The increasing fertility of sandy soil and chili production through the application of organic fertilizers, zeolite and cane blotong

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The increasing fertility of sandy soil and chili production through the application of organic fertilizers, zeolite and cane blotong

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Abstract: The problem of chili cultivation on sandy land is not optimal due to several reasons, including not supported by the availability of sufficient nutrients and water. Therefore, in order to optimize the agricultural production of horticultural commodities, it is necessary to provide organic matter, zeolite sand and cane blotong. The purpose of this study was to determine the effect of giving organic matter, zeolite sand and cane blotong on increasing soil fertility and chili production on beach sand. The research implementation time starts from May-November 2019. The research was carried out at an altitude of 90 m above sea level, namely at the Green House of the Plant Laboratory and Soil Laboratory, Jember State Polytechnic, East Java. This study used a completely randomized design with three factors, namely the dosage of organic fertilizer, namely 20 tonnes ha^{-1} and 40 tonnes ha^{-1}, zeolite doses, namely 20 tonnes ha^{-1} and 40 tonnes ha^{-1} and cane blotong doses, namely 20 tonnes ha^{-1} and 40 tonnes ha^{-1} . The observational variables include the level of soil fertility before and after as well as the chile production variable. The results showed that the application of organic fertilizers, zeolite and cane blotong was able to improve the fertility of sandy soil in Puger District. The increase in soil fertility is indicated by the improvement of the physical and chemical properties of sandy soil after treatment. The effect of giving organic fertilizers, zeolite and cane blotong was only able to increase the weight of chilies/fruit and chili fruit diameter, while zeolite was only able to increase chili fruit weight/plant and number of chilies.

Keywords:

1. Introduction

The problem of chili cultivation on sandy land is not optimal due to several reasons, including not supported by the availability of sufficient nutrients and water. The application of organic matter to sand land is intended to improve soil structure so as to increase water infiltration into the soil, increase the ability to bind water, and use chemical fertilizers more efficiently [1]. Provision of BO will increase the soil C content. This soil carbon (C) will affect soil properties for the better. The presence of this element in the soil will spur the activity of microorganisms thereby increasing the soil weathering process which has an effect on increasing the volume of slow drainage pores (VPDnL).

Zeolite is a natural inorganic soil amendment which is a hydrated aluminosilicate crystal mineral from cations and alkaline soil. Zeolite has the following properties that it is able to exchange ions, functions as a molecular filter, as a catalyst and can experience dehydration or rehydration, containing bases such as K, Na, Ca. Zeolite can increase the efficiency of nitrogen fertilization and can free microelements [2] [3]. The addition of zeolite to the soil can increase the value of cation exchange capacity [4]. Cane blotong can be used directly as an organic fertilizer, because this material can function to increase soil fertility by improving soil texture characterized by soil physical properties, in

particular increasing water holding capacity, reducing the rate of nutrient leaching, and improving soil drainage. Another benefit of cane blotong is that it functions to neutralize the effect of Al-dd, which can lead to P availability in more available land [5]. Therefore, it is necessary to have the application of technology in increasing soil fertility in sandy land in order to optimize agricultural production of horticultural commodities, among others, by providing organic matter, zeolite sand and cane blotong in increasing water retention and cation exchange capacity and nutrient content in the soil. The purpose of this study was to determine the effect of giving organic matter, zeolite sand and cane blotong on increasing soil fertility and chili production on beach sand.

2. Methods

The research implementation time starts from May-November 2019. The research was carried out at an altitude of 90 m above sea level, namely at the Green House of the Plant Laboratory and Soil Laboratory, Jember State Polytechnic, East Java. The equipment used in the research includes stationery, hammer, camera, ruler, calipers, scissors, colling boxes, and analytical scales. Meanwhile, the materials used in the research included organic fertilizers, anogranics, mulch, chili seeds, zeolite, cane blotong and pesticides. This study used a completely randomized design with three factors, namely the dosage of organic fertilizer, namely 20 tonnes ha-1 and 40 tonnes ha-1, zeolite doses of 20 tonnes ha-1 and 40 tonnes ha-1 and doses of cane blotong, namely 20 tonnes ha. -1 and 40 tonnes ha-1. The observational variables include the level of soil fertility before and after as well as the chili production variable which is analyzed by analysis of variance and followed by the Duncan test (DMRT) 5% if there is a significant effect.

3. Result and Discussion

The results of physical analysis of the soil after applying organic fertilizers, zeolite and cane blotong were able to improve soil physical properties and soil pH. The administration of the three treatments was able to improve the water content of the field capacity, which previously was only 27% increased by 21-31% for the application of organic fertilizers, 25-26% for the application of zeolite and 16-34% for the provision of cane blotong.

Table 1. Analysis result of soil physical properties before treatment

No.	Parameter	Analysis Results				Analysis Method
1	Field capacity	27 %				Gravimetri
2	Color boundary moisture changed	6,31 %				Gravimetri
3	Texture	Sand 77,51 %	Clay 11,47 %	Dust 11,02 %	Texture class (Sandy Loam)	Hydrometer
4	pH	6, 23				Actual, Digital Ph Meter

Table 2. Analysis result of soil physical properties after treatment

Treatment	Field capacity	Color boundary moisture changed	pH	Texture			
Organic fertilizer	**(%)**	**(%)**		**Sand (%)**	**Clay (%)**	**Dust (%)**	**Texture class**
P1 (20 ton ha^{-1})	32,67	6,67	6,9	78,49	12,16	9,33	Sandy Loam
P2 (40 ton ha^{-1})	35,38	7,35	6,8	79,41	11,16	9,41	Sandy Loam
Zeolites							
Z1 (20 ton ha^{-1})	33,945	6,86	6,9	78,79	11,20	10,00	Sandy Loam
Z2 (40 ton ha^{-1})	34,10	7,17	6,8	79,12	12,13	8,74	Sandy Loam
Cane blotong							
V1 (20 ton ha^{-1})	31,33	6,74	6,8	79,57	11,63	8,78	Sandy Loam
V2 (40 ton ha^{-1})	36,72	7,29	6,9	78,335	11,69	9,96	Sandy Loam

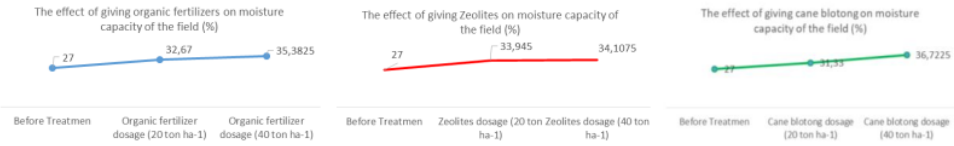

Figure 1. The effect of giving various treatments on moisture capacity on the field

According to [6], the sand land in Puger District has the characteristics of a clay sand texture, very fast soil drainage and very low salinity levels. Beach sandy soil has a fairly high coarse texture. A high sand fraction causes more macro pores than micro pores so that the ability of the soil to bind nutrients and water is low, even though the availability of water in the soil is an important factor for plant growth because water is an important reagent in photosynthetic processes and in other processes. Besides that, water is a solvent from salts, gases and materials that move into plants through cell walls

and essential tissues to ensure the presence of turgidity, cell growth, leaf shape stability, the process of opening and closing the stomata, the continuity of plant structure. Lack of water will interfere with physiological and morphological activities, resulting in stoppage of growth. Continuous deficiency of water will cause irreversible changes (irreversible) and in turn plants will die [7]. According to [8], the ability of the soil to hold water is considered to be equivalent to the moisture content of the field capacity. In general, the water content of field capacity is defined as the soil water content in the field when the drainage water has stopped or almost stopped flowing due to the gravity force after the soil has previously been completely saturated [9]. The water that the soil can hold is continuously absorbed by plant roots or evaporates so that the soil is getting drier over time. Therefore, the higher the water content in the field capacity, the better the soil properties so that the provision of various treatments has been able to improve the water content of the field capacity. Good water content is also supported by the increase in the C / N ratio in the soil.

The soil pH observation variable experienced an increase of 9-11% for the application of organic matter, zeolite and cane blotong. This is due to the treatment of organic fertilizers, zeolite and cane blotong which are added to the soil which will further decompose or mineralize releasing minerals in the form of alkaline cations (Ca, Mg, Na, K) which cause the concentration of OH ions to increase, resulting in increased pH goes up. According to [10] the increase in pH is due to the use of organic fertilizers (manure and cane blotong) which can increase the amount of organic compounds in the soil that can bind H and Al as a cause of soil acidity. Zeolite is a natural inorganic soil amendment agent. In study [4], the addition of zeolite to the soil was able to increase the value of cation exchange capacity, whereas in study [11], the application of zeolite and compost could have a significant effect on increasing water retention and cation exchange capacity.

Table 3. Results of soil chemical analysis before treatment

No.	Types of analysis	Unit	Analysis results
1	C-Organic	%	0,196
2	N-Total	%	0,044
3	C/N ratio	%	4,653
4	P_2O_5 Available	%	0,064
5	K_2O Available	%	not detected

Table 4. Results of soil chemical analysis after treatment

Treatment	C-Organic	N-Total	C/N Ratio	P_2O_5 Available	K_2O Available
Organic fertilizer	**(%)**	**(%)**		**(%)**	**(%)**
P1 (20 ton ha^{-1})	1,28	0,08	15,51	33,79	0,46
P2 (40 ton ha^{-1})	1,63	0,07	22,58	45,35	0,38
Zeolites					
Z1 (20 ton ha^{-1})	1,51	0,08	17,31	41,86	0,41
Z2 (40 ton ha^{-1})	1,40	0,06	20,77	37,29	0,43
Cane blotong					
V1 (20 ton ha^{-1})	1,44	0,07	18,64	38,59	0,50
V2 (40 ton ha^{-1})	1,47	0,07	19,00	40,56	0,35

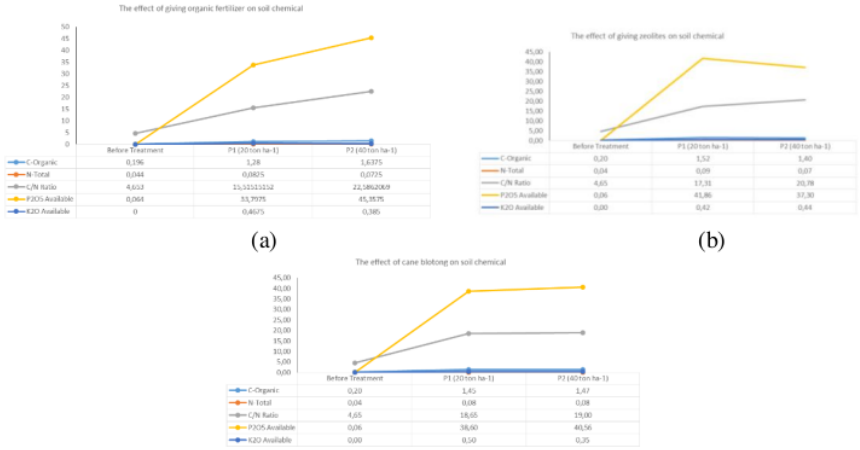

Figure 2. The Effect of (a) giving fertilizer, (b) zeolites, (c) cane blotong on soil chemical

The results of the chemical analysis of the soil showed that the treatment of organic fertilizers, zeolite and cane blotong could improve soil fertility. This improvement can be seen from the increase in the content of C-Organic, N-Total, C/N Ratio, P_2O_5 Available, K_2O Available after treatment compared to the chemical content of the soil before treatment. This result is in accordance with the opinion [6] that the application of organic matter is intended to improve soil structure so as to increase the ability to bind water and use chemical fertilizers more efficiently. In addition, organic matter that is given to the soil can increase the C-organic content in the soil and help in the mineralization process because organic matter will completely release plant nutrients (N, P, K, Ca, Mg, S and other micro nutrients.) and improve the life of soil microorganisms. In general, organic matter contains N, P, and K nutrients as well as micro nutrients needed by plants [12] cane blotong can be used directly as organic fertilizer, because these materials can function to increase soil fertility, reduce the rate of nutrient leaching, and improve soil drainage. Another benefit of blotong is that it functions to neutralize the effect of Al-dd, which can lead to P availability in more available land [13]. Meanwhile, Zeolite application also increases the efficiency of nitrogen fertilization and can free micro elements such as Fe, Zn, Mn, Cu [2] [3]. Form P_2O_5 Available, K_2O Available available for plants or the amount that can be taken up by plants is only a small part of the amount in the soil.

Table 5. Recapitulation of variance from the effect of applying organic fertilizers, zeolites and blotong and their interactions on the production of chilli plants on sandy fields

Observation parameters	Organic fertilizer	Zeolites	Cane blotong	Organic fertilizer *Zeolites	Organic fertilize *Cane blotong	Zeolites * Cane blotong	Organic fertilizer* Zeolites* Cane blotong	F 5 %	F 1 %
Chili fruit weight/plant (g)	0,103 ns	6,335 *	0,001 ns	2,072 ns	0,556 ns	1,520 ns	1,437 ns	4,6	8,86
Weight of chilies/fruit (g)	9,916 **	0,515 ns	0,032 ns	1,659 ns	0,792 ns	1,432 ns	2,594 ns	4,6	8,86
Number of chilies	0,002 ns	5,813 *	0,001 ns	2,330 ns	0,362 ns	0,463 ns	2,807 ns	4,6	8,86
Chili Fruit Diameter (mm)	9,367 **	0,818 ns	2,981 ns	2,163 ns	2,615 ns	1,521 ns	2,383 ns	4,6	8,86
Chili Fruit Length (cm)	0,904 ns	0,312 ns	1,129 ns	0,904 ns	1,418 ns	0,186 ns	0,261 ns	4,6	8,86

Note: (**) Very significant difference at 1% level, (*) Very significant difference at 5% level

Table 6. Recapitulation from the effect of applying organic fertilizers, zeolites and blotong on the production of chilli plants on sandy fields

Treatment	Chili fruit weight/plant (g)	Weight of chilies/fruit (g)	Number of chilies	Chili Fruit Diameter (mm)	Chili Fruit Length (cm)
Organic fertilizer dosage					
P1 (20 ton ha^{-1})	527,75	7,46 a	27,48	13,46 a	11,22
P2 (40 ton ha^{-1})	506,73	8,43 b	27,33	13,74 b	11,42
Zeolites dosage					
Z1 (20 ton ha^{-1})	599,52 b	7,83	30,77 b	13,56	11,26
Z2 (40 ton ha^{-1})	434,95 a	8,05	24,04	13,64	11,38
Cane blotong dosage					
V1 (20 ton ha^{-1})	517,03	7,91	27,36	13,68	11,43
V2 (40 ton ha^{-1})	517,45	7,97	27,46	13,52	11,21

Note: The numbers followed by the difference letters on the same line show significant difference

The application of organic fertilizers was only able to increase the weight of chilies/fruit and chili fruit diameter variables, while zeolite was only able to increase the chili fruit weight/plant and number of chilies. The provision of cane blotong and the interaction between treatments did not show a significant effect. The real effect of organic fertilizers and zeolite on several observation variables was due to the increase in soil fertility which also resulted in an increase in several variables of chili crop production. These results are also supported by research [14], [15], [16] where an increase in the dose of manure was followed by an increase in the weight of the harvested tubers on shallots and [17] in the sesame plant in the Purworejo.

4. Conclusion

The application of organic fertilizers, zeolite and cane blotong was able to improve the fertility of sandy soil in Puger District. The increase in soil fertility is indicated by the improvement of the physical and chemical properties of sandy soil after treatment. The effect of giving organic fertilizers, zeolite and cane blotong was only able to increase the Weight of chilies/fruit and chili fruit diameter, while zeolite was only able to increase the chili fruit weight/plant and number of chilies.

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