Application of Goat Manure Briquettes on Red Chili Cultivation in Coastal Sandy Soil

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Abstract. Application of organic matter could prevent a high infiltration problem commonly found in coastal sandy soil. Due to its slow-release properties, organic matter added to this sandy soil may improve the groundwater retention capacity. This study was aimed to investigate the capacity of goat manure briquettes (GMB) in comparison with goat manure to support the productivity of red chili cultivated in coastal sandy soil. The study was carried out in a completely randomized design consisting of 3 doses of goat manure briquettes (GMB) and goat manure (GM) applied (30, 35, 40 tons/ha) with 12 replications. Each dose was applied to the fertilized soils (400 kg/ha urea + 300 kg/ha SP-36 + 300 kg/ha KCl) then incubated for a week. These treated soils were then used for red chili cultivation. Plant growth and yield were monitored and data collected were statistically analysed using DNMRT with significance level of 5%. GMB application showed insignificant effect towards the chili performance in sandy soil. In contrast, GM application revealed higher plant performance and yield. Application of 40 tons/ha GM exhibited the highest fruit weight compared to other treatments. According to these results, the formulation of GM into briquette might reduce its capacity in supporting plant growth.

Keywords: marginality of coastal sandy soil, goat manure briquette, soil amendments.

1. Introduction
Indonesia is an archipelagic country with a coastline of 95,181 kilometers, and part of its area is used for agriculture [1]. According to Sui et al. [2], for 28 years, Indonesia experienced an increase in the length of its coastline by 777.40 kilometers. The area along the coastline is a coastal ecosystem area influenced by the tidal dynamics of seawater. In general, the soil in coastal areas is coarse-textured due to the dominance of sand content, so it has high permeability [3]. Coastal sandy soils have many productivity constraints, including low water content and low fertility quality. Therefore, coastal sandy soils are generally classified as marginal soils, which require special treatment before being used as a growing medium.

One of the primary efforts in improving the quality of coastal sandy soil is adding organic matter as a soil amendment. Organic matter can improve the physical, chemical, and biological fertility of the soil. Soil organic matter can increase the ability of the soil to store water, increasing the supply of plant nutrients. Organic matter can also function as a soil buffer that improves the quality of the soil absorption complex as a plant nutrient reservoir and increases the efficiency of inorganic fertilizer application [4, 5]. The organic matter with various levels of C/N ratio affects the effectiveness of the benefits of these
materials when applied to the soil. Compost or manure is usually applied to the soil at a C/N ratio close to the soil C/N ratio so that it has an effective period of up to 1 – 2 months. Even in areas with drier climates, such as coastal areas, the effective period of effect of these organic materials can be shorter. Research conducted by Budiyanto [6] showed that the application of organic matter in the form of sugarcane press mud compost caused the sandy soil to have a C/N ratio of about 20 and could increase the vegetative growth of maize plants in coastal sandy soils.

Many organic matter sources can be used as fertilizer, namely manure, sewage sludge, plant stems, compost, biogas residue, biogas slurry [7]. The application of organic fertilizers is usually combined with inorganic fertilizers. Even Kakar et al. [8] stated that the efficacy of organic fertilizers needed to be optimized so that it could replace the using of inorganic fertilizers without compromised with plant growth performance. Processed animal manure is one of the fertilizer ingredients to increase nutrient availability and improve soil properties. Manure has a complete nutrient content, including macro and micronutrients. Manure also contains organic acids, including humic acid and fulvic acid, hormones, and enzymes that are not found in inorganic fertilizers [9]. One of the organic matters commonly applied to sandy soil is goat manure. Besides increasing the nutrient supply, application of goat manure also functions as a soil amendment, especially in improving the water retention capacity of sandy soil. Rastiyanto et al. [10] stated that goat manure contains 0.63-0.95% N, 0.35 -0.51% P2O5 and 1.0-1.2% K2O. The durability of the goat manure effect of manure can be extended when applied in the form of solid formulation (briquettes or pellets).

The use of organic matter briquettes have been studied by Putra et al. [11] by mixing peat briquettes with liquid NPK fertilizer. This study confirmed that the combination of peat briquette and liquid NPK fertilizer increased the growth of rubber rootstock in root trainer. Similarly, Putra and Widyasari [12] reported the increase of rubber seedlings growth resulted from the application NPK fertilizer and organic peat briquette. Supporting these previous studies, Kokare et al. [13] mentioned the higher yield of green chili due to the application of organic matter briquettes and NPK fertilizer. Other study reported different combination between urea and cow manure applied in solid form resulting in better performance of maize [14]. According to these previous studies, it is necessary to investigate the efficacy of organic fertilizer briquettes to increase the plant productivity in coastal areas. This study compared the application of goat manure briquettes (GMB) with non-briquette ones in increasing the growth and yield of red chili cultivated in coastal sandy soil.

2. Materials and Methods

This study was carried out using an experimental method arranged in a completely randomized design (CRD) consisting of three doses of GMB or GM application (30, 35, and 40 tons/ha). Each treatment was repeated 12 times. Sandy soil used was collected from coastal area of Parangkusumo, Bantul, Yogyakarta at a depth of 20 cm. Goat manure used was collected from goat farm complex in Imogiri, Bantul.

Soil samples was air-dried for a week, then filtered using strainer with 2.0 mm pores. Soil was transferred into polybag and fertilized with 400 kg/ha urea + 300 kg/ha SP-36 + 300 kg/ha KCl before the GM or GMB was applied according to the designated doses. The treated soils were incubated for a week and maintained under field capacity condition. Red chili Royal-77 was grown in the treated soils and maintained regularly. Application of fertilizers were performed twice as recommended, namely at 30 and 45 days after planting. Plant performance was monitored based on its height, number of leaves, biomass and yield. Data collected were statistically analysed using one-way anova supplemented with DNMRT at the significance level of 5%.

3. Results and Discussion

Application of GMB showed insignificant effect towards several parameters of chili performance compared to non-briquette GM ones, except in number of leaves (Fig. 1). It indicated that different form of goat manure applied did not directly affect the vegetative growth of chili at 75 days after planting. However, the chili habitus during this stage seemed to be highly determined by the variety used, nutrient
supply, and environmental condition. Similar to this study, Usfiani [15] found the same phenomenon when applying the combination of cow manure, sugarcane bagasse charcoal briquette and Azolla to the chili grown in coastal area. Variety used might be one of the reasons enabling the difference of growth performance, including plant height, stem diameter and branch formation [16]. The application of goat manure might not significantly the vegetative growth of chili, but tended to affect the generative growth instead, thus resulting in higher yield and biomass. The form of goat manure applied was assumed to affect the plant in different efficacy since the reformation process would affect the speed of nutrient supply resulted. In line with this present study, briquette manure was predicted to generate faster nutrient supply compared to non-briquette ones. In addition, this present study also highlighted that both forms of goat manure did not show any effect on the improvement of sandy soil aggregation indicated by insignificantly different root weight among GMB and GM-treated plants.

Figure 1. Comparison of plant height (top), number of leaves (middle), and root weight (bottom) between GMB (goat manure briquette) and GM (goat manure) treated chili at 75 days after planting. Bars followed by the same lowercases were insignificantly different based on DNMRT with a p<0.05.

Unlike other vegetative parameters, effect of different GM form applied was significantly seen in the number of leaves (Fig. 1). However, this present study showed that non-briquette GM triggered more
leaves to develop. This pattern might be associated with faster supply of nutrients released by the GM to support plant growth. In addition, this result also showed that the GMB might take longer time to reform and release the nutrient, so that the nutrients supplied was not as high as the one resulted by GM. Situmeang et al. [17] reported that the application of organic fertilizers, both in the form of compost and solids (biochar), did not significantly affect the chili growth. However, since it has different physical properties, both briquette and non-briquette organic matters might result in different compressive strength, bulk density, porosity, and water holding capacity. Hermawan et al. [18] showed that different source of organic matter would contribute to certain physical characteristic of briquette. The higher the compressive strength and bulk density, the lower the porosity and water holding capacity resulted. These characteristics would affect its capacity in providing water and nutrients for plant.

The application of organic matter into the soil can provide nitrogen and water for plants [19]. However, the combination between organic matter and nitrogen fertilizer would boost better plant productivity. As reported by Roy et al. [20], application of organic matter and urea briquettes on lowland rice cultivation produced higher volume of root biomass. Furthermore, when the briquettes were reformed, it might release nitrogen, phosphorus, and potassium for plants. Arun-Sankar et al. [21] mentioned that the nutrient release of briquette organic matter took at least 45 days after application.

Considering the plant biomass, application of GM revealed significantly higher biomass in both fresh and dried biomass compared to GMB-treated ones (Fig. 2). Application of 40 tons/ha GM produced the heaviest plant biomass, although it did not differ significantly with the biomass weight resulted from the lower doses of GM (Fig. 2). These results showed that GMB required longer time to decompose and supply nutrients for plant. It also implied that the effect of organic matter application stimulated higher biomass, even did not much affect the growth of plant’s vegetative parts. Weight of plant biomass is an indicator of the accumulative condition during plant growth and development. Fresh and dry weight of biomass indicates plant capacity in storing water in its organs. The increase of dried biomass weight showed the growth rate in the plant’s vegetative period.

Figure 2. Comparison of fresh (top) and dried biomass (bottom) weight between GMB (goat manure briquette) and GM (goat manure) treated chili. Bars followed by the same lowercases were insignificantly different based on DNMRT with a p<0.05.
Application of GM also exhibited significant effect on number and weight of chili fruits per plant. As shown in Fig. 3, higher yield was recorded from GM-treated plants compared to GMB ones. Similar to this present study, Dalimunthe [22] reported no significant increase on number and weight of chili after being treated with cow manure and oil palm shell briquettes. It then emphasized that GMB application might be less compatible to be applied in sandy soil. In line with this hypothesis, Hermawan et al. [18] mentioned that briquette form of organic matter would have lower porosity and water holding capacity due to the increase of its compressive strength and bulk density. Moreover, the decomposition of this form of organic matter tends to be slower since its compact texture might inhibit the nutrient supply.

![Figure 3. Comparison of number (top) and weight (bottom) of chili fruits per plant between GMB (goat manure briquette) and GM (goat manure) treated chili. Bars followed by the same lowercases were insignificantly different based on DNMRT with a p<0.05.](image)

### 4. Conclusion

This study proved that the use of GMB in coastal sandy soil could not stimulate better plant growth compared to those using non-briquette GM. Though it did not affect the vegetative growth significantly, application of organic matter tended to support the generative stage, thus resulting in higher biomass and yield.

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