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Production and harvested nutrient of cassava (*manihot esculenta l.*) affected by compost and its combination with NPK inorganic fertilizer for the 5th planting period

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SUMMARY

One of the reasons for decreasing cassava production is the degradation of soil quality especially in a humid tropical climate. To increase cassava production is usually by adding inorganic fertilizers. The objectives of this research were to determine the effect of compost and its combination with NPK inorganic fertilizer on the production, and harvested nutrient by cassava in the 5th planting period and to determine the combination of compost with inorganic NPK on the production, and harvested nutrient by cassava in the 5th period. Treatments in this research were T1 = control; T2 = 800 kg urea ha^{-1}, 300 kg TSP ha^{-1} and 600 kg KCl ha^{-1}; T3 = 400 kg urea ha^{-1}; 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1} and 1 Mg compost ha^{-1}, T4 = 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1} and 5 Mg compost ha^{-1} , T5 = 100 kg urea ha^{-1}, 50 kg TSP ha^{-1}, 100 kg KCl ha^{-1} and 10 Mg compost ha^{-1} and T6 = 20 Mg compost ha^{-1} with 3 replications. The results showed that the combination treatment of compost with inorganic NPK with a rate of 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and 5 Mg compost ha^{-1} produced the highest production, harvested C and harvested N in cassava compared to other treatments. While the treatment of compost at a rate of 20 Mg of compost ha^{-1} produced the highest harvested P and K in cassava compared to other treatments.

Introduction

In order to increase the productivity of cassava one of many ways is to apply fertilizer into the soil. In many cases, farmers usually using the synthetic inorganic fertilizer NPK such as in the form of urea, TSP and KCl. But continuous applying of inorganic fertilizer with every planting period can lead into the degradation of soil fertility. To encounter the problems, a combination of inorganic NPK and organic fertilizer can be used to help prolonged and maintain soil fertility. According to Subowo (2010) organic materials have important roles as a soil fertility stimulus, whether directly as a nutrient source for the plants or as food source for other organisms.

Materials and methods

The experiment in conducted the field with the treatments in 3 replications of T1= control; T2= 800 kg urea ha^{-1}, 300 kg TSP ha^{-1}, and 600 kg KCl ha^{-1}; T3= 400 kg urea ha^{-1}, 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1}, and 1 Mg compost ha^{-1}; T4= 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and 5 Mg compost ha^{-1}; T5= 100 kg urea ha^{-1}, 50 kg TSP ha^{-1},100 kg KCl ha^{-1}, and 10 Mg compost; T6= 20 Mg compostants T1= control; T2= 800 kg urea ha^{-1}, 300 kg TSP ha^{-1}, and 600 kg KCl ha^{-1}; T3= 400 kg urea ha^{-1}, 200 kg TSP ha^{-1}, 400 kg KCl ha^{-1}, and 1 Mg compost ha^{-1}; T4= 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, and 5 Mg compost ha^{-1}; T5= 100 kg urea ha^{-1}, 50 kg TSP ha^{-1},100 kg KCl ha^{-1}, and 10 Mg compost; T6= 20 Mg compost. Plant and tuber dry matter, C-organic contents of both soil and plant, Total N of the soil and plant, available Phosphor of soil samples and P of the plant, exchangeable potassium of the soil and of the plant had been measured as described by Thom and Utomo (1991).

Result and discussions

The application compost and its combination with NPK inorganic fertilizer on T4 treatment produced the highest total fresh weight of the cassava. The effect of T4 was on total fresh tuber was significantly higher than that of the other treatments (Table 1).

However, the lowest tuber dry mass showing in Table 2 were in the treatment T1 and T2 which were significantly lower compare to that of treatment T3, T4, T5 and T6. Combination of compost and NPK fertilization was higher production compare to that of the only inorganic

fertilization treatment. This result could be because of the combination of both organic (organitrofos) and inorganic (NPK) provides both of micro and macronutrients that necessary for the growth of the cassava.

Table 1. Effect of compost and inorganic fertilizer NPK on the gross weight of cassava

Treatment	Fresh weight (Mg ha^{-1})		
	Tuber	Tuber skin	Tuber total
T1	16,5 a	1,5 a	18,0 a
T2	25,2 a	1,1 a	26,3 a
T3	48,0 b	1,3 a	49,3 b
T4	63,1 c	2,0 b	64,6 c
T5	51,4 b	1,5 a	53,4 b
T6	44,1 b	2,0 b	46,1 b
LSD 5%	11,5	0,4	11,6

Using LSD 5% standard test

Table 2. Effect of compost and NPK inorganic fertilizer to the dry weight of cassava

Treatment	Dry Weight (Mg ha^{-1})				Total
	Stem	Leaves	Tuber	Tuber	plant
T1	12,2	3,4	14,6 a	1,1	34,1 a
T2	26,3	3,3	17,5ab	0,7	44,9 a
T3	27,3	3,6	33,5 c	0,8	65,2 b
T4	19,6	5,5	33,6 c	0,9	59,6 b
T5	16,7	3,4	33,5 c	1,4	54,9 b
T6	22,1	4,9	23,2 b	1,1	51,3 b
F test	ns	ns	*	ns	*
LSD 5%	-	-	0,71	-	16,8

Using LSD 5% standard test

However, the lowest tuber dry mass showing in Table 2 were in the treatment T1 and T2 which were significantly lower compare to that of treatment T3, T4, T5 and T6. Combination of compost and NPK fertilization was higher production compare to that of the only inorganic fertilization treatment. This result could be because of the combination of both organic (organitrofos) and inorganic (NPK) provides both of micro and macronutrients that necessary for the growth of the cassava.

Carbon

The highest of harvested carbon on tuber found on T4 treatment which was 11.61 Mg ha-1 followed by T3 and T5 treatments (Table 3). The highest of total harvested carbon by cassava also found on T4 treatment and was not significantly different compare to that of T6, T5 and T3 treatments. Based on those results, it can be concluded that the application of the combination of compost and NPK inorganic fertilizer caused a noticeable increased on the amount of total harvested carbon on the cassava plant and the tuber.

The application of compost and NPK inorganic fertilizer provide both of micro and macro nutrients that necessary for the cassava growth the harvested nutrients increase as the biomass of the cassava increased. According to Utomo et al (2016), carbon hold an important roles in the construction of organic material, it is because the most of the dry parts of a plant are organic material (47% carbon). This shows the importance of carbon as the one of main the main ingredient in a construction of a plant.

Table 3. Effect of compost and NPK inorganic fertilizer on the harvested carbon

Treatment	Carbon Transported by plant (Mg ha^{-1})				
	Stem	Leaves	Tuber	Tuber skin	Total plant
T1	3,5 a	1,0 a	4,9 a	0,5 b	9,1 a
T2	4,3 a	1,5 a	4,0 a	0,2 a	10,0 a
T3	4,3 a	1,5 a	8,6 b	0,4 ab	14,8 b
T4	3,8 a	1,7 a	11,6 c	0,3 ab	17,4 b
T5	4,5 a	1,3 a	8,8 b	0,6 b	15,1 b
T6	7,1 b	2,0 a	5,7	0,4 b	15,3 b
F test	*	Ns	*	*	*
LSD 5%	2,3	-	2,1	0,2	10,2

LSD 5% standard test

Nitrogen

The highest amount of harvested nitrogen of the cassava was found on the stem. The high amount of harvested N on T2 and T6 treatments could be caused by high rate application of urea and organitrofos fertilizer. In general, the highest harvested N in leaves and tuber and the harvested nitrogen in plant were found on T4 treatment (Table 4).

Table 4. Effect of compost and NPK inorganic fertilizer on the harvested nitrogen

Treatment	Harvested Nitrogen (kg ha^{-1})				Total
	Stem	Leaves	Tuber	Tuber skin	
T1	38,1 a	15,7 a	27,5 a	4,6 ab	86,1 a
T2	93,9 d	17,3 a	30,7 a	3,1 a	145,1 b
T3	66,3 c	17,7 a	65,2 c	2,6 a	151,8 b
T4	48,3 b	34,9 c	80,6 d	4,2 ab	168,1 c
T5	63,2 c	17,0 a	53,3 b	7,2 b	140,8 b
T6	84,6 d	22,3 b	60,2 bc	5,9 b	173,1 c
LSD 5%	9,72	3,67	10,83	2,75	11,10

LSD 5% standard test.

Phosphor

The highest amount harvested phosphor in them stem, leaves and total plant was found on T6 treatment (Table 5). Furthermore, the highest harvested phosphor in tuber skin found on T5 treatment and it was not significantly different compare to that of T6 treatment. On the other hand, the highest harvested phosphor in tuber found on the treatment T4. Generally the lowest amount of harvested phosphor in each plant's part found on the control and T2 treatment.

Table 5. Effect of compost and NPK inorganic fertilizer on the harvested phosphor

Treatment	Harvested Phosphor (kg ha^{-1})				
	Stem	Leaves	Tuber	Tuber	Total
T1	18,6 a	5,1 b	17,3 a	1,1 ab	42,1 a
T2	26,9 b	2,8 a	17,1 a	0,7 a	47,4 a
T3	34,3 c	5,8 b	26,6 b	0,9 ab	67,5 b
T4	33,7 c	8,3 c	34,7 c	1,0 ab	77,8 bc
T5	36,2 c	6,2 b	29,0 b	1,5 b	72,7 b
T6	49,5 d	12,1 d	25,4 b	1,3 b	88,3 c
LSD 5%	6,7	2,0	5,0	0,5	11,2

Column that followed by the same alphabet, did not differ significantly on the LSD 5% standard test

Potassium

Generally, the highest potassium harvested in stem, leaves, tuber, and tuber skin was found on T6 treatment (Table 6). The application of compost, which was produced from the fresh cow manure as an ingredient could be the reason of this.

Table 6. Effect of compost and NPK inorganic fertilizer on the harvested potassium

Treatment	Harvested Potassium (kg ha^{-1})				
	Stem	Leaves	Tuber	Tuber	Total
T1	33,7 a	6,5 a	8,4	1,2 a	49,8 a
T2	77,9 c	9,9 a	11,4 b	1,1 a	100,3 c
T3	58,8 b	8,9 a	23,7 d	2,3 b	93,7 c
T4	32,9 a	15,2 c	23,1 d	2,4 b	73,6 b
T5	61,5 b	11,5 b	20,2 c	2,4 b	95,6 c
T6	83,4 c	17,0 c	24,5 d	3,6 c	128,6 d
LSD 0,05	11,1	3,5	2,1	0,9	12,7

LSD 5% standard test

CONCLUSION

1. The application of combined compost and NPK inorganic fertilizer with the rate of 200 kg urea ha-1, 100 kg TSP ha-1, 200 kg KCl ha-1, and 5 Mg compost ha^{-1} (T4) produced the highest yield of cassava compared to that of the other treatments in the 5th planting period.
2. The application of combination of compost and NPK inorganic fertilizer with the rate of 200 kg urea ha^{-1}, 100 kg TSP ha^{-1}, 200 kg KCl ha^{-1}, dan 5 Mg compost ha^{-1} and 20 Mg compost ha^{-1} (T4 and T6) produced the highest harvested C and N, while the application of 20 Mg compost ha^{-1} (T6) produced the highest transported P and K on the cassava in its the 5th planting period.

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