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The early growth and development of 10 genotypes Gajah ginger as intercrops system in *Jatropha curcas* plantation

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ABSTRACT

INFORMATION
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Ginger (*Zingiber officinale* Rosc.) is one of the medicinal plants and can be processed into products such as essential oils and starches. Ginger was planted under a tree because it has a good sunlight tolerant plant. Ginger can grow and develop normally, even in low light intensity. Indonesia has a lot of land with shade conditions and potential for ginger production. It can be supported to increase national ginger production. This study aims to assess the growth and development of ginger in Gajah variety, with several genotypes, that are cultivated as intercropping at Jatropha curcas. The study was conducted in Jatropha plantation at 2.144 dap age, which is located at Desa Kedungpenggaron, Kec. Kejayaan, Pasuruan city (117 m above sea level, with coordinates 7 ° 46'18.6 "112 ° 50'25.2"). The study began on October 2017 to March 2018. The study used Gajah variety, with 10 genotypes, consist of Banyuwangi, Sidoarjo, Malang, Bojonegoro, Jombang, Bandung, Purwakarta, Banten, Lampung, Jambi, which were arranged in a Randomized Block Design. The results showed that ginger's growth and development at 14 to 105 dap was not significantly different in all parameters. Based on cluster analysis for 14 quantitative variables, showed that two grouped, specifically 9 genotypes and 1 Lampung's genotype with 31.71% similarity. The similarity of Ginger Gajah, approved by the Banyuwangi and Jombang genotypes, which reached 86.26%.

Keywords: *ginger, intercropping, Jatropa curcass.*

INTRODUCTION

Optimizing agricultural land is an effort to increase land resources into agricultural, horticulture, and plantations. This aims to make the land more productive. Land optimization is also to support the realization of national food security (Ditjen PSP, 2015).

Ginger (Zingiber officinale Rosc.) is one of the medicinal plants and can be processed into products such as essential oils and starches. Essential oils contain zingeton or gingerol, zingibetol, zingiberin, borneol, kamfen, sineol, and falandren, while starch content of about 20% to 60% contains organic acids, oleoserin, and gingerin. Ginger was planted under a tree because it has a good sunlight tolerant plant. Ginger can grow and

develop normally, even in low light intensity. Indonesia has a lot of land with shade conditions and potential for ginger production. It can be supported to increase national ginger production.

The various geographical situations in Indonesia, significantly influence the level of plant adaptation. Plant adaptation to the soil, water, and climatic conditions in the area. Based on data and agricultural information systems in 2013, there are 21.78% of ginger production came from Central Java and West Java (20.82%), East Java (15.37%), South Kalimantan (5.55%), North Sumatra (5.32%), Lampung (4.92%), Bengkulu (3.34%) and the remaining 22.90% were received from other provinces. Based on the center of ginger production in Indonesia, it shows that the area has different climate and soil conditions. Climates and soil different conditions, make ginger have different characteristics (Wijayanto, et al., 2012). This study aims to assess the growth and development of ginger in Gajah variety, with several genotypes, that are cultivated as intercropping at Jatropha curcas.

RESEARCH METHOD

The study was conducted in Jatropha plantation at 2.144 dap age, which are located at Desa Kedungpenggaron, Kec. Kejayaan, Pasuruan city (117 m above sea level, with coordinates 7 ° 46'18.6 "112 ° 50'25.2"). The study began on October 2017 to March 2018. The study used Gajah variety, with 10 genotypes, concist of Banyuwangi (ZGBA), Sidoarjo (ZGSD), Malang (ZGML), Bojonegoro (ZGBJ), Jombang (ZGJB), Bandung (ZGBD), Purwakarta (ZGPW), Banten (ZGBN), Lampung (ZGLM), Jambi (ZGJM), which were arranged in a Randomaize Block Design.

The instruments that were used are agricultural devices, hoes, rulers, calipers, scale, leaf color chart, chlorophyll meter, chemical beaker, water container, and camera. The materials that were used are 10 genotypes of ginger Gajah, organic liquid fertilizer, NPK fertilizer, cow manure, and fungicides with Benomil active ingredients.

Planting of ginger was carried out between jatropha plantations, with plant maintenance according to the procedure. Observation variables consisted of the number of leaves, plant height, number of tillers, stem diameter, and fresh weight of the plant. The data obtained, were analyzed by ANOVA, significantly 5% and 1%. Data were presented in the table or curve form.

RESULT AND DISCUSSION

The number of leaf

The leaf number of Gajah ginger planting among Jatropha was not significantly different. The growth rate leaf number of 10 ginger genotypes at 14 to 105 dap shown in Figure 1.

Figure 1 shows that the number of 10 genotypes ginger leaves increased significantly on 84 to 98 dap. The significant increase was due to the dormancy period completion in this age of the plant. Figure 2 shows the rate of plant height, Fig. 3 number of tillers increased significantly at 98 dap. Lujiu et al. (2010) divided the growth phase of ginger into two, the

fast phase which covers the 70 up to 90 dap (vigorous stage) and the rhizome development phase which includes the 90 up to 120 dap (rhizome expansion stage).

absorbed light for the photosynthesis process causing it becomes very important for the plant (Gardner et al., 1985).

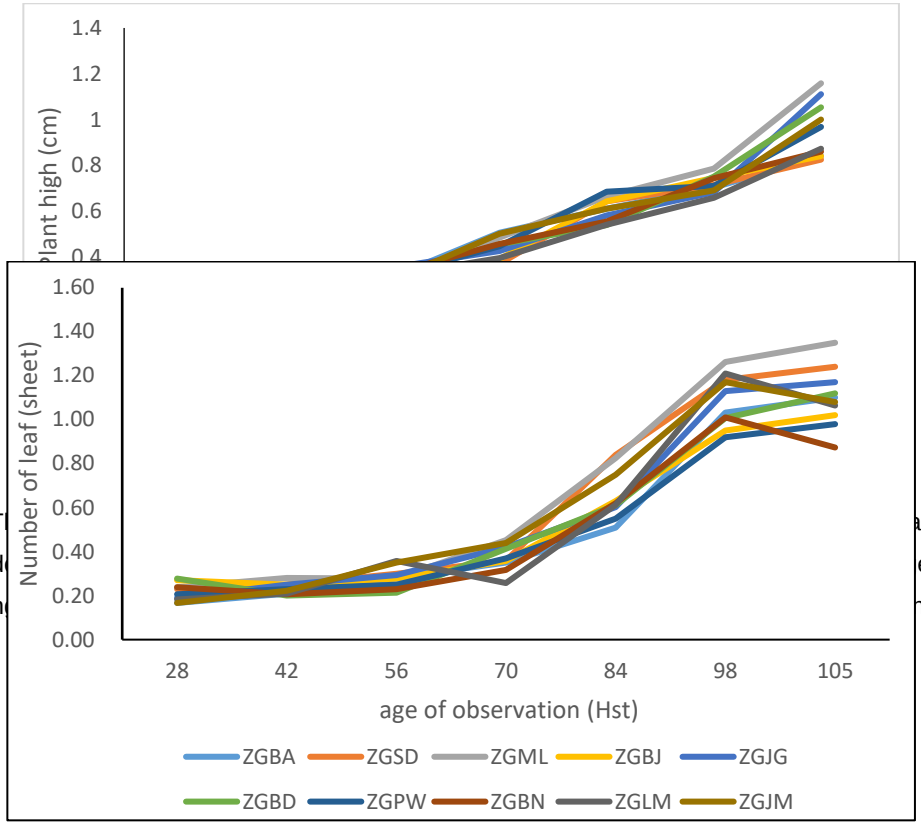

Figure 3. T ngi ginger, ZGSD=Sid er, ZGBD= Bandung gin nger, ZGJM=

Figure 1. The growth rate of leaf Gajah ginger at 14 to 105 day

note : ZGBA= Banyuwangi ginger, ZGSD=Sidoarjo ginger,ZGML= Malang ginger (ZGBJ= Bojonegoro ginger, ZGJG= Jombang ginger, ZGBD= Bandung ginger, ZGPW= Purwakarta ginger, ZGBN= Banten ginger (ZGBN), ZGLM= Lampung ginger, ZGJM= Jambi ginger

The genotype of Gajah ginger from Malang had the highest rate of leave number increase, 1.34 strands/day on 84 to 98 dap. The high rate was possibly due to light exposure on the 2nd and 3rd block are different from the genotypes from Bojonegoro which had a low rate relatively. The factors that affect the number of leaves are the genotypes and the environment. Besides those two factors, the number of leaves determines the amount of

Plant Height

The plant height-growth rate of 10 genotypes ginger did not show any significant differences. The growth rate plant height parameters at 14 to 105 dap as a Figure 3.

Based on the figure above, the best average tillers number of 10 genotypes Gajah ginger was mostly found in genotype from Malang of 8.22 tiller/day and a several Gajah

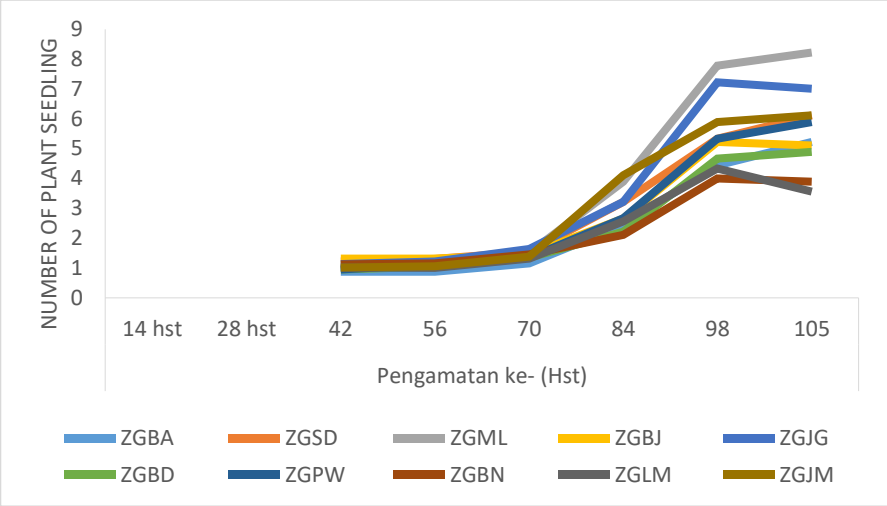

Figure 3. The growth rate of plant seedling Gajah ginger at 14 to 105 day

note : ZGBA= Banyuwangi ginger, ZGSD=Sidoarjo ginger,ZGML= Malang ginger (

ZGBJ= Bojonegoro ginger, ZGJG= Jombang ginger, ZGBD= Bandung ginger, ZGPW= Purwakarta ginger, ZGBN= Banten ginger (ZGBN), ZGLM= Lampung ginger, ZGJM= Jambi ginger

ginger genotypes on Jambi genotype of 1.02 tiller/day relatively.

Picture. 2 shows the comparison of plant growth rates between genotypes. The similarity of genotypes does not affect the same high rate of plant growth. Plant height greatly depends on the plant adaptability to soil and climate conditions. The same variety of the same environment will result in different height because each plant has a different adaptation level (Filter et al. 1998). The height rate was on the ZGML genotype because the length plant stem defines the number of segments where the leaves grow. Ginger plants with a relatively high stem will have more leaves which affected the plant assimilation process (Sintia, 2011).

Number of Seedlings

The number of seedling in 10 genotypes of Gajah ginger as intercrops of Jatropha did not show any significant differences. The number of plant seedling at 14 up to 105 dap as Figure 3.

Based on the figure above, the highest average Gajah ginger seedling of 10 genotypes was from Malang with the amount of 8.22 seedling/day, while the lowest average was from Jambi with the amount of 1.02 seedling/day. The number of 10 genotypes Gajah ginger seedling increased started from 70 to 98 dap significantly. Genetically there was no significant difference in the genotypes tested. It did not significantly different was because the seedling indicates the same development and branching of Gajah ginger's rhizome. The genotype from Malang was the genotype with the growth of the largest seedlings number. On the other hand, Lampung ginger became the genotype with the least number of seedlings. The relationship between plant height and number of leaves affected the seedling number, where genotype from Malang which had the number of leaves

and height plant highest relatively. Idwar et al. (2010) state that the increase in leaves number will improve the photosynthesis activity and chlorophyll content which results in the growth of ginger's new buddings. Another study stated that three new seedlings appeared after adding 1% of acacia oil to the 4-months-old of Gajah ginger, and 6.71 new seedlings appeared after adding 3% of mangrove oil and acacia charcoal (Nurliani, 2003).

The diameter of clump ginger

The diameter of clumping ginger for the 10 genotypes of Gajah ginger as intercrops for Jatropha did not show any significant difference. The result of variant analysis did not follow by further tests because it did not have a significant effect on the clum ginger parameter. The average clump ginger diameters of 10 genotypes on 14 to 105 dap as Figure 4.

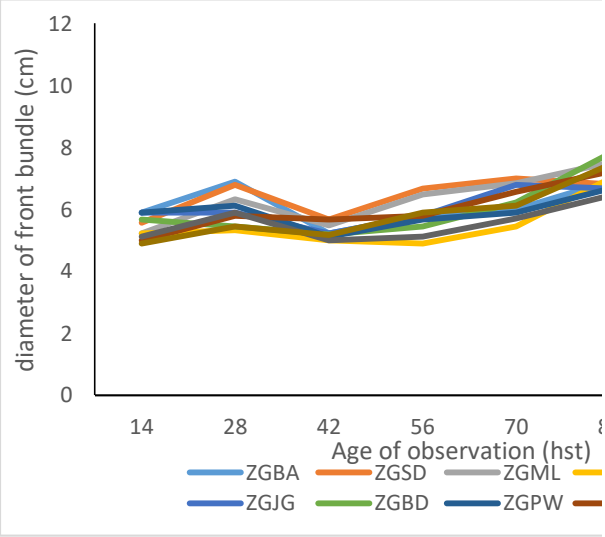

Figure 4. Diameter of clump Gajah ginger at 14 to 105 dap note : ZGBA= Banyuwangi ginger, ZGSD=Sidoarjo ginger,ZGML= Malang ginger (ZGBJ= Bojonegoro ginger, ZGJG= Jombang ginger, ZGBD= Bandung ginger, ZGPW= Purwakarta ginger ZGBN= Banten ginger (ZGBN), ZGLM= Lampung ginger, ZGJM= Jambi ginger

Based on Figure 4, the average clumping ginger diameter increase relatively the highest for the one from Malang (9.51 cm/day), and the lowest was from Banten with the average rate of 4.89 cm/day. The average diameter of the ginger stem was on the range of 5.11 to 9,81 mm in Lampung and Malang genotypes respectively. The result is suitable for the research conducted by Satrio (2012) who found that the stem of the Gajah ginger at the age of 98 dap had a diameter range of 9.15 mm to 10.11 mm on the paclobutrazol-free treatment. Other research conducted by Pikri (2011) showed that the midget collection of 8 mm to 9.04 mm. The decrease in the diameter of the clump ginger compartment at 42 and 70 dap, was due to the presence of a plant like a bamboo. Heaping up is to keep the rhizome under the soil. Besides, the heaping up will maintain the drainage system (Rostiana, 2012).

Fresh Weight of plant

The plant fresh weight of 10 genotypes of Gajah ginger as intercrops of Jatropha did not show any significant difference. The result of variance analysis was not continued to the advanced test because it had no significant effect on the observation parameter. The average fresh weight of plants for 10 Gajah ginger genotypes at 105 dap was shown in Figure 5

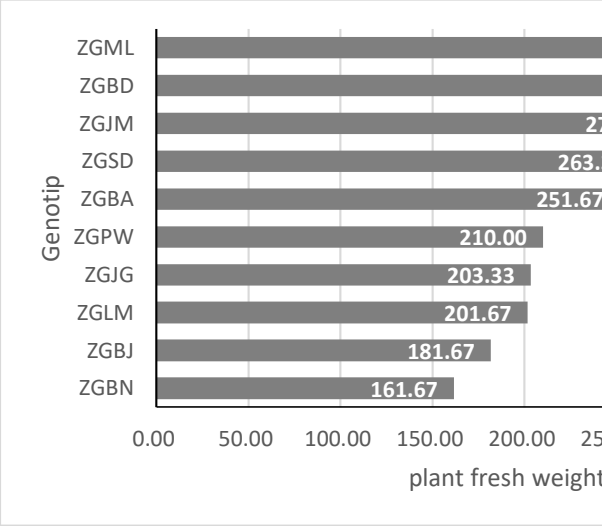

Figure 5. Average plant fresh weight of Gajah ginger at 14 to 105 day
note : ZGBA= Banyuwangi ginger, ZGSD=Sidoarjo ginger,ZGML= Malang ginger (
ZGBJ= Bojonegoro ginger, ZGJG= Jombang ginger, ZGBD= Bandung ginger, ZGPW= Purwakarta ginger, ZGBN= Banten ginger (ZGBN), ZGLM= Lampung ginger, ZGJM= Jambi ginger

Based on figure 5, the average fresh weight of ginger plants at 160 and 380 g on genotype from Banten and Malang respectively. The translocation process of nutrients from the ground to the leaf through the stem transported by xylem and phloem. Xylem has a function as a tissue carrying nutrients obtained from the soil such as H2O, N, and P, whereas the phloem tissue carries photosynthesis in the photosynthates forms, such as sucrose, amino acids, and potassium. According to Tjitrosoepomo (2015), it has been known for a long time that photosynthesis results are transported from leaves to other organs such as roots, stems, and productive organs by phloem. The transportation process that occurs will pass through the stem so that the diameter of the stem will continue to increase to smooth in the process of transporting photosynthesis and nutrients. According to Rahardjo (2012), if the rate of cell division, elongation, and formation of tissue running fast, growth of stems, and roots will also run fast and vice versa this all depends on the availability of carbohydrates. The fresh weight of the ginger plant shown in Figure 10, had a susceptible weight of 160 to 380g at 195 dap. This result had similarities with Agus et al (2014) study, that ginger plant at 4 months weighs 182 g at control treatment and weighs 314 g on the addition of organic fertilizer from turnip greens.

Analysis of Gajah Ginger Genotypes

Diversity of 10 Gajah ginger genotypes was analyzed based on the degree of similarity between each genotype. The calculated level of similarity based on the average value indicated by each observation parameter. The dendrogram was used as a picture of the relationship between genotypes with a 0.0-100% similarity scale presented in Figure 14. The increasingly differentiated relationship shows high diversity in the sample (Sukartini, 2008).

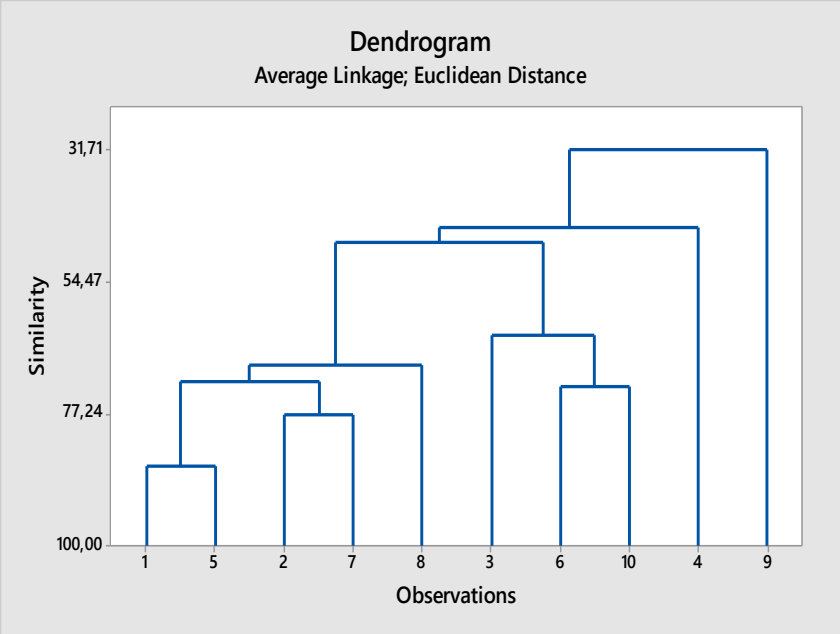

Figure 6. Dendrogram of diversity 10 Gajah ginger genotypes

The dendrogram in Figure 14 shows the results of genotype 9 (Genotip origin Lampung) had a difference with the other 9 genotypes for 31.71%. The group of 9 genotypes of Gajah ginger was divided into subgroup I consisting of 8 genotypes with one genotype of from Bojonegoro which had a 44.94% similarity level. Subgroup I was divided into subgroups 1a and subgroups 1b which have been a value of 45.57%. The closest relationship level in ginger genotype from Banyuwangi with ginger genotype from Jombang with 86.26% similarity level.

The high relationship value of the dendrogram was due to the high diversity in the sample. The Lampung genotypes had far differences with other genotypes that can be due to related by origin geographic conditions to the place of study. Similarity values are genotypes from Jombang and Banyuwangi can be attributed to the equation of environmental conditions of origin of the genotype. Farmers in Banyuwangi cultivate a lot of ginger in the Raung mountain slope area, meanwhile, the data of the Investment Office of Jombang Regency states 37.85 tons of ginger was produced in Wonosolam area. A cultivar comes from the same region, but if different environments will affect genetic diversity and genotypes from the same region are not always in the same group. The more feature equations, to the closer relationship, is. (Purbayanti, 2008).

CONCLUSION

The early growth and development of 10 genotypes of Gajah ginger as intercrop in Jatropha curcass plantation, observed at age 14 to 105 dap did not differ significantly on all parameters. Based on similarity analysis on 14 quantitative variables obtained, one group of 9 genotypes with 1 genotype origin Lampung had

of 31.71% similarity level. Genotype from Banyuwangi and Jombang with 86.26% had the closest similarity level.

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