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EFFECT OF BIOCHAR RESIDUE, COMPOST, AND UREA COMBINATION ON GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.)

MOHD. CHALISZAR, ZAITUN, E. NURAHMI

Agrotechnology Study Programme, Agriculture Faculty, Syiah Kuala University, Banda Aceh, Indonesia.
Corresponding Author: zaitundara@ymail.com

ABSTRACT

The objective of this study was to know the effect of biochar residue, compost and urea fertilization on growth and yield of maize. The research was conducted at University Farm Ie Seum Research Station, Aceh Besar district, Aceh Province, Indonesia. The experimental arranged in a randomized complate block non factorial design with four replications. There were eight treatment combinations: P_1 (without biochar residue + without compost + without urea), P_2 (without biochar residue + without compost + urea), P_3 (without biochar residue + compost + without urea), P_4 (without biochar residue + compost + urea), P_5 (biochar residue + without compost + without urea), P_6 (biochar residue + without compost + urea), P_7 (biochar residue + compost + without urea), P_8 (biochar residue + compost + urea). Based on the plant growth, biochar residue, compost, and urea fertilizer treatment did not significantly affect on plant height age of 30, 45 and 60 days after planting, leaf number aged 30, 45 and 60 days after planting, stem diameter ages 30, 45 and 60 days after planting. At the P_7 treatment (biochar residue + compost + without urea) gave the best value but does not differ significantly with all treatments tested. Based on plant yield, biochar residue, compost, and urea fertilizer treatment did not significantly affect on cornhusk ear length, cornhusk cob diameter, cornhusk cob weight, cob length without cornhusk, cob diameter without cornhusk, cob weight without cornhusk, and yield. At P_5 treatment (biochar residue + without compost + without urea) cornhusk cobs and P_7 (biochar residue + compost + without urea) cornhusk cobs and without cornhusk provide the best value but does not differ significantly with all treatments tested.

Keywords: biochar, compost, urea, maize

Introduction

Indonesian corn production according to the BPS-Statistics Indonesia (2012) is 19.38 million tons but decreased to 18.51 million tons in 2013 (BPS-Statistics Indonesia, 2013). Indonesia, therefore, still import those corn from other countries. Setiawan (2013) stated that the import of corn to Indonesia in 2012 reached 1.7 million tons and increased to 2 million tons in 2013. .

An effort to increase the production of corn can be done with fertilization treatment and application of organic manures into the soil or land because it can increase the nutrient content and can improve soil conditions. Fertilization can be done with organic fertilizer and inorganic fertilizers such as compost and urea. Land or soil containing biochar residue will be combined with the addition of compost and urea fertilizers. The addition of compost and urea was needed to inceptisol soil conditions that require nutrients and organic matter that supported by the presence of residual biochar with a high water holding capacity and nutrient retention on the availability of nutrients to plants so that fulfilled (Gani, 2009).

This research uses of land that has been containing biochar residue from previous studies (Muhammad, unpublished). Field observations indicated that biochar residue was still there with subtle form of black-gray color. Span of biochar application on previous research was 10 months. Soil conditions in the field are basically belong to the order inceptisol who have high levels of soil fertility and low organic matter content.

Biochar or charcoal biodiversity is an organic material that similar to the charcoal or the remnants of the agricultural and forestry biomass such as rice husk and coconut shell, processed with incomplete combustion without oxygen that produces biological charcoal that was instrumental in improving the properties of physical and chemical soil, and can bind to its high water content in the soil and can also bind nutrients contained in runoff due. Biochar serves as ameliorant in soil and not as a fertilizer, it is necessary to increase fertilizer as a nutrient in the soil (Gani, 2009).

This study aims to determine the effect of biochar residue, compost and urea fertilizer on growth and yield of maize.

Materials and Methods

The field experiment was established at University Farm Ie Seum Research Station, Aceh Besar District, Aceh Province.

The experimental arranged in a randomized complate block non factorial design with four replications. There were eight treatment combinations: P_1 (without biochar residue + without compost + without urea), P_2 (without biochar residue + without compost + urea), P_3 (without biochar residue + compost + without urea), P_4 (without biochar residue + compost + urea), P_5 (biochar residue + without compost + without urea), P_6 (biochar residue + without compost + urea), P_7 (biochar residue + compost + without urea), P_8 (biochar residue + compost + urea).

There were two variables i.e. plant growth and yield. Variable of plant growth consisted of the plant height as if 30, 45 and 60 day after planting (DAP), number of leaves 30, 45, and 60 DAP, and stem diameter 30, 45, and 60 DAP. Variable of plant yield were corn length with cornhusk and without cornhusk, corn diameter with cornhusk and without cornhusk, corn weight with cornhusk and without cornhusk, and corn production with cornhusk and without cornhusk.

Results and Discussion

The effect of biochar residue, compost and urea fertilizers on maize growth

The results of the study showed that all treatments not significantly affect on the plant height of maize ages 30, 45 and 60 DAP, number of leaves aged 30, 45 and 60 DAP, stem diameter ages 30, 45 and 60 DAP .

Based on the character of the high growth of plant life of 30, 45 and 60 DAP on treatment of biochar residue and compost (P_7) showed the best condition of plants growth. The number of leaves at the age of 60 DAP on biochar residue treatment (P_5) gave the highest values. The diameter of the stem at those age on urea fertilizer treatment (P_2) tend to give the greatest value, each not significant with all treatments tested. This is presumably because the biochar and fertilizer as providing nutrient availability for plant growth.

Table 1. Effect of biochar residue, compos, and urea fertilizer application on maize vegetative growth

Treatment	Plant height (cm)			Number of leaves (total)			Stem diameter (cm)		
	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP	30 DAP	45 DAP	60 DAP
P_1	124.75	185.35	194.90	9.55	10.75	10.85	1.86	2.06	2.13
P_2	126.20	178.40	197.90	9.35	10.75	10.95	1.96	2.15	2.26
P_3	118.10	167.70	190.90	8.55	10.45	10.80	1.85	2.11	2.17
P_4	126.40	184.50	207.95	9.70	11.20	10.95	1.89	1.99	2.07
P_5	121.65	182.85	198.15	9.55	10.55	11.60	1.77	2.12	2.19
P_6	126.70	184.25	198.40	9.30	10.70	10.45	1.86	2.06	2.12
P_7	138.40	194.90	215.65	9.75	11.00	11.40	2.04	2.17	2.25
P_8	119.25	175.10	196.10	9.20	10.55	10.85	1.86	1.96	2.05
Average	125.18	181.63	199.99	9.37	10.74	10.98	1.88	2.07	2.15

The effect of biochar residue, compost and urea fertilizers on maize yield

Based on the results of the study showed that the cornhusk cob length, cob diameter cornhusk, cornhusk cob weight, cob length without cornhusk, cob diameter without cornhusk, cob weight without cornhusk not significantly affect with the all treatments.

Table 2. Effect of biochar residue, compost, and urea fertilizer application on maize yield

Treatment	Corn length (cm)		Corn diameter (cm)		Corn weight (g)		Production (ton ha^{-1})	
	Corn-husk	without cornhusk	Corn-husk	without cornhusk	Corn-husk	without cornhusk	Corn-husk	without cornhusk
P_1	22.77	15.40	4.63	3.87	180.00	137.50	14.40	11.00
P_2	22.59	15.60	4.48	3.84	167.50	130.50	13.40	10.44
P_3	22.76	14.45	4.38	3.69	160.00	124.00	12.80	9.92
P_4	22.34	15.35	4.34	3.86	161.00	128.00	12.88	10.24
P_5	24.42	15.95	4.48	3.88	185.00	141.00	14.80	11.28
P_6	23.89	15.95	4.54	3.89	180.50	140.50	14.44	11.24
P_7	24.25	16.13	4.45	3.90	185.00	147.00	14.80	11.76
P_8	21.98	14.05	3.92	3.43	127.00	99.00	10.16	7.92
Average	23.12	15.36	4.40	3.79	168.25	130.94	13.46	10.48

On yield potential, biochar residue and compost treatment (P_7) tend to be the highest that was not significantly different from all treatments were tested. It is alleged that biochar residue, beside as an soil ameliorant and reduce environmental damage, the use of biochar can also improve soil fertility and crop yields as well as the presence of compost which helps increase productivity. This is in accordance with the opinion of Gani (2009)which states that, when biochar was applied with organic fertilizers such as compost that provides essential nutrients for plants, biochar can increase crop yields and nutrient retention and availability. Biochar can overcome the use of organic materials that are short term due to the rapid decomposition process resulting in the addition of organic material should be done every year, with biochar that can bind water and nutrients in the soil it will give fertility and crop yields will also increase and can resolve important issues such as the destruction of agricultural land, water pollution by agrochemicals, climate change and increasing land productivity and crop.

Conclusions

Based on plant growth biochar treatment residues, compost and urea fertilizer was not significantly effect on plant height age of 30, 45 and 60 DAP, leaf number aged 30, 45 and 60 DAP, stem diameter ages 30, 45 and 60 DAP. At P_7 treatment (biochar residue, compost and without urea) provide the best value and not significant with all treatments tested.

Based on the plant yield, biochar residue, compost and urea fertilizer application was not significantly effect on the cornhusk cob length, diameter of cornhusk cob, cornhusk cob weight, cob length without cornhusk, cob diameter without cornhusk, cob weight without cornhusk, and yield. On the treatment of P_5 (biochar residue, without compost and without urea) cornhusk cobs and on P_7 treatment (biochar residue, compost and without urea) cornhusk cobs and without cornhusk provide the best value and not significant with all treatments tested.

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