Seed briquette composition for the direct seeding of Gmelina *Gmelina arborea* Roxb.

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ABSTRACT

The study of the effect of briquette composition on the seedling survival and growth of Gmelina in the field with the Randomized Group Design (RGD) experimental method. The parameters observed in the seed briquette composition test in the field were seedling diameter, seedling height and life percentage. The data were analyzed by Analysis of Variance (ANOVA) and Duncan's Test using SAS and SPSS programmes to determine the success of the seed briquette composition test. The composition of seed briquette has a significant effect on the survival percentage and growth of direct seeding Gmelina in the field. The application of the composition of B-5 with land preparation in the form of cleaning gives the best percentage of life and growth of Gmelina seedlings. This composition also gave a high growth of 45.29 cm, a diameter of 5.16 cm and a percentage of life of 58.33%. The composition of the B-5 seed briquettes has a proportional composition of the main ingredients in the form of soil and compost which is 20% and 40% as a growing medium and a source of nutrition for Gmelina seedling growth.

ABSTRAK

Penelitian tentang pengaruh komposisi briket terhadap persen hidup serta pertumbuhan Gmelina di lapangan dengan metode eksperimen Rancangan Acak Kelompok (RAK). Parameter yang diamati pada uji komposisi briket benih di lapangan adalah diameter semai, tinggi semai dan persentase hidup. Data dianalisis dengan Analisis Ragam dan Uji Duncan dengan menggunakan program SAS dan SPSS untuk mengetahui keberhasilan dari uji komposisi briket benih. Komposisi briket benih berpengaruh nyata terhadap persentase hidup dan pertumbuhan *direct seeding* Gmelina di lapangan. Penerapan komposisi B-5 dengan persiapan lahan berupa pembersihan memberikan persentase hidup dan pertumbuhan semai Gmelina terbaik. Komposisi ini juga memberikan pertumbuhan tinggi sebesar 45,29 cm, diameter sebesar 5,16 cm dan persen hidup sebesar 58,33%. Komposisi briket benih B-5 memiliki komposisi bahan utama berupa tanah dan kompos yang proporsional yaitu sebesar 20% dan 40% sebagai media tanam dan sumber nutrisi untuk pertumbuhan semai Gmelina.

Keywords: Direct seeding, seed briquette, Gmelia

INTRODUCTION

The extent of degraded land is a sign of unsustainable natural resource management that causes disruption to water systems, high erosion and sedimentation, and increases the potential for natural disasters such as floods, droughts and landslides. According to data from the Ministry of Environment and Forestry (2017), the area of critical land reaches 24.30 million hectares with a rate of degradation of forest land reaching 700-800 thousand hectares per year.

So far, land rehabilitation activities in Indonesia have used planting methods using seedlings in polybag containers. However, the extent of degraded land and difficult accessibility to most degraded land areas make the land rehabilitation efforts are not optimal and it requires other alternative methods that are practical and can be applied on a large scale, involving little labor and are relatively inexpensive. One planting technique that has great potential to use on a large scale is direct seeding (Willoughby et al., 2007). Direct seeding for reforestation is a long-standing practice that has redeveloped considering the high costs for nurseries in nursery farms (Woods and Elliott, 2004) and operational planting in the field (Sudrajat et al., 2018). This technique is easier, simpler and cheaper than planting seedlings and has been adopted in the restoration of

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degraded tropical lands (Woods and Elliott, 2004; Garcia-Orth and Martinez-Ramos, 2008). The problem that often arises in the application of direct seeding is the low viability and vigor of the seed when it is sown directly in the field so that the activities of direct seeding is often ended in failure.

In the application of direct seeding, seed germination and seedling development are the initial stages of the plant life cycles (Vieira and Scariot, 2006), and the failure at this stage can be caused by seed predators, herbivores, competition and biotic factors (extreme temperatures, drought and excessive sunlight). This failure can be reduced by seed treatment (Birkedal, 2010) and desiccation (Woods and Elliott, 2004), appropriate sowing methods (Woods and Elliott, 2004; Nurhasybi and Sudrajat, 2013), sowing time (Vieira et al., 2008), and a combination of these techniques.

Seed briquette technology is one of the seed treatments that can be applied to improve the success of direct seeding (Sudrajat et al., 2015; Sudrajat et al., 2018). The use of seed briquettes can improve biological control capacity (Choong et al., 2006), increase the percentage and speed of seed germination (Podlaski and Wyszkowska, 2003) and increase drought resistance (Abusuwar and Eldin, 2013). Seed briquette technology combined with land management techniques and the addition of a water absorbent material (aquasorb) is expected to increase the success of direct seeding which allows the seeds to germinate more quickly, avoid seed predators, make the seedlings develop faster and are more drought resistant (Sudrajat et al., 2015; Sudrajat et al., 2016a).

The selection of suitable species for direct seeding is important (Engel and Parrota, 2001). Species with large seed sizes, such as *Gmelina arborea* (Gmelina), are an option in the application of direct seeding because they are able to compete with weeds. Large seeds have sufficient food reserves to support the early growth of seedlings (St-Denis et al., 2013). Production of Gmelina seeds is also quite high (between 30 kg and 170 kg /hectare/year (Rachmawati et al., 2002) so that it will be able to support the application of direct seeding for a broad scale. In addition, Gmelina is also a potential species for rehabilitation of degraded land through direct seeding (Engel and Parrota, 2001; Tuheteru et al., 2010). Gmelina is also a kind of potential and has good economic value as a type of wood producer.

The purpose of this study was to determine the composition of seed briquettes on the growth of Gmelina (*Gmelina arborea*) seeds in the field.

METHODS

Research location and time

This research was carried out in a Special Area with Special Purpose (KHDTK) Parung Panjang, at the Forest Plant Seed Technology Research and Development Center (BP2TPTH), Research Development and Innovation Agency (BLI), Ministry of Environment and Forestry (KLHK). The location is located between 106° 06' East Longitude and 06° 20' South Latitude, at an altitude of 51.71 m above sea level. The topography is relatively flat (slope <15%) with haplik podsolic soil types. It has low soil fertility (low N, P, K content) with a pH between 4.2 and 4.8. The initial vegetation is in the form of Puspa (*Schima* sp.) clusters, shrubs and reeds which has fast growth after weed removal (Sudrajat et al., 2016b). The study was conducted in April 2019 until August 2019.

Materials and equipment

Material used was Gmelina (*Gmelina arborea*) seeds that had been given wet extraction treatment. The ingredients for seed briquettes are soil, compost, husk charcoal, plant lime and tapioca. The tools used are the equipment for making seed briquettes (mixing tanks, shovels and seed briquettes) and planting equipment in the field (hoes, ground forks, stakes and mines).

Table 1. Seed briquette composition at each field treatment during field study in KHDTK.

T	Composition
B-0	Seed
B-1	40% compost, 30% rice husk charcoal, 20% lime, 10% tapioca
B-2	5% soil, 45% compost, 30% rice husk charcoal, 15% lime, 5% tapioca
B-3	10% soil, 45% compost, 25% rice husk charcoal, 10% lime, 10% tapioca
B-4	15% soil, 40% compost, 25% rice husk charcoal, 10% lime, 10% tapioca
B-5	20% soil, 40 %compost, 25% rice husk charcoal, 10% lime, 5% tapioca

Research design

The research design used was Randomized Group Design (RGD) with three planting blocks. Field treatment (T) experiment of seed briquette composition in KHDTK Parung Panjang is as seen on Table 1.

Growth parameters measured in the test composition of seed briquettes in the field is life percentage, height and diameter.

Production of seed briquette

Briquettes are produced with different ingredients. Tapioca as an adhesive is dissolved in boiling water and allowed to cool. Tapioca solution is mixed with other ingredients and stirred evenly, then manually printed using a round hand with a diameter of 5 cm and 3 cm thickness (Figure 1). Seed briquettes that have been printed were directly dried in the sun for two days. Seed briquettes are filled with one Gmelina seed.

Figure 1. Production process of seed briquettes.

Figure 2. Seed briquettes in field experiment.

Sowing of seed briquettes in the field

The process of sowing of seed briquettes in the field is carried out by land preparation in the form of land clearing in the circle with diameter of about 30 cm. Land clearing can increase the percentage of seedling life as reported by Nurhasybi and Sudrajat (2013). Gmelina seed briquettes are sown around the stake that have prepared with a spacing of 2 m x 1 m (Figure 2).

Data collection

Measurement of Gmelina seedling growth was carried out at the Parung Panjang KHDTK. Gmelina seedling growth was observed for three months period. The parameters measured are life percentage, height and diameter.

Data Analysis

Data were analyzed by ANOVA and Duncan Test using SAS and SPSS programme to determine the success of seed briquette composition experiment.

RESULTS

The results of the diversity analysis showed that the composition of the seed briquettes significantly affect the growth parameters (height, diameter and life percentage) of Gmelina. The diversity that arises due to differences in site (soil quality), topography and other factors even though the block treatment has been arranged in relatively uniform conditions. Further information can be seen in Table 2.

Table 2. Anova of seed briquette composition experiment in the field against growth parameter.

Parameters	Significance		
	Height	Diameter	%life
Block	1942.10 **	9.28*	16067.3 **
Briquette Composit	863.82 **	6.90*	2822.21 **

Note: * = very significant effect on the level of 5%
** = very significant effect on the level of 1%

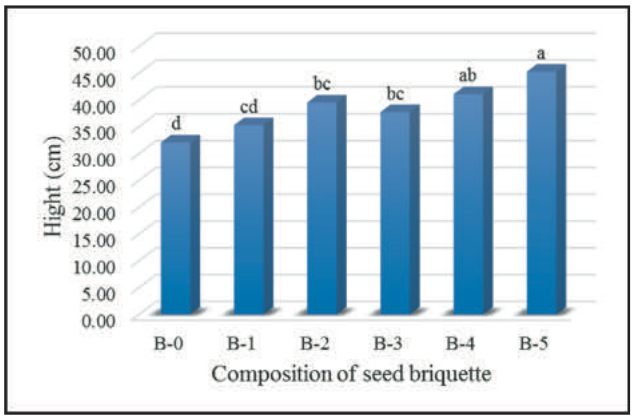
To determine the difference in response among the compositions of seed briquette, then the analysis was continued with Duncan's Test of the mean value of the growth parameters at each observation block.

Growth of seedling height

Based on Duncan's Test results, the composition of seed briquettes gave a significant difference to the highest growth height parameters shown in the treatment of seeds with a B-5 briquette composition of 45.29 cm, but did not show any significant difference with B-4 of 41.09 cm. Significant differences were shown in the control (B-0) with a

height of 32.08 cm, briquette composition B-1 (height 35.31 cm), B-2 (height 39.54 cm) and B-3 (height 37.75 cm) as presented in Figure 3.

Briquette composition B-5 is composed of 20% soil, 40% compost, 25% rice husk charcoal, 10% lime and 5% tapioca, while B-4 briquette composition is composed of 15% soil, 40% compost, 25% rice husk charcoal, 10% lime and 10% tapioca. From the composition of the soil and compost in the composition of seed briquettes B-5 and B-4, it can be seen that the composition of the soil B-5 (20%) is greater than the composition of the soil in seed briquette B-4 (15%). The combination of the main composition of the briquettes namely soil and compost is shown by the B-5 seed briquettes which can help Gmelina seed germination in the process of finding energy from sunlight.

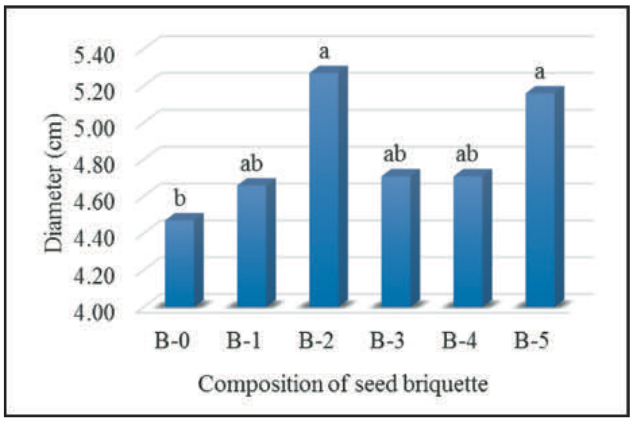


Note: the numbers followed by the same letters show results that are not significantly different at 99% confidence level based on Duncan's multiple interval test.

Figure 3. The height of Gmelina seedlings in the seed briquette composition experiment in field.

Growth of seedling diameter

Further test results using Duncan, in general Gmelina diameter growth show the significant differences with the control seed briquette composition (B-0). There is no significant effect between the composition of the briquettes on the diameter growth parameters. The highest significant effect was shown by the composition of the B-2 briquettes at 5.27 cm, but did not show any significant difference with B-1, B-3, B-4 and B-5 briquettes (Figure 4). The growth in diameter requires nutrition in stem formation. Briquette composition that influences the diameter growth is soil and compost.

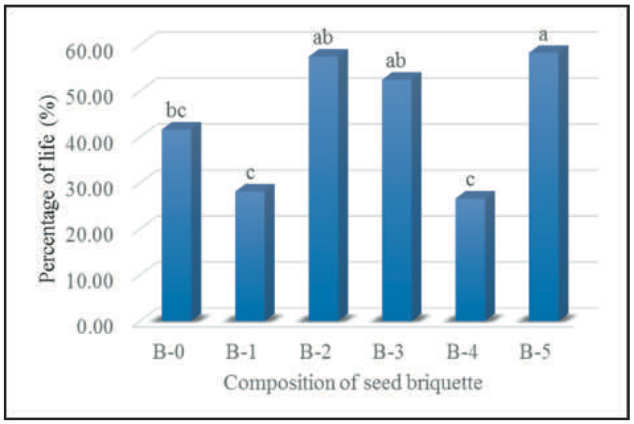


Note: the numbers followed by the same letters show results that are not significantly different at 99% confidence level based on Duncan's multiple interval test.

Figure 4. The diameter of Gmelina seedlings in the seed briquette composition experiment in the field.

Percent of seedling life

The results of Duncan's further tests show that the treatment briquette composition gives a real difference to the percentage of Gmelina seedling life. The composition of the briquettes with the highest percentage of life was shown in the treatment of seeds with the composition of the briquette B-5 of 58.33%, but did not show any significant difference with the briquette B-2 (percentage of life 57.50%) and B-3 (percentage of life 52.50%).



Note: the numbers followed by the same letters show results that are not significantly different at 99% confidence level based on Duncan's multiple interval test.

Figure 5. Percentage of Gmelina seedling life in the experiment of seed briquette composition in the field.

Significant differences were shown in the B-0 control (percentage of life 41.67%), briquette composition B-1 (percentage of life 28.18%) and B-4 (percentage of 26.67%) as seen in Figure 5. Percentage of Gmelina seed survival is mostly dependent on nutrition and environmental factors. The media is one of the most important factors in growth because sprouts require nutrients.

In the B-2 briquettes, it was seen that the percentage of compost (45%) was higher compared to B-5 (40%). The composition of the B-2 briquettes has less soil composition when compared to the composition of the B-5 soil by only 5%. High soil composition and compost is very required for plants to grow.

DISCUSSION

From the results of the field research, the most significant results were obtained between the compositions of the seed briquettes with growth parameters. Thus, it can be concluded that Ho is rejected and Ha is accepted. This is meaning that the composition of the seed briquettes have affected all growth parameters namely height, diameter and percentage of life. To determine the best composition in the test of the composition of the seed briquettes in the field against growth parameters determined based on Table 3.

Table 3. Table of Test Results of the Composition of Seed Briquettes against Growth Parameters in the Field

Briquette Composition	Height	Diameter	%life
B-0			
B-1			
B-2		X	
B-3			
B-4			
B-5	x	X	x

Note: x = shows the highest significance difference.

Based on the further Duncan's test results of seed briquette composition experiment, the composition obtained B-5 briquette gives the highest significant difference for all Gmelina seed growth parameters in the field.

CONCLUSION

The composition of seed briquettes significantly affected the growth of direct seeding Gmelina (*Gmelina arborea*) in the field. The best composition of seed briquettes with land preparation in the form of clearing and shaping is B-5 seed briquettes that composed of 20% soil, 40% compost, 25% rice husk charcoal, 10% lime and 5% tapioca. The composition of the B-5 seed briquettes gave a height growth of 45.29 cm, a diameter of 5.16 cm and the survival or life percentage of 58.33%.

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