Conference Paper

The Effect of Bio-fertilizer on Soil Chemical Properties of Sugarcane in Purwadadi Subang

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Abstract

Biofertilizer is a biological product that can be used to improve the soil fertility. It is useful in enriching soil with micro-organisms that produces organic nutrients and may also reduce the plant diseases. This experiment investigates the usefulness of biofertilizer which can increase the soil properties. This study was conducted at sugarcane plantation, Purwadadi Subang Bandung. The experiment was arranged in a Randomized Block Design (RBD) with 6 treatments and 4 replications. The treatments were (50; 25) g/treatment Biofertilizer + (¼; ½; ¾; 1) of the recommended dose of NPK and the recommended dose of NPK as a control. The chemical properties (potential K, K sorption, potential P, P sorption, total N and pH) were affected by biofertilizer application, except for N sorption. The best treatment from this product was combination from high level of biofertilizer (50 g) and (1/2 - 1) of the recommended dose of NPK. The application of biofertilizer can substitute NPK fertilizer 25%-50% in soil. In general, this product has a good potency especially to increase some of soil chemical properties in a short time with simple application in the field.

Keywords: Biofertilizer, Efficay, Inorganic Fertilizer.

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1. Introduction

The decreasing of soil characteristics have occurred in most places in Indonesia. With respect to this problem, there is an importance to improve the soil condition. One of the methods is through soil fertilization. In the other side, type of fertilizers can affect the soil properties differently. Some of them may also affect the environmental condition. For example, the use of inorganic chemical fertilizer can cause environmental damage because they give the chemical residue in soil. The application of chemical fertilizers in agricultural land in Indonesia are often applied without considering the precise need of the plants and also its soil characteristics. The negative effects of synthetic fertilizers actually can be reduced by applying the appropriate material to the soil. One of the good management of soil nutrient is the application organic materials.

In addition, to be environmentally friendly the application organic fertilizers into soil can improve its physical and chemical properties, such as raising the pH; increasing CEC; providing macro and micro nutrients, and improving biological properties of the soil [1]. Nevertheless, the use of organic fertilizer not entirely fulfill the need of plants nutrients. Therefore, the addition of inorganic fertilizer is still needed to support the optimum growth of plants. Reference [2] reported that NPK fertilizer has an impact to nutrient content of soil and plant growth because of macro nutrients consists of N, P, and K that are necessary for plant growth.

Previous studies have shown that fertilizer application can increase the crop productivity [3–5]. Management systems that rely on organic inputs as plant nutrient sources have different dynamics of nutrient availability from chemical fertilizers. For sustainable crop production, integrated use of chemical and organic fertilizer has been proven to be highly beneficial. The application of microorganisms in the enriched content of fertilizers has been done. This method is more environmentally friendly and does not give residuals such as chemical fertilizer in soil. This is because microorganisms that grow in the soil will be very important in the sustainability of nutrient cycles. The application of various fertilizers into the soil can lead the variety of effects depending on the function of the fertilizer and soil reaction. The application this fertilizer can increase the production of plantation crops in Indonesia such as sugarcane.

Sugarcane plant is a grass plant species that need to grow in an appropriate climatic conditions to produce maximum production. In addition, the sugarcane crop needs a high level of water to produce high sugar content. It requires a lot of water during the growth phase, but less water during ripening phase [6]. In addition to the conditions of growing media and water intake, sugarcane seedling must be well prepared because it will affect the growth potential, sucrose content, pests and diseases attacks, germination rate, and drought resistancy.

To support this, we provide new bio-fertilizer product that proper for crop fertilizer nutrient intake. This bio-fertilizer with its active ingredients developed from a brown powder, using a special formulation consisted of endomycorrhiza mixed with the growing substrate, humic acid and phytocompound. Mycorrhiza is a form of symbiosis between fungi with higher plants (vascular plants, tracheophyta), especially in the root system. This mycorrhizal fungi usually infect plant roots. This product has a concept to combine a variety of material (growing substrate, humic acid and phytocompound) which is expected to increase the growth of sugarcane crop.

Table 1: List of Treatments.

CODE	Description of Treatments
A	50 g treatment of Bio-fertilizer + ¼ of the recommended dose of NPK This bio-fertilizer should be applied at least 15-20 days after the application of synthetic fertilizer
B	50 g treatment of Bio-fertilizer + ½ of the recommended dose of NPK This bio-fertilizer should be applied at least 15-20 days after the application of synthetic fertilizer
C	50 g treatment of Bio-fertilizer + ¾ of the recommended dose of NPK This bio-fertilizer should be applied at least 15-20 days after the application of synthetic fertilizer
D	50 g treatment of Biofertlizer + The recommended dose of NPK This bio-fertilizer should be applied at least 15-20 days after the application of synthetic fertilizer
E	25 g concentration of Bio-fertilizer + The recommended dose of NPK This bio-fertilizer should be applied at least 15-20 days after the application of synthetic fertilizer
F	The recommended dose of NPK

Description: NPK recommendation dose in sugarcane plantation is 250 N, 100 P, 125 K
The application inorganic fertilizer is interval 7 days (4 times during this trial).

2. Materials and Methods

This study had been conducted at sugarcane plantation Purwadadi Subang Bandung for 6 (six) months. The experimental plots were arranged in a Randomized Block Design (RBD) with 6 treatments and repeated 4 times (Table 1).

Observation was conducted on plant growth variables (stem length, stem diameter, internode distance and leaf area). Nitrogen, phosphorus, potassium content in the soil were analysed before and after applications. All statistical analysis were performed using the SPPS 20. The data were analyzed with analysis of variance (ANOVA). To detect treatments with significant of differences ($P < 0.05$), the data were analyzed with Duncan Multiple Range test.

3. Results

3.1. Chemical Properties (Total N and N Sorption)

The result showed that there were significant differences in total N after the applications. This condition is strengthened by the data in Table.2 that the recommended dose of NPK give the lower value of N total than other treatments (the applications of bio-fertilizer can increase N total in soil by 1.51%-18.01% from control).

Table 2: The Effect of Bio-fertilizer on Total N and N Sorption.

Treatments	The average of Total N (%)	The average of N Sorption (%)
A (50 g treatment of Biofertilizer + ¼ of the recommended dose of NPK)	1.7525 e	0.1270 a
B (50 g treatment of Biofertlizer + ½ of the recommended dose of NPK)	1.5725 bc	0.1148 a
C (50 g treatment of Biofertlizer + ¾ of the recommended dose of NPK)	1.5925 cd	0.1339 a
D (50 g treatment of Biofertlizer + the recommended dose of NPK)	1.6475 d	0.1166 a
E (25 g concentration of Biofertlizer + the recommended dose of NPK)	1.5075 ab	0.1106 a
F (the recommended dose of NPK)	1.4850 a	0.1183 a
Description: The average value of the same letter are not significantly different according to Duncan's Multiple Range Test at the 5% critical level.		

Table 3: The Effect of Bio-fertilizer on Potential K and K Sorption.

Treatments	The average of Potential K (mg K_2O/100g)	The average of K Sorption (mg K_2O/100g)
A (50 g treatment of Biofertilizer + ¼ of the recommended dose of NPK)	12.8150 a	1.2325 ab
B (50 g treatment of Biofertlizer + ½ of the recommended dose of NPK)	13.1650 a	1.2450 b
C (50 g treatment of Biofertlizer + ¾ of the recommended dose of NPK)	13.7075 a	1.0575 a
D (50 g treatment of Biofertlizer + the recommended dose of NPK)	12.6650 a	1.3475 b
E (25 g concentration of Biofertlizer + the recommended dose of NPK)	13.1200 a	1.1900 ab
F (the recommended dose of NPK)	18.6625 b	1.2825 b
Description: The average value of the same letter are not significantly different according to Duncan's Multiple Range Test at the 5% critical level.		

3.2. Chemical Properties (Potential K and K Sorption)

The result showed that the NPK recommendation gives the highest value of Potential K and K sorption than other treatments (Table 3). This condition occurs because the chemical fertilizers are still the dominant source of pottasium availability in the soil.

3.3. Chemical Properties (Potential P and P Sorption)

There was a significant effect of bio-fertilizer product on potential P and P sorption for all the treatments after the applications (Table 4).

Table 4: The Effect of Bio-fertilizer on Potential P and P Sorption.

Treatments	The average of Potential P (mg P_2O_5/100g)	The average of P Sorption (mg P_2O_5/100g)
A (50 g treatment of Biofertilizer + ¼ of the recommended dose of NPK)	17.9000 a	0.1575 b
B (50 g treatment of Biofertlizer + ½ of the recommended dose of NPK)	19.6400 c	0.1425 ab
C (50 g treatment of Biofertlizer + ¾ of the recommended dose of NPK)	18.1725 ab	0.1250 a
D (50 g treatment of Biofertlizer + the recommended dose of NPK)	19.3800 bc	0.1575 b
E (25 g concentration of Biofertlizer + the recommended dose of NPK)	17.6400 a	0.1350 a
F (the recommended dose of NPK)	19.5400 bc	0.1350 a
Description: The average value of the same letter are not significantly different according to Duncan's Multiple Range Test at the 5% critical level.		

Table 5: The Effect of Bio-fertilizer on pH.

Treatments	The average of pH
A (50 g treatment of Biofertilizer + ¼ of the recommended dose of NPK)	4.95 a
B (50 g treatment of Biofertlizer + ½ of the recommended dose of NPK)	5.45 a
C (50 g treatment of Biofertlizer + ¾ of the recommended dose of NPK)	6.20 b
D (50 g treatment of Biofertlizer + the recommended dose of NPK)	4.93 a
E (25 g concentration of Biofertlizer + the recommended dose of NPK)	5.09 a
F (the recommended dose of NPK)	5.37 a
Description: The average value of the same letter are not significantly different according to Duncan's Multiple Range Test at the 5% critical level.	

3.4. Chemical Properties (pH)

In general, this bio-fertilizer did not give significant effect after the treatments, except for 50 g treatment of biofertilizer + ¾ of the recommended dose of NPK which give the pH value more higher that of control (Table 5).

4. Discussion

In general, the parameters of N sorption, potential P, P sorption, and pH in soil gives different effect significantly after the applications. However, there are several parameters such as potential K and sorption K which describe that the major impact is influenced by inorganic fertilizer (the recommended dose of NPK). The treatment of 50 g bio-fertilizer + the recommended dose of NPK has the highest effect than the other

treatments to the sorption of K (1,3475 mg K_2O/100g). For total N, the treatment of 50 g bio-fertilizer + ¼ the recommended dose of NPK, give different effect significantly than other parameters. The treatment of bio-fertilizer application give the result of 1.7525% total N that can substitute the NPK fertilizer more than 50% of the total N in soil. In addition, the combination of bio-fertilizer with high level and ¼ the recommended dose of NPK gives different result for potential P in sorption and in soil. This condition is different with pH parameter. The treatment of 50 g biofertilizer + ¾ the recommended dose of NPK give significant effect than others treatments (6,2025).

From the experimental data above, it can be said that in general the application of bio-fertilizer gave significant effect to almost all of soil parameters. This condition can happen because the symbiotic relationship between AM fungi and a variety of plants that can produce colonies on the outside part in a root system. This condition can make the uptake of water and nutrients by the plant roots increases. The AM fungi can improve plant performance under drought stress through the increase in absorption of water and some nutrients. That are zinc (Zn) and copper (Cu), and also plant variables like a leaf height, leaf water turgidity, stomatal activities, and root growth [7]. The AM fungi performance as an agent which can improve plant-water relationship through increasing stomatal resistance by adjusting plant hormonal balance. Moreover, through this chain, the P element can increasing by the activity of AM fungi in a growth phase [8]. The AMF symbiosis can also increasing the absorption of other nutrients such as P, N, Cu and Zn [9, 10]. Beside that process, the additional material combined with biofertilizer (growing substrate, humic acid and phyto-compound) can make the performance from this product much better. This is supported, that humic acid has a role in the release of P adsorbed in the soil and can increase the availability of P in the soil [11]. Humic acid can replace phosphate ions by sorptions mechanism and also has the ability to binding the organic compounds. This process can happen because the negative charge on the functional groups in the humic acid has the ability to react and interact with positively charged ions [12].

5. Conclusion

In general, the result of this experiment shows that the chemical properties of soil were affected by bio-fertilizer application, except for N sorption. This can be seen in further Duncan test that gives a significant effect of the treatments on some parameters (potential K, sorption K, potential P, sorption P, total N and pH). The best treatment from this product are combination from high level bio-fertilizer (50 g) and (1/2 - 1) the recommended dose of NPK. The treatments of biofertilizer applications can substitute the NPK fertilizer 25% - 50% in soil. In general, this product has a good potential,

especially to increase some of soil chemical properties in a short time with simple application in the field.

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