	**14**
P1 (5 kg)	10.10	11.07	11.86	13.76	15.54
P2 (7.5 kg)	11.14	11.89	12.47	14.00	15.88
P3 (10 kg)	10.82	11.51	12.26	13.88	16.03
HSD 5%	ns	ns	ns	ns	ns
CV	24.65	25.31	22.73	18.11	14.68

Note: Within a column for each site, means followed by the same letters are not significantly different according to HSD (0.05). ns: not significantly different WAP: week after planting.

On observation of leaves number parameter, there was significant difference in observations at 11 and 14 WAP. At observation of 14 WAP, there was a significant difference between L1 with L2 and L3 and L4 treatments. Results of analysis of variance showed that there was no interaction between the planting hole size and goat manure to the number of leaves at age 2 to 14 WAP. Planting hole size treatment had significant effect on the number of leaves at age 11 to 14 WAP, but it did not occur in the application of manure (Table 3). Table 3 shows that the flush changes to mature parameter at 2, 5, and 8 wap were not significantly different in all planting hole size treatments. However at 11 and 14 wap there were significantly different. At the age of 2 wap and 5

wap the highest average yield of the flush changes to mature was in the planting hole treatment of 70 x 70 x 70 cm^3. At the age of 8, 11, and 14 wap, the highest yield was obtained on the planting hole treatment of 90 x 90 x 90 cm^3. In observation of the flush change to mature, there was a significant difference at 11 and 14 weeks after planting. At observation of 14 weeks after planting, a significant difference occurred between L1 with L2 and L2 with L3 treatments. The effect gave a average yield of significant the flush change to mature leaves between treatments. Similarly, the increase of number of leaves in the planting hole treatments the flush change to mature leaves was also influenced by the greater application of planting holes. Although the average flush change to mature leaves on L3 and L4 treatments did not give any significant difference. The results of this significant difference affected the growth of plants in the vegetative phase. However, the data showed no interaction between planting hole size and goat manure on early vegetative growth of gold teak plants.

Table 3. Average of the flush change to mature leaves

Treatment	**Flush Change to Mature Leaves (WAP)**				
Planting Hole Size	**2**	**5**	**8**	**11**	**14**
L1 (30 x 30 x 30) cm^3	3.20	4.76	5.61a	6.08a	6.27a
L2 (50 x 50 x 50) cm^3	3.64	5.70	6.42b	7.27b	7.49b
L3 (70 x 70 x 70) cm^3	3.75	5.81	7.54c	8.44c	8.73c
L4 (90 x 90 x 90) cm^3	3.56	5.68	7.86c	8.54c	9.19c
HSD 5%	tn	tn	0.62	0.66	0.61
CV	27.02	15.63	11.31	10.86	9.65
Goat Manure	**2**	**5**	**8**	**11**	**14**
P1 (5 kg)	4.52	7.31	9.03	10.04	10.34
P2 (7.5 kg)	4.91	7.34	9.22	10.15	10.55
P3 (10 kg)	4.73	7.30	9.19	10.15	10.80
HSD 5%	ns	ns	ns	ns	ns
CV	24.65	25.31	22.73	18.11	14.68

Note: Within a column for each site, means followed by the same letters are not significantly different according to HSD (0.05). ns: not significantly different; WAP: week after planting.

The differences of planting holes and manure contributed a good results for the growth of teak plants. However, in addition to both treatments there are also other factors that can affect the growth of teak plants. According to Ambardini et al. (2015), planting hole size has no significant effect on plant height, shoot number, and stem diameter because there are other factors that directly affect the growth of plants such as climate factor, rainfall, and also soil physical and chemical properties. Results of the analysis of variance showed no interaction between the planting hole size and manure treatments. This means that there is no relevance of influence is given to the recommended treatment of planting hole and goat manure. In accordance with the statement of Taiyeb et al. (2007) in determining of manure application needed should be used local fertilization recommendations to calculate the absorption of plants toward fertilizer given. The regulation of planting hole size is one of the planting methods to provide space for strengthening the root system of teak plants. The large planting hole size will improve the availability of nutrients for plant growth. However, it does not mean that the bigger the planting hole size will have a positive impact on the growth of each plant (Asmayannur et al, 2012). Teak is one of the annual crops that requires large planting holes for growing roots that function as water absorption and nutrients from the soil that teak plants use for metabolic sustainability processes (Uwah and Eyo, 2014). Variables of plant height, number of leaves, and the flush change to mature in this study showed significantly different results in treatments of planting hole. Observation of variables such as stem diameter, number of deciduous leaves, buds, leaf area, and percentage of death plants did not show significant effect to each other among treatments. This does not mean that the recommended planting hole or manure are

unsuitable for the growth of teak plants. In accordance with Wartono (2014) statements, the influence of factors other than planting holes that directly affect the growth of plants, are climatic factors such as light intensity, rainfall, and soil physical and chemical properties.

Conclusion

The was no significant interaction between planting hole size and goat manure treatment to the early vegetative growth of the golden teak plants. The significant effect of planting hole size showed at plant height variables. Significant effects were also seen in the number of leaves at age 11 and 14 WAP, and in the flush change to mature leaves at the age of 8, 11, and 14 WAP.

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