

Growth Response and Yield of Sorghum (*Sorghum bicolor* L.) with NPK Application and Cassava Bark Compost in Ultisol Land

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Growth Response and Yield of Sorghum (*Sorghum bicolor* L.) with NPK Application and Cassava Bark Compost in Ultisol Land

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ABSTRACT

Sorghum is a plant that has the potential to be developed on dry land such as ultisols. Provision of organic matter and application of NPK is one of the efforts to optimize plant growth on critical land. Cassava peel block compost and cassava peel compost are organic materials that can be used to increase productivity in ultisol fields. This study aims to determine the effect of the type of organic matter and the best dose of NPK on the growth and yield of sorghum. This study used an experiment method with factorial randomized block design and also consist of 4 replications. The first factor is the type of organic matter consisting of cassava peel compost (K0) and cassava peel block compost (K1), while the second factor is the dose of NPK fertilizer, namely 11,25 grams of NPK fertilizer/plant (P1), 22,5 grams of NPK fertilizer/plant (P2) and 45 grams of NPK fertilizer/plant (P3). The results showed that the type of organic matter had a very significant effect on the parameters of seed weight and dry stover weight, and had a significant effect on root length. The application of NPK fertilizer had a significant effect on the parameters of seeds weight, but had no significant effect on other parameters. The interaction between the type of organic matter and the application of NPK dose had a significant effect on stem diameter, but had no significant effect on other parameters. Combination treatment of cassava peel block compost with a dose 11,25 grams of NPK fertilizer/plant was the best result because it showed the best growth indicators on plant height, root length and total dissolved solid parameters. Combination treatment of cassava peel block compost with a dose 45 grams gave the best results on the parameters of weight of wet stover and dry stover weight.

Keywords: *Sorghum, block compost, NPK, ultisol soil*

1. INTRODUCTION

Bangka Belitung is one of the province which dominated by ultisol soil. Ultisol soil have characteristics such as low nutrients, relatively slow permeability, poor porosity, sandy clay texture and yellowish brown color. Ultisol soil has obstacles to be developed as agricultural land because it is poor in nutrients and organic matter, and has the potential for Al poisoning. [3] ultisol soil is identical to soil that is less fertile because of its low nutrient content, organic matter and low pH. Land conditions like this need to be made efforts to improve land as productive land for agricultural activities. The limited amount of productive land in Bangka Belitung for agricultural development needs to be improved by adding organic matter. [11] The addition of organic matter into the soil can improve soil physical properties such as porosity and water content so that nutrient and

water absorption becomes greater and has an impact on increasing plant growth and yield. One of the organic materials that can be used is cassava block compost. [5], cassava peel contains 59,13% carbon, 9,78% hydrogen, 28,7% oxygen, 2,06% nitrogen, 0,11% sulfur and 11,4% water as the elements needed for plant growth. [13] Block compost is one of the developments in composting technology, where this compost is used as a planting medium. Cassava block compost has high N and P nutrient content, and has a high level of mineralization and decomposition compared to other organic materials so that it is easier for plants to absorb nutrients in the soil. One of the plants that can be cultivated on ultisols is sorghum (*Sorghum bicolor* L.). [8] Sorghum is a plant that is able to survive in dry land because it has drought-tolerant properties. This research is expected to be a solution in utilizing cassava peel waste as block compost in ultisol land to improve soil

structure and reduce the use of inorganic fertilizers in sorghum cultivation.

2. MATERIAL AND METHODS

This research was conducted in November 2021 – April 2022, at the experimental and research garden (KP2), Faculty of Agriculture, Fisheries and Biology, University of Bangka Belitung. The tools used in this study were hoe, chopping machine, machete, rake, oven, digital scale, gembor, pot tray or seedling tub, compost block mold, stationery, camera, scissors, meter, hand sprayer and caliper. Meanwhile, the materials used were sorghum variety of Numbu, cassava peel, NPK fertilizer, EM-4, sugar, water and tapioca flour. This research is using experimental method. The design used was a factorial randomized block design (RAKF) with 2 factors, the first factor was organic matter K0: No cassava block compost, K1: cassava block compost, NPK fertilizer dose factor consisted of 3 treatment levels, namely: P1: 11, 25 grams of NPK fertilizer/plant, P2: 22,5 grams of NPK fertilizer/plant, P3: 45 grams of NPK fertilizer/plant. There are 6 treatment combinations. Each treatment combination was repeated 4 times, so there were 24 experimental units. Each experimental unit consisted of 10 plants and 8 plants were taken as samples so that the total plant sample was 192 plants. Parameters observed were plant height, number of leaves, stem diameter, leaf color, weight of wet stover, weight of dry stover, root length, total dissolved solids and weight of plant seeds.

3. RESULTS AND DISCUSSION

The results of variance (Table 1) showed that the type of organic matter gave a very significant effect on the parameters of seed weight and dry stover weight, and had a significant effect on the parameters of root length and gave no significant effect on the parameters of plant height, number of leaves, stem diameter, weight of wet stover and total dissolved solids (TPT). The provision of NPK had a significant effect on the seed weight parameters, but had no significant effect on other parameters. The interaction between types of organic matter and NPK had a significant effect on stem diameter parameters, while the parameters for height, number of leaves, root length, and total dissolved solids (TPT) had no significant effect.

Based on the research results, the growth and yield of sorghum with the addition of cassava peel block compost gave the best results compared to cassava peel compost. Cassava peel block compost has the ability to

hold high water and release nutrients for a longer time. [10], a high water holding capacity indicates better soil aggregate so that the movement of roots in the soil is easier to absorb water and nutrients. Cassava peel block compost gave the best results on the weight of sorghum seeds in ultisol soils because it had a high water content and was slow in releasing nutrients so as to optimize plant growth and yield. [12] the amount of nutrient content in organic matter and the high water content in block compost affect the plant growth process.

Table 1. Prints of various factors of organic matter with NPK application

Parameters	Type of organic material	NPK	Interact ion	Diversity coefficient
	Pr>F	Pr>F	Pr>F	
Plant height	0.7306 ^{tn}	0.9026 ^{tn}	0.9890 ^{tn}	8.26%
Number of leaves	0.3277 ^{tn}	0.8456 ^{tn}	0.6735 ^{tn}	6.07%
Stem diameter	0.2872 ^{tn}	0.7048 ^{tn}	0.0284*	5.38%
Root length	0.0360**	0.8967 ^{tn}	0.8481 ^{tn}	11.35%
Weight of plantingseeds	0.0032**	0.0480*	0.3124 ^{tn}	11.32%
Wet barren weight ^T	0.1377 ^{tn}	0.5519 ^{tn}	0.4807 ^{tn}	19.93%
Dry barren Weight	0.0001**	0.3456 ^{tn}	0.3826 ^{tn}	10.70%
Total dissolved solids	0.1129 ^{tn}	0.8024 ^{tn}	0.1304 ^{tn}	25.48%

Description:

- F hit : F count
- Pr>F : probability value
- * : have a real impact
- ** : very real effect
- tn : not real effect
- T : Transform, SQRT (original data +0.5)

The results of the Duncan Multiple Range Test (DMRT) showed that the types of organic matter gave significant differences to the parameters of root length, seed weight and dry weight of stover (Table 2). The treatment of cassava peel block compost was significantly different compared to cassava peel compost for the dry stover weight parameter, but not significantly different for the root length and seed weight parameters.

Provision of compost blocks of cassava skin gives the best results to the length of the roots, the weight of the planting seeds and the weight of the dry safe. This is because compost blocks of cassava skin have a high capacity to hold water so that it makes it easier for the roots to absorb nutrients. [10] high water holding capacity indicates that the aggregate of the soil is better so that the movement of roots in the soil is easier to

absorb water and nutrients. Compost Block Cassava Skin gives the best results on the weight of sorghum seeds in ultisol soils because it has high water content and is slow in releasing nutrients so that it can optimize plant growth and yield. [12] the amount of nutrient content in organic matter and the high water content in block compost affects the process of plant growth.

Table 2. The results of the Duncan Multiple Range Test (DMRT) for types of organic matter on the parameters of root length, stem diameter, seed weight and dry stover weight.

Type of organic material	Parameters		
	Root length	seed weight	Dry barren Weight
Cassava peel block compost (K1)	45,67a	156,85a	220,33a
Cassava peel compost (K2)	41,05b	127,15b	177,11b

Note : numbers followed by the same letter in the same column indicate that they are not significantly different in the DMRT test

Table 3. The results of the Duncan Multiple Range Test (DMRT) NPK dose application

NPK Dose	Parameter
	Planting seed weight
NPK 11,25 grams (P1)	130,73 b
NPK 22,50 grams (P2)	152,47 a
NPK 45,00 grams (P3)	142,80 ab

Note: numbers followed by the same letter in the same column show no significant difference in the DMRT test

The Duncan Multiple Range Test (DMRT) test results showed that the NPK applications were not significantly different. The treatment of NPK 22,5 grams showed a better treatment compared to other treatments. These results indicate that the administration of NPK has more influence on the production of sorghum plants than organic matter. DMRT test results NPK dose application shows the administration of NPK with a variety of different doses and 22,5 gram NPK doses give the highest results compared to other doses. The NPK 22,5 gram dose is thought to be the maximum dose in the supply of nutrients for sorghum crop yields. [15] the more nutrients are absorbed by plants, the more carbohydrates are formed, as well as the presence of the absorbed nutrients and important roles in photosynthesis.

The results of the further testing of the organic material with the application of NPK to the diameter of the compost combination of the cassava block with 11.25 grams of NPK (K1P1) are significantly different

from the combination of compost of cassava skin with 11.25 grams of NPK (K0P1). This is allegedly because the compost block of cassava skin has effective nutrition to increase plant growth. [9] block compost is able to hold water for a long time and release nutrients slowly according to plant needs.

Table 4. Duncan Multiple Range Test (DMRT) test results for types of organic matter with NPK application

Treatment combination	Parameter
	Rod Diameter
Cassava peel compost + 11,25 grams (K0P1)	17,62 b
Cassava peel compost + 22,5 grams (K0P2)	19,50 ab
Cassava peel compost + 45 grams (K0P3)	19,10 ab
Cassava peel block compost + 11,25 gram (K1P1)	19,83 a
Cassava peel block compost + 22,5 gram (K1P2)	18,78 ab
Cassava peel block compost + 45 gram (K1P3)	18,99 ab

Note : numbers followed by the same letter in the same column indicate not significantly different in the DMRT test

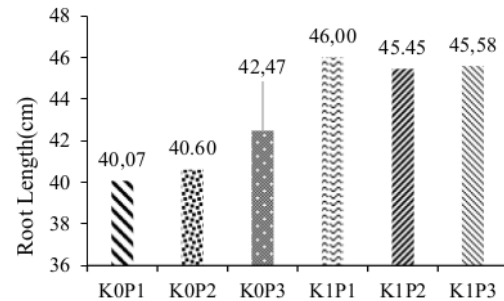


Figure 1 Root length with treatment of types of organic matter and NPK application.

The result of the average root length parameter is 43,36 cm. Treatment of cassava peel block compost + 11,25 grams (K1P1) gave the highest yield and exceeded the average value, followed by cassava peel block compost, treatment + 45 grams (K1P3) and cassava peel block compost + 22,5 grams (K1P2) are 45,58 cm and 45,45 cm, respectively (Figure 1). The lowest treatment was found in K0P1 of 40,07 cm. This is suspected that composting the cassava skin block has the ability to hold high water so as to facilitate the roots in absorbing nutrients, while the compost of the cassava skin has a crumb texture so that the absorption of nutrients by the roots is easy to do. [17] the length of the root is related to the height of the plant, the longer the roots, the more nutrients absorbed by plants, the higher and the better the growth of the plant.

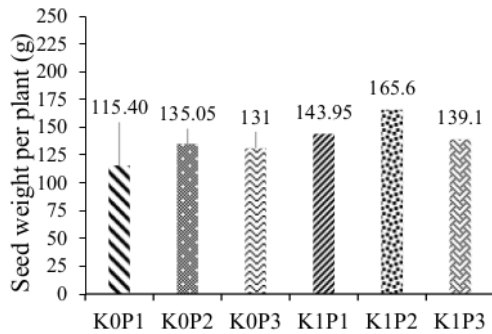


Figure 2 Seed weight with treatment of types of organic matter and application of NPK.

The average yield of sorghum seed weight is 138,35 grams. The highest treatment was found in cassava peel block compost + 22,5 grams (K1P2) at 165,6 grams above the average and followed by cassava peel block compost treatment + 11,25 (K1P1) and cassava peel block compost + 45 grams (K1P3) of 143,95 and 139,1 grams (Figure 2). The lowest seed weight was found in the treatment of cassava peel compost + 11,25 grams (K0P1) of 115,4 grams. This is because the provision of NPK can increase the availability of nutrients, P and K, the more nutrients are available, it can increase nutrient absorption by plants. [4] the more the availability of nutrients, it can spur plant growth and development so that it can provide optimal results. According to the growth of sorghum plants can be obtained by the fulfillment of nutrients, especially nutrients, P and K. [19] N was nutrient is the main limiting factor, then K and the lightest, namely P, without N, the yield is very low.

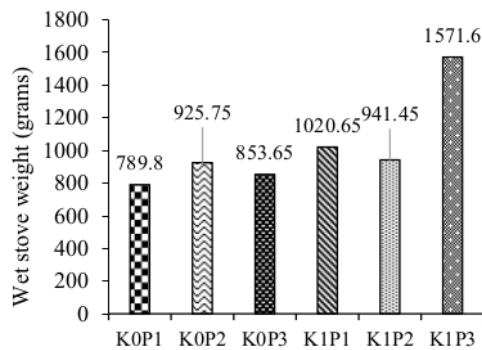


Figure 3 Weight of wet stover with treatment of types of organic matter and application of NPK

The average value of the wet stover weight is 1017,15 grams. Treatment of cassava peel block compost + 45 grams (K1P3) gave the highest yield of 1571,6 grams and exceeded the average value, then followed by treatment of cassava peel block compost + 11,25 grams (K1P1) (Figure 3). the lowest weight of

wet stover was found in the combination of cassava peel compost + 11,25 grams NPK (K0P1) of 789,8 grams.

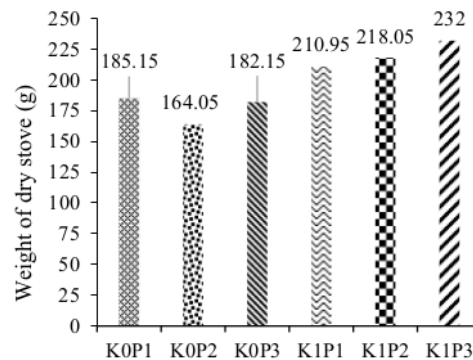


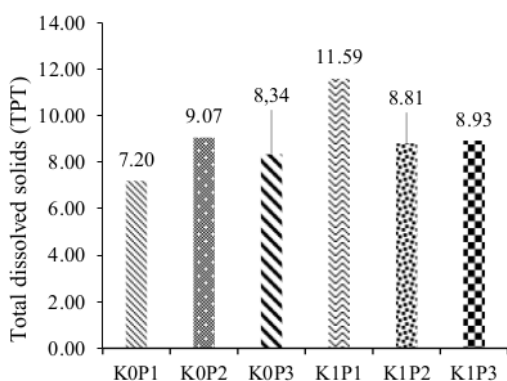
Figure 4 Weight of dry stover with treatment of types of organic matter and application of NPK

The dry weight of sorghum stover has an average of 198,725 grams (Figure 4). The highest results were found in the treatment of cassava peel block compost + 45 grams (K1P3) above the average value, then followed by treatment with cassava peel block compost + 22,5 grams (K1P2) and cassava peel block compost + 11,25 grams (K1P1) are 218,05 and 210,95, respectively. The lowest dry weight was found in the combination of cassava peel compost + 22,5 grams of NPK (K0P2) of 164,05 grams.

Compost Block Cassava peel with 45 grams of NPK (K1P3) gives the highest yield to the weight of wet stales and dry barren weight (Table 5). This is thought to be influenced by the nutrient content contained in the compost of the cassava skin block and the addition of the maximum NPK dose so that it can meet the needs of plants. If nitrogen is available in an amount that suits the needs of the plant, the growth of the plant will be optimum and quickly as a whole. [21] the increase in nutrients given will stimulate plant growth and increase weight, the number of organs such as (stems, leaves, roots) so that the weight of the safe will increase, whereas by administering various NPK doses can increase the weight of dry safe. [1] the higher the plant and the more leaves, the weight of the safe will also increase. [2] the higher the plant, the higher the biomass production.

The average value of total dissolved solids (TPT) of sorghum is 8,988 °brix (Figure 5). Treatment of cassava peel block compost + 11,25 grams of NPK (K1P1) showed the highest yield of 11,59 °brix above the average value and followed by treatment of cassava peel block compost + 22,5 grams NPK (K0P2) of 9,065 °brix. The lowest treatment was found in cassava peel, compost + 11,25 grams of NPK (K0P1) of 7.2 °brix. The results

showed that the highest total dissolved solids were found in the combination of composting cassava block compost with 11,25 grams of NPK. This is suspected to be the addition of adequate nutrition for plants such as n can facilitate the process of photosynthesis going well, and the resulting glucose will be more. The optimum photosynthate will affect the sugar content of the stem, where sugar is the result of photosynthesis. The availability of adequate essential nutrients in the soil can make it easier for plants to do photosynthesis so that the sugar content in the stem increases. [16]The more carbon rate, the rate of sugar formation in the sorghum rod is also increasingly abbreviated. [20] an increase in sap levels in sorghum shows that when the seeds in sorghum are cooked because there are more



carbohydrates stored in the stem.

Figure 5 Total Dissolved Solids (TPT) with treatment of types of organic matter and application of NPK

4. CONCLUSION

Cassava peel block compost had an effect on the growth and yield of sorghum, the best dose of NPK fertilizer for growth and yield of sorghum was 11.25 grams of NPK fertilizer/plant. Combination treatment of cassava peel block compost with a dose 11,25 grams of NPK fertilizer/plant was the best result because it showed the best growth indicators on plant height, root length and total dissolved solid parameters. Combination treatment of cassava peel block compost with a dose 45 grams of NPK fertilizer/plant gave the best results on the parameters of weight of wet stover and dry stover weight.

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